Special Exposure Cohort Petition
under the Energy Employees Occupational Illness Compensation Act

07-27-09 P12:40 IN

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

OMB Number: 0920-0639 Expires: 07/31/2010

Special Exposure Cohort Petition — Form B

Use of this form and disclosure of Social Security Number are voluntary. Failure to use this form or disclose this number will not result in the denial of any right, benefit, or privilege to which you may be entitled.

General Instructions on Completing this Form *(complete instructions are available in a separate packet)*:

Except for signatures, please **PRINT** all information clearly and neatly on the form.

Please read each of Parts A — G in this form and complete the parts appropriate to you. If there is more than one petitioner, then each petitioner should complete those sections of parts A – C of the form that apply to them. Additional copies of the first two pages of this form are provided at the end of the form for this purpose. A maximum of three petitioners is allowed.

If you need more space to provide additional information, use the continuation page provided at the end of the form and attach the completed continuation page(s) to Form B.

If you have questions about the use of this form, please call the following NIOSH toll-free phone number and request to speak to someone in the Office of Compensation Analysis and Support about an SEC petition: 1-877-222-8570.

If you are:			
	☐ A Labor Organization,	Start at D	on Page 3
	☒ An Energy Employee (current or former),	Start at C	on Page 2
	☐ A Survivor (of a former Energy Employee),	Start at B	on Page 2
	☐ A Representative (of a current or former Energy Employee),	Start at A	on Page 1

A Representative Information — Complete Section A if you are authorized by an Employee or Survivor(s) to petition on behalf of a class.

A.1 **Are you a contact person for an organization?** ☐ Yes (Go to A.2) ☐ No (Go to A.3)

A.2 **Organization Information:**

Name of Organization

Position of Contact Person

A.3 **Name of Petition Representative:**

Mr./Mrs./Ms. First Name Middle Initial Last Name

A.4 **Address:**

Street Apt # P.O. Box

City State Zip Code

A.5 **Telephone Number:** ( ) -

A.6 **Email Address:**

A.7 ☐ Check the box at left to indicate you have attached to the back of this form written authorization to petition by the survivor(s) or employee(s) indicated in Parts B or C of this form. An authorization

If you are representing a Survivor, go to Part B; if you are representing an Employee, go to Part C.

Name or Social Security Number of First Petitioner: [redacted]

B Survivor Information — Complete Section B if you are a Survivor or representing a Survivor.

B.1 **Name of Survivor:**

Mr./Mrs./Ms. First Name Middle Initial Last Name

B.2 **Social Security Number of Survivor:** _____

B.3 **Address of Survivor:**

Street Apt # P.O. Box

City State Zip Code

B.4 **Telephone Number of Survivor:** (___) ___-_____

B.5 **Email Address of Survivor:** _____

B.6 **Relationship to Employee:** ☐ Spouse ☐ Son/Daughter ☐ Parent ☐ Grandparent ☐ Grandchild

Go to Part C.

C Employee Information — Complete Section C UNLESS you are a labor organization.

C.1 **Name of Employee:** [redacted]

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.2 **Former Name of Employee** (e.g., maiden name/legal name change/other):

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.3 **Social Security Number of Employee:** [redacted]

C.4 **Address of Employee (if living):** [redacted]

Street Apt # P.O. Box

City State Zip Code

C.5 **Telephone Number of Employee:** [redacted]

C.6 **Email Address of Employee:**

C.7 **Employment Information Related to Petition:**

C.7a Employee Number (if known): [redacted]

C.7b Dates of Employment: Start 1955 End 1990 / 1993

C.7c Employer Name: North American Aviation (see Attachment A)

C.7d Work Site Location: Various -- see Attachment A

C.7e Supervisor's Name: see Attachment A

Go to Part E.

D Labor Organization Information — Complete Section D ONLY if you are a labor organization.

D.1 **Labor Organization Information:**

_____
Name of Organization

_____
Position of Contact Person

D.2 **Name of Petition Representative:**

_____

D.3 **Address of Petition Representative:**

_____
Street Apt # P.O. Box

_____
City State Zip Code

D.4 **Telephone Number of Petition Representative:** (____) _____

D.5 **Email Address of Petition Representative:** _____

D.6 **Period during which labor organization represented employees covered by this petition** (please attach documentation): Start _____ End _____

D.7 **Identity of other labor organizations that may represent or have represented this class of employees** (if known):

_____

Go to Part E.

E Proposed Definition of Employee Class Covered by Petition — Complete Section E.

E.1 **Name of DOE or AWE Facility:** see Attachment A

E.2 **Locations at the Facility relevant to this petition:**
see Attachment A

E.3 **List job titles and/or job duties of employees included in the class. In addition, you can list by name any individuals other than petitioners identified on this form who you believe should be included in this class:**
see Attachment A

E.4 **Employment Dates relevant to this petition:**

Start Nov 1955 End June 1960 see Attachment A

Start _____ End _____

Start _____ End _____

E.5 **Is the petition based on one or more unmonitored, unrecorded, or inadequately monitored or recorded exposure incidents?:** ☐ Yes ☐ No

If yes, provide the date(s) of the incident(s) and a complete description (attach additional pages as necessary):
see Attachment A

Go to Part F.

Name or Social Security Number of First Petitioner: [redacted]

F Basis for Proposing that Records and Information are Inadequate for Individual Dose — Complete Section F.

Complete **at least one** of the following entries in this section by checking the appropriate box and providing the required information related to the selection. You are not required to complete more than one entry.

F.1 ❑ I/We have attached either documents or statements provided by affidavit that indicate that radiation exposures and radiation doses potentially incurred by members of the proposed class, that relate to this petition, were not monitored, either through personal monitoring or through area monitoring.

(Attach documents and/or affidavits to the back of the petition form.)

Describe as completely as possible, to the extent it might be unclear, how the attached documentation and/or affidavit(s) indicate that potential radiation exposures were not monitored.

F.2 ❑ I/ We have attached either documents or statements provided by affidavit that indicate that radiation monitoring records for members of the proposed class have been lost, falsified, or destroyed; or that there is no information regarding monitoring, source, source term, or process from the site where the employees worked.

(Attach documents and/or affidavits to the back of the petition form.)

Describe as completely as possible, to the extent it might be unclear, how the attached documentation and/or affidavit(s) indicate that radiation monitoring records for members of the proposed class have been lost, altered illegally, or destroyed.

Part F is continued on the following page.

Name or Social Security Number of First Petition [redacted]

F.3 [X] I/We have attached a report from a health physicist or other individual with expertise in radiation dose reconstruction documenting the limitations of existing DOE or AWE records on radiation exposures at the facility, as relevant to the petition. The report specifies the basis for believing these documented limitations might prevent the completion of dose reconstructions for members of the class under 42 CFR Part 82 and related NIOSH technical implementation guidelines.

(Attach report to the back of the petition form.) see Attachment A

F.4 [X] I/We have attached a scientific or technical report, issued by a government agency of the Executive Branch of Government or the General Accounting Office, the Nuclear Regulatory Commission, or the Defense Nuclear Facilities Safety Board, or published in a peer-reviewed journal, that identifies dosimetry and related information that are unavailable (due to either a lack of monitoring or the destruction or loss of records) for estimating the radiation doses of employees covered by the petition.

(Attach report to the back of the petition form.) see Attachment A

Go to Part G.

G Signature of Person(s) Submitting this Petition — Complete Section G.

All Petitioners should sign and date the petition. A maximum of three persons may sign the petition.

[redacted] July 23, 2009
Signature Date

Signature Date

Signature Date

Notice: Any person who knowingly makes any false statement, misrepresentation, concealment of fact or any other act of fraud to obtain compensation as provided under EEOICPA or who knowingly accepts compensation to which that person is not entitled is subject to civil or administrative remedies as well as felony criminal prosecution and may, under appropriate criminal provisions, be punished by a fine or imprisonment or both. I affirm that the information provided on this form is accurate and true.

Send this form to:
SEC Petition
Office of Compensation Analysis and Support
NIOSH
4676 Columbia Parkway, MS-C-47
Cincinnati, OH 45226

If there are additional petitioners, they must complete the Appendix Forms for additional petitioners. The Appendix forms are located at the end of this document.

Name or Social Security Number of First Petitioner: [redacted]

Public Burden Statement

Public reporting burden for this collection of information is estimated to average 300 minutes per response, including time for reviewing instructions, gathering the information needed, and completing the form. If you have any comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, send them to CDC Reports Clearance Officer, 1600 Clifton Road, MS-E-11, Atlanta GA, 30333; ATTN:PRA 0920-0639. Do not send the completed petition form to this address. Completed petitions are to be submitted to NIOSH at the address provided in these instructions. Persons are not required to respond to the information collected on this form unless it displays a currently valid OMB number.

Privacy Act Advisement

In accordance with the Privacy Act of 1974, as amended (5 U.S.C. § 552a), you are hereby notified of the following:

The Energy Employees Occupational Illness Compensation Program Act (42 U.S.C. §§ 7384-7385) (EEOICPA) authorizes the President to designate additional classes of employees to be included in the Special Exposure Cohort (SEC). EEOICPA authorizes HHS to implement its responsibilities with the assistance of the National Institute for Occupational Safety (NIOSH), an Institute of the Centers for Disease Control and Prevention. Information obtained by NIOSH in connection with petitions for including additional classes of employees in the SEC will be used to evaluate the petition and report findings to the Advisory Board on Radiation and Worker Health and HHS.

Records containing identifiable information become part of an existing NIOSH system of records under the Privacy Act, 09-20-147 "Occupational Health Epidemiological Studies and EEOICPA Program Records. HHS/CDC/NIOSH." These records are treated in a confidential manner, unless otherwise compelled by law. Disclosures that NIOSH may need to make for the processing of your petition or other purposes are listed below.

NIOSH may need to disclose personal identifying information to: (a) the Department of Energy, other federal agencies, other government or private entities and to private sector employers to permit these entities to retrieve records required by NIOSH; (b) identified witnesses as designated by NIOSH so that these individuals can provide information to assist with the evaluation of SEC petitions; (c) contractors assisting NIOSH; (d) collaborating researchers, under certain limited circumstances to conduct further investigations; (e) Federal, state and local agencies for law enforcement purposes; and (f) a Member of Congress or a Congressional staff member in response to a verified inquiry.

This notice applies to all forms and informational requests that you may receive from NIOSH in connection with the evaluation of an SEC petition.

Use of the NIOSH petition forms (A and B) is voluntary but your provision of information required by these forms is mandatory for the consideration of a petition, as specified under 42 CFR Part 83. Petitions that fail to provide required information may not be considered by HHS.

Name or Social Security Number of First Petitioner: [redacted]

Attachment A
Amplification of the statements made on the Special Exposure Cohort Petition - Form B: for the
Santa Susanna Field Laboratory (SSFL)/Area IV –Canoga Facility site

Attachment A – C.7b Dates of Employment
My employment began on [redacted] 1955 (North American Aviation--employer), and continued with successor Corporations (North American Rockwell and subsequently, Rockwell International) unti[redacted] 1990. Employment continued at Rockwell International facilities as a subcontract employee from [redacted] 1990 through [redacted] 1993.

Employment for the period addressed in this Petition is from Nov 15, 1955 through June 28, 1960. During this period I was employed by North American Aviation. (Note: North American was the Corporation for such identities listed as Atomics International, Rocketdyne, Canoga facility, Vanowen Building, DeSoto facility, Santa Susanna Field Laboratory, SSFL, ETEC, and Area IV. None of these identities were ever corporations, or ever held a contract directly with any agency of the United States Government, but rather "names" for divisions, subdivisions or groups within the Corporation's structure.)

Attachment A – C.7c Employer Name
The name of the Corporation was North American Aviation (until Sept, 1967), subsequently North American Rockwell (until Feb. 1973) and after that date, Rockwell International.

Attachment A – C.7d Work Site Location
During the period addressed in this Petition, from Nov 15, 1955 through June 28, 1960, I worked at the SSFL/Area IV - Canoga Facility site, located at 6633 Canoga Ave., Canoga Park, CA. (From [redacted] 1955 to [redacted] 1955 I worked at the Corporation's Downey and Slausen facilities in central Los Angeles.)

The SSFL/Area IV - Canoga Facility site is shown in the circa 1950's photograph in Figure A. The aerial view is looking south. The site is bounded by Canoga Ave. (parallel to the railroad tracks) on the east side; on the west by Owensmouth St.; on the north by Vanowen Blvd; and on the south by Victory Blvd: all located in Canoga Park, CA. Within these boundaries at the SSFL/Area IV - Canoga Facility site are the Main Building (001) on the southern part of the site, the Vanowen Building (038) in the north-west, and the Engineering Annex (004) on the north-east. A small building (043) was constructed between the Vanowen building and Engineering Annex building in the late 1950's or early 1960's, and originally was used a cafeteria/lunch room. Several small buildings and a water tank facing Owensmouth Blvd are also on the site. The site includes a building (009) on the south-side of Canoga Ave., directly across the street from the Main building (038); this building was used for material receiving and inspection, and for material storage in the 1950's and early 1960's, and was later enlarged for added manufacturing and assembly operations.

During this period I also was assigned numerous work tasks, and days, on temporary assignments at the Corporation's Santa Susanna Field Laboratory. I worked at all areas in the SSFL site, including Area IV. (The SSFL was, at the time period specified in this Petition located in an unincorporated area in the Post Office code of Santa Susanna, CA; Simi, CA is now the address for the SSFL).

Attachment A
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Since the Canoga facilities, Canoga Park and Vanowen building (etc.) are all addressed in the NIOSH documents in Ref 1-a through 1-f as a part of the SSFL/Area IV site, I have used as the site name for this Petition the designation: SSFL/Area IV – Canoga Facility site. (Note: The site was sold to Boeing in (circa1994), and subsequently sold to United Technologies, the present owner.)

Attachment A – C.7e Supervisors Name:
During the period addressed in this Petition, I worked under the supervision, at various times, of the following managers or supervisors: [redacted]

Attachment A – E.1 Name of DOE or AWL facility.
The SSFL/Area IV - Canoga Facility site (as addressed in Attachment A – C.7d, previously) has been defined in the EEOIC Program and NIOSH documents using, or as a part of, numerous "names", that have included "Canoga Park, Atomics International, SSFL/Area IV, ETEC, Vanowen building, Rocketdyne, North American Aviation, and Rockwell International".

The SSFL/Area IV - Canoga Facility site is noted in Ref. 1-b, ORAUT-TKBS-0038-2 report, Energy Technology Engineering Center (ETEC)—Site Description on page 8, as follows—

> *"In addition to the facilities in SSFL that supported DOE, Rockwell under contracts or grants to DOE or its predecessor agencies, had performed DOE activities at the Downey, Canoga Park, and DeSoto Facilities. These three facilities are all located outside the boundaries of the SSFL site. Since Rockwell International workers could have worked at any and all of these sites as well as Area IV., Section 2.2,2 in this site descriptions describes them"..*

On page 22 in Ref. 1-b, the following is written in *Section 2.2.2, Canoga Park---*

> *"AEC-funded activities at Rockwell's Canoga Park, California, occurred in the Van Owen Building from approximately 1954 to 1960. This work had been performed at North American Aviation's Downey Facility, but was moved to Canoga Avenue at the end of 1955. Principal work in the Vanowen Building included design, development, and operation of small aqueous fuel reactors, fuel development, and radiochemistry, and beryllium machining is believed to have occurred".*

Also in Table 2-4, in Ref. 1-b, the two reactors that were assembled and operated in the Vanowen building at the Canoga Facility site are listed. In the table, the facility is listed as "Canoga Park Plant VanOwen Building" and the L-47 and L-77 reactors are listed as having the following operating period — 1954 -1960.

Attachment A
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Attachment A – E.2 Locations at the Facility relevant to this petition.

This Petition includes all facilities and all locations at the SSFL/Area IV - Canoga Facility site, including the Main building (001), the Vanowen building (038), the Engineering Annex (004), the small building originally used as a cafeteria (043) that is not shown in Figure A, the several small outbuildings that are shown on Figure A, and the manufacturing building (009), which is on the east-side of Canoga Ave.

Attachment A – E.3 List of job titles and job duties included in this petition.

This Petition, as detailed in Attachment A – F.1/F.2, beginning on page 13, is based on the deficiencies in monitoring of effluents, gasses and particulate emissions, and the deficiencies and lack of bioassay monitoring (and data) from the nuclear activities at the SSFL/Area IV – Canoga Facilities site and located in the Vanowen building (038), including the two nuclear reactors located in the south-east corner of the Vanowen building (038), as reported in the various U. S. Government reports cited in this Petition.

This Petition is for the coverage of all employees of North American Aviation that worked in the SSFL/Area IV - Canoga Facility site. This inclusion of all North American Aviation site employees is based on:

(a) the arrangement of the Vanowen Building (038), and the location and operation of the two nuclear reactors in that building located on the SSFL/Area IV - Canoga Facility site;
(b) the close proximity and the essentially common environment for all the buildings and locations at the SSFL/Area IV - Canoga Facility site;
(c) the NIOSH position in Ref. 2, the "Petition Evaluation Report, Petition SEC-00093, Rev 01, submittal date: February 6, 2008' regarding the employees to be included in the Special Exposure Cohort for the SSFL/Area IV site;
(d) the type of possible radiation exposures to employees, the availability (and lack thereof) of a comprehensive monitoring data base, and the lack of monitoring that took place for radiation exposure (during the time period addressed in this Petition);
(e) the Corporation's practice of common usage of the facilities at the SSFL/Area IV - Canoga Facility site; and
(f) the practice of employee loan-outs and the transfer of employees between divisions, subdivisions, departments and work groups located at the SSFL/Area IV - Canoga Facility site.

(a) the arrangement of the Vanowen Building (038), and the location and operation of the two nuclear reactors in the SSFL/Area IV - Canoga Facility site

The Vanowen Building housed operating nuclear reactors and numerous nuclear support activities. In Ref.1-d "Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Van Owen Building), the Downey Facility, and the DeSoto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics

International) – Occupational Environmental Dose", Report No. ORAUT-TKBS-0038-4, on page 7, the following is written ----

> *"Between 1955 and 1960, nuclear research and development was preformed at a facility known as the Vanowen Building (Building 0038) on Canoga Ave. in Canoga Park, CA. Two small aqueous 93% enriched urayl sulfate research reactors designative L-47 and L-77 were designed, developed, and operated at the Vanowen facility. The maximum power ratings were 5 and 10 watts, respectively. Other operations included reactor design, fuel development, and radiochemistry. L-47 operated between August 1957 and June 1958, and L-77 operated between May 1958 and Feb1960. The reactors were in the southeast corner of the building in what is now a loading dock".* (Added note: the Vanowen building has been demolished.)

The arrangement of the Vanowen building (038) was as follows. The front (facing Victory Blvd) had a row of managers' offices, than (moving to the rear) were engineering offices and bull-pens; further back were manufacturing and assembly areas, Many small, and a few larger, laboratories for testing and research were located in the rear part of the building and along the west side of the building (nearest Owensmouth St.) On the west-side of the building, facing Owensmouth St., numerous, partially-enclosed test cells were located. As stated above, the L-47 and L-77 reactors were on the far south-east corner of the Vanowen building.

The Main Building (001) and the Vanowen building (038), in the 1950's and early 1960's, each had a cafeteria/lunch room which was available for breakfast or lunch. Each location was available to all employees of North American Aviation. (I specifically recall having lunch in the Vanowen cafeteria/lunch room shortly after it opened in late-1955 or early1956) to "check it out").

(b) the close proximity and the essentially common environment for all the buildings and locations at the SSFL/Area IV - Canoga Facility site

All the buildings on the SSFL/Area IV - Canoga Facility site are in close proximity. Figures A clearly illustrates this close proximity and lack of boundaries between buildings at the site. (The photograph shown was taken before the two-story (Engineering) building addition was added to the Main building (001) on the south-east corner, before the large, two-story high furnace-braze addition was added to the south side of the Main building (001), and before Building 043 was constructed.

Location of the two reactors in the south-east corner of the Vanowen building (038) placed it near the center of the site (see Figure A).

All the areas outside the buildings in the site were paved in the 1950's and 1960's, with asphalt or concrete. Parking lots were on the north, east and south sides as shown in Figure A. Employee walking paths and access surrounded the buildings, and permitted easy worker

accessibility. The reactors were in close proximity to a walkway between the Vanowen Building (038) and the Engineering Annex (0-4), and after Building (043) was constructed, close to that building.

The distance form the rear of the Vanowen Building (038) to the Main Building (001) was approximately 40 feet. (see Figure A).

The Vanowen and the Main buildings were separated by an east-west access road; access was available from Owensmouth St. and Canoga Ave. Although the main entrance was off Canoga Ave., in the 1950's the rear (Owensmouth) gate was the most-used entrance for company trucks, deliveries and at times by company automobiles. This gate was also used regularly by employees (it was handy for employee drop-offs). Note the green-roofed guard-shack near the water tower. This rear gate was closed in the mid-1960's due to the greatly increased traffic on Owensmouth Street when the Topanga Shopping Mall was constructed on the west side on Owensmouth Street between Vanowen and Victory Blvds).

Loading docks were on the north side of the Main building (001) and south side of the Vanowen building (038) (re: Figure A), and were directly and easily accessible for deliveries, and to employees for off-loading, receiving inspection and in-factory delivery. Considerable truck and pedestrian traffic, and constant employee activity occurred at the two loading docks. The Main building (001) was a very large, major manufacturing building for the Corporation. The Vanowen building (038) was the "hub" for the Corporation's nuclear programs. Several times, assemblies of all the North American Aviation employees that worked at the site occurred in this central open-air area between the buildings for special Corporate events. As shown in Figure A, there was "full" employment at the site in the 1950's and 1960's.

Emissions from the Vanowen building would have affected all employees working at the SSFL/Area IV - Canoga Facility site.

(c) the NIOSH position in Ref. 2, "Petition Evaluation Report, Petition SEC-00093, Rev 01, submittal date: February 6, 2008' regarding the employees to be included in the Special Exposure Cohort for the SSFL/Area IV site

In Ref 2, page 3, paragraph 4 the following is written---

> *"The revised NIOSH- proposed class includes all employees of the Department of Energy (DOE), its predecessor agencies, and DOE contractors and subcontractors who worked in any area of Area IV of the Santa Susana Field"*..... (underlining added)

And on page 4, paragraph 1 states (relative to the changes made between Revision 00 and Revision 01 to that document) ----

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"The change in the proposed class definition was triggered by the additional information collected by NIOSH indicating that there was a possibility that not all workers who entered controlled areas were necessarily monitored for external radiation exposure."

And on page 18, in paragraph 2, the Ref 2 NIOSH report states---

"Following World War II the potential of atomic energy captured the interest of the United States.....SSFL was initially established in 1947 .....to meet the requirements to static-fire large rocket engines: however it also met NAA's requirement for a nuclear Test Facility. As a result, Area IV was established in 1953 at SSFL as a Nuclear Research and Development Facility. Since then, SSFL-Area IV has housed both nuclear development and rocket development groups, albeit in distinct and separate locations." (underlining added)

Further, the NIOSH Ref 1-d report, ORAUT-TKBS-0038-4, on page 6, paragraph 1, in: *Section 4.2 Purpose* the following is stated-----

"Occupational environmental dose refers to radiation exposures received by workers, while on the site but outside the Santa Susana Field Laboratory (SSFL) facilities, from facility discharges to the atmosphere, from ambient external radiation originating in the facilities, and from inadvertent ingestion of site-generated radionuclides. The receptors of concern are SSFL employees who did not wear external dosimetry or who were not monitored for internal exposures. (underlining added)

Note that this statement does not read 'receptors of concern are SSFL/Area IV employees'.

NIOSH has clearly stated in these NIOSH reports that working in any area of the "Site" is the approach established by NIOSH for a Special Exposure Cohort when at lack of monitoring and/or proximity to the radiation source exists, and when the radiation release source is---

"from facility discharges to the atmosphere, from ambient external radiation originating in the facilities, and from inadvertent ingestion of site-generated radionuclides".
(from Ref 1-d, page 6, paragraph 1,as stated above)

This is the basis I have taken in preparing this Petition for the SSFL/Area IV - Canoga Facility site: to include all employees that worked at the site.

(d) the type of possible radiation exposures to employees, the availability (and lack thereof) of a comprehensive monitoring data base, and the lack of monitoring that took place for radiation exposure (during the time period addressed in this Petition)*---which existed at the SSFL/Area IV site, and similarly existed at the SSFL/Area IV - Canoga Facility site (and which applies to all employees of North American Aviation at the SSFL/Area IV - Canoga Facility site).*

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NIOSH has stated in their report Ref. 2, SEC Petition Evaluation Report, Petition SEC-00093 Report Rev 01 , that---

> *"NIOSH cannot estimate internal exposures with sufficient accuracy during the period from 1955 through 1958 (which is a period with limited internal monitoring data). This includes the time from the beginning of Area IV radiological activities in 1955, to late 1958 (selected as December 31, 1958 for SEC evaluation purposes). This timeframe corresponds with the date after which an established bioassay program existed at SSFL and after which sufficient internal monitoring has been identified."*

And in the Ref 1-d report, ORAUT-TKBS-0038-4, on page 8, in Section 4.5 "Inhalation of On-site Airborne Radionuclides" the following regarding the SSFL/Area IV site---

> *"The environmental monitoring program at Area IV was established in May 1954 before construction of the first radiological facility (Sapere and Boeing 2005, p. 3-13), with emphasis on soil, vegetation, and water sampling in the environment around Area IV. The program had been initiated in 1952 at the Downey Facility but was terminated in the move to Canoga Park (Moore, Fisher, and Rowe 1962). From 1959 to present, ambient gross beta activity in air has been measured continuously in five locations. From 1963 on, gross alpha activity was measured. Ambient air samples are currently analyzed for isotopic content (Sapere and Boeing 2005, p. 3-15)"*

However the next sentence reads---

> *"No information is available for the Downey or Canoga Park facilities other than the De Soto facilities; information for the De Soto facilities is not available until ambient data are reported together with Area IV data in environmental monitoring reports."*

This lack of monitoring in the 1950"s (including direct, airborne, effluent and bioassay monitoring), although considered adequate at that time, has resulted in today's lack of reliable and complete monitoring data. These deficiencies in the monitoring practices, monitoring data and monitoring equipment used in the 1950's (and later) and has been addressed in a detailed manner in the NIOSH Subcontractor Report, Ref 3, "Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program, Review of the Santa Susana Field Laboratory (SSFL)- Area IV Special Exposure Cohort (SEC) Petition-00093 and the NIOSH SEC Petition Evaluation Report", report no. SCA-SEC-TASK5-0066, dated January 30, 2009, and prepared by S. Cohen and Associates . Key elements are summarized below. (For completeness, these briefly summarized excerpts from the report, SCA-SEC-TASK5-0066, are shown in Attachment A-1. as full texts.)

Attachment A
Amplification of the statements made on the Special Exposure Cohort Petition - Form B: for the
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Re: Section 4.3.2 in the report--- "monitoring for internal exposure of SSFL workers was incomplete and poorly documented for most years of facility operation—referring to the 1950's and 1960's.

Re: Section 4.3.3 in the report--- "Insufficient correlation between bioassay data and potential exposures"—to specific radionuclides exist in what data that is available.

Re: Section 4.3.4 in the report--- "missing radionuclides in bioassay data" exist in most of the monitoring records.

Re: Section 4.3.6 in the report--- there is a *"Lack of Source Term Data"* and *"without bioassay or air sample data, the last resort is determination of airborne concentrations using source term evaluations"*, and *"data on the amount of dispersible material available does not appear to be available for SSFL/Area IV".*

Re: Section 4.3.7 in the report--- "Interpretation of reported values by the contract Laboratory Nuclear Science and Engineering Corp. (NSEC) may not be correct" "related to urinalyses for gross alpha, gross beta, and MFPs".

Re: Section 4.3.8 in the report--- "potential difficulties associated with uranium bioassay data" exists, and *"it is unclear whether urine samples were consistently analyzed by both fluorometric and radiometric methods".*

Re: Section 4.3.9 in the report--- "there are unanswered questions regarding the completeness and quality of personnel exposure records".

Re: Section 4.3.10 in the report--- "Use of SSFL Site Survey Data/Source Term cannot be Regarded as Useful Surrogate Data for Bioassay Data in Dose Reconstruction" and the guidelines are *"deficient and place an unrealistic responsibility on the dose reconstructor".*

The lack of viable radiation dose monitoring data for the SSFL/Area IV site is directly applicable, and in the same manner, to the SSFL/Area IV – Canoga Facility site, which is addressed in this Petition.

(e) the Corporation's practice of common usage of the facilities at the SSFL/Area IV - Canoga Facility site

All of the buildings and other facilities at the SSFL/Area IV - Canoga Facility site were either owned or leased by the parent Corporation, North American Aviation. As can be seen in Figure A, "business was booming" for both the divisions that shared this site in the 1950's,, and this business boom continued until the very late 1960's. During this period floor space, of any type, at the SSFL/Area IV - Canoga Facility site was at a premium. In the early 1960's three additional manufacturing building were constructed, and leased, south-east of

the corner of Canoga Ave and Victory Blvd; and a new, four-story office building was constructed at the south-east corner of Canoga Ave and Victory. Blvd.)

It was the practice of the Corporation to use floor space, test labs and manufacturing facilities where-ever they existed for which-ever of the Corporation's programs or divisions needed them, and such usage could be re-assigned overnight, immediately. As a result employees of a Corporation division or subdivision often worked, for varying periods, in locations not normally associated with their division or subdivision.

In the late 1950's construction began at a new site (i.e., the DeSoto Facilities site) approximately 4 miles north-east of the Canoga Facilities site. I believe that occupancy at the DeSoto site first started in the large manufacturing building (101) in 1959. Vanowen building employees and manufacturing capabilities started transferring to the DeSoto Facility site. As the administrative and engineering buildings (building 102 and 103) were completed employees moved in. The L-77 reactor in the Vanowen building was later moved into Building 104 at the DeSoto Facilities site. The entire move into the DeSoto site was completed, as I recall, over a period of about 2 years. As space became available in the Vanowen building other North American Aviation operations and employees moved into the building.

The Corporation's aggressive building program is discussed to illustrate the growing "floor space" needs that occurred in the 1950's. The Corporation was similarly aggressive in its policy of allocation of building floor space to which-ever Corporation division, subdivision, etc. had immediate needs.

(f) ***the practice of employee loan-outs and transfer of employees between divisions, subdivisions, departments and work groups located at the SSFL/Area IV - Canoga Facility site***

North American Aviation utilized an internal support system called "Interdivisional Work Authorization's" (IDWA's) to effectively permit rapid, easily-implemented transfer of a task or work effort from one Corporate division to another, and with a minimum of paperwork. Such a task or work effort could be an engineering analysis or design task, laboratory testing, machining, welding or assembly of hardware, etc. The IDWA system was encouraged by the Corporation and permitted a task or work effort to be transferred from one Corporate division (or subdivision, etc.) to another, to balance division work loads and/or to utilize special capabilities that might be available (i.e., specialized machine tools, unique lab capabilities, available test facilities, etc).

When an IDWA was used, personnel from the sponsoring group were assigned as the interface. and provided on-location support and direction. This would result in an employee's work location to be temporally changed for what was often an extended period.

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Another "work efficiency" practice at North American Aviation was the use of employee transfers and less-formal employee loan-outs. These options were used to balance both long-term and short-term periods of needs for a specific category of personnel, thereby minimizing lay-offs and hiring. Either of these options could be accomplished in a day or two; paperwork was required for a transfer but not for a "loan-out". Both transfers and "loan-outs' could be within a Corporate division or between Corporate divisions. All the personnel involved needed was a good "charge number", and thus get paid.

Loan-outs were common for laboratory and test activities. Electronic and computerized test data recording was a dream for the future in the 1950' and most of the 1960's. For a test, in that period, data was recorded on paper disks and paper roles with mechanical instrumentation, or it's was an engineer reading a gage and writing down the data. The mechanical recorders also need an engineer or technician to make sure the recording pen did not hang-up. Also test observers were needed; reliable combustion and leak sensors were a thing of the future. A test, if at all complex, could require ten of more additional personnel for set up, and more than twice that number for the actual testing.

As a result the daily workplace for many SSFL/Area IV - Canoga Facility site personnel could, and most often did, vary daily and weekly.

The comments by [redacted], at worker at SSFL/Area IV at the time of the Sodium Reactor Experiment incidents, regarding employee assignments within the Corporation, clearly acknowledges this work-sharing operational approach which was prevalent at North American Aviation at that time. As he is quoted in the article in the Ventura County Star, July 12, 2009 (Ref. 5)--- *"It's true,* [redacted] *said, that workers from Rocketdyne, Atomics International's sister division that conducted rocket engine tests at the lab, were brought over to help with the cleanup."*

Attachment A – E.4 Employment Dates relevant to this petition.

The dates for this Petition for the establishment of a Special Exposure Cohort for the SSFL/Area IV – Canoga Facility site are: Nov. 15, 1955 through June 28, 1960.

I worked for North American Aviation at the Canoga Facility site from mid-November 1955 through mid-August 1984. (Following this period I worked at the DeSoto Complex, in Chatsworth, CA. I worked for a short period at the Westlake building site in Westlake Village, CA)

During this period, [redacted] I also spent numerous days working at the SSFL (all areas).

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Attachment A – E.5 Is the Petition based on one or more unmonitored, unrecorded, or inadequately monitored recorded exposure incident

Yes

If yes provide the Date(s) of the incident and a complete description .

This Petition for a Special Exposure Cohort for the SSFL/Area IB – Canoga Facility site is based (as previously stated) on the deficiencies in monitoring of effluents, gasses and particulate emissions, and the deficiencies and lack of bioassay monitoring (and data) from the nuclear activities located in the Vanowen building (038), including the two nuclear reactors located in the south-east corner of the Vanowen building (038), as detailed in Attachment A – F.1/F.2. This Petition is based on the facts that the same situations that existed regarding air-borne nuclear-radiation effluents, dose monitoring deficiencies and lack of bioassay monitoring that existed at the SSFL/Area IV site, as established and documented by NIOSH in Ref 2, SEC-00093, also existed at the SSFL/Area IV – Canoga Facility site.

The dates presented for this Special Cohort Group Petition (Nov. 15, 1955 through June 28, 1960) are essentially consistent with the dates established by NIOSH for the SEC-00093 petition.

The SEC period "start date" for this Petition is Nov. 15, 1955. Although nuclear operations began at the Vanowen building in the SSFL/Area IV – Canoga Facility site in 1954, the Nov. 15, 1955 date is based on the date I began working at the site. I do not know of, nor can I locate, any North American Aviation employee that worked at the site prior to this date and that has an EEOIC Program defined presumptive cancer, and thus provide a basis for an earlier start-date.

The cohort period ending-date for this Petition differs from the ending-date for the SEC-00093 Special Exposure Cohort for the SSFL/Area IB because of the following factors.

(a) Nuclear inspection, machining, processing and nuclear reactor operations, and the potential for radiation hazards and emissions, existed at the Vanowen building. The Vanowen building was not a remote or seldom used building. From the beginning of nuclear operations at SSFL/Area IV and the Vanowen building, the Vanowen building at the SSFL/Area IV – Canoga Facility site was the "hub" for North American Aviation's nuclear reactor program operations. The Vanowen building's loading docks were the delivery site for materials, and vendor supplied parts and fabricated hardware destined for either SSFL/Area IV or the nuclear activities in the Vanowen building. At the loading docks materials, supplies and vendor parts were off-loaded and receiving inspection performed.

The Vanowen building was the principle manufacturing facility for the SSFL/Area nuclear reactor operations. Incoming materials or hardware requiring machining,

assembly or testing (or other processing) would be inspected, and then these operations preformed using the Vanowen building's extensive material processing machining, hardware fabrication and laboratory testing capabilities that, in the 1950's, greatly exceeded those available at SSFL/Area IV.

Deliveries to the SSFL/Area IV site, following receiving inspection, were by company trucks using company drivers. North American Aviation was a union shop. All deliveries between company sites were made using company transportation. The road up the hill to the SSFL was a private, rather narrow, windy road; access was controlled by a company guard gate at the bottom of the hill. Only company trucks, company cars, and employee's cars had access. Few supplier trucks were allowed on this private road, but only after a permit from the company was obtained.

These activities at the Vanowen building continued until all the facilities at the DeSoto building 001 were completed in the early 1960's.

(b) No evidence has been uncovered of bioassay monitoring ever being performed for employees at the SSFL/Area IV - Canoga Facility site during the 1950's. Eight reports have been found, Ref 6-a through Ref 6-h, which address radiation monitoring data at North American Aviation sites. These reports present monitoring data for North American Aviation sites including Downey, Canoga Park, SSFL, Area IV, DeSoto, and in the later reports, out-lying sites east and west of the SSFL. No differences in monitoring or radiation recording at the various sites are noted in those reports. None mention bioassay monitoring, or results of such monitoring. Although other reports may exist that indicate bioassay monitoring at the SSFL/Area IV - Canoga Facility site at dates prior to 1960, these reports do not.

Ref 6-i, A Comprehensive Dose Reconstruction Methodology for Former Rocketdyne/Atomics International Radiation Workers, authored by John D Boice, et. al, and published in the Health Physics Journal, Nov 2005, presents a detailed review of over 46,000 Rocketdyne and Atomics International workers, covering the 1948 to 1999 time period. Twelve and one-half (12.5%) of the total work force were monitored (in some manner) over this period. However the data presented does not address specific time periods. I find only one reference to 1950's monitoring data and that is for--- urinary data for a worker exposed to uranium before starting work at Rocketdyne/Atomics International in the early 1960's The earliest references for bioassay monitoring are that "urine monitoring started in 1963", and "bioassay sample.....summary cards for the time period Jan 1, 1961 to Dec 31, 1967". Nothing in the report indicates any differences in monitoring, or monitoring data, between the SSFL site and the site addressed in this Petition.

(c) The planning for the move out of Vanowen building to the new facility at DeSoto had been 'in the works' for at least four years prior to the move (which initiated in 1959). It

is unlikely that new or additional monitoring would have begun at Vanowen, with a move out of the building being eminent.

(d) A letter from the Atomic Energy Commission, dated June 28, 1960 (Ref 5), grants North American Aviation permission to move the L-77 reactor from the Vanowen building to the DeSoto site. Since the L-77 reactor could not be moved without this permit, this "License" dates the earliest date for the removal of the L-77 reactor from the Vanowen building, and thus the conclusion of nuclear operations at the Vanowen building, prior to decontamination and clean-up. *This date for the "license" to move the L-77 reactor out of the Vanowen building, granted June 28, 1960 has been used to establish the concluding date for this Petition for a Special Exposure Cohort for the SSFL/Area IV – Canoga Facility site.*

Some anomalies exist (re: Ref 7, Attachment 1) regarding the disposition of the L-47 reactor, that was operated in the Vanowen building at the SSFL/Area IV - Canoga Facility site. On Nov. 15-16, 1995, representatives of the United States Nuclear Regulatory Commission toured the Vanowen building. Records regarding the date of disposition of the L-47 reactor, and the location to which it was moved, were limited. Only ten percent (10%) of the reactor fuel purchased for the L-47 could be accounted for. The building site was surveyed on the above, Nov. 15, 1995 date for radioactive contamination (approx 35 years after nuclear operation were removed from the building). The report states that no contamination was identified. That report further states that *"The former reactor room was found to free of radioactive materials which indicated that the area had been successfully remediated by either Atomics International or Rockwell International."* The question of at what date this occurred, and what contamination existed prior to the remediation, was not addressed. No comments were included in the report regarding the material handling, machining and nuclear processing facilities that were in the Vanowen building in the 1950's, prior to the move to the DeSoto building 101.

Attachment A – F.3/F.4 **Section F-3 Requests that attached report(s) from a health physicists or other individual....., and Section F-4 Requests attached technical report(s), issued by an agency of the Executive Branch of Government (re; NIOSH),----be employed in order to**
"provide a basis for proposing that records and information are inadequate for individual dose (reconstruction)"

The basis for this Petition that <u>*dose reconstructions can not be performed for North American Aviation employees at the SSDL/Area IV - Canoga Facility site, from November 15, 1955 through June 28, 1960*</u> is derived, in part, from the NIOSH prepared Ref 2 report, "SEC Petition Evaluation Report, Petition, SEC-0093, dated February 6, 2008 which addresses the SSFL/Area IV site. The basis for this Petition is that the same dose monitoring deficiencies that existed at the SSFL/Area IV site also existed at the SSFL/Area IV – Canoga Facility site. Specifically regarding these deficiencies NIOSH states in the Ref 2 report, on page 3, the following---

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"NIOSH cannot estimate internal exposures with sufficient accuracy during the period from 1955 through 1958 (which is a period with limited internal monitoring data). This includes the time from the beginning of Area IV radiological activities in 1955, to late 1958 (selected as December 31, 1958 for SEC evaluation purposes). This timeframe corresponds with the date after which an established bioassay program existed at SSFL and after which sufficient internal monitoring has been identified."

Some aspects of this basis for this Petition, as detailed by NIOSH in Ref 2,, that amplify and detail this above statement have been presented previously in Attachment A - E-2, in the presentation regarding the facilities (i.e., the site description) that are included in this Petition.

Additional supporting documents and statements follow-- through page 20-- of this Petition attachment. The radiation monitoring data collected by Atomics International, a Division of North American Aviation, as reported in Ref 6-a through 6-h, include both the SSFL/Area IV site and SSFL/Area IV - Canoga Facility site. These reports provide similar types of measured radiation data (or lack thereof) for both sites. It is inconceivable to believe that a site, such as the Vanowen building in the SSFL/Area IV - Canoga Facilities site (or other buildings at this site), would be monitored differently than the SSFL/Area IV site, or that monitoring data would have been collected, recorded or maintained differently

A review of the three NIOSH-prepared documents (for North American Aviation site locations at: SSFL/Area IV, Downey, Canoga Park Vanowen building, and DeSoto) that address radiation doses support the above statements. The three NIOSH documents (Ref 1-d, 1-e, 1-f, and 1-g) address Occupational Environmental Dose, Occupational Internal Dose and Occupational External Dose, respectively.

Nothing is found in these three documents to suggest that the radiation monitoring programs, in any aspect, for the SSFL/Area IV site and Canoga Park Vanowen building site were conducted differently, or had different objectives, or used differing technologies, or were recorded differently. To the contrary, most of the statements in the three documents tied the monitoring programs at the SSFL/Area IV site and the Canoga Park Vanowen building site, together.

Statements in Ref 1-d, Occupational Environmental Dose, in Section 4.5 (page 8), Section 4.5.4 (page 10) and Section 4.6.5 (page 15): and in Ref 1-e, Occupational Internal Dose in Section 5.3.1.1 (page 13) and Section 5.3.3 (19): and in Ref 1-g, Occupational External Dose, in Section 6.2 (page 6) address radiation monitoring (or lack thereof) and available monitoring data (or lack thereof) for the SSFL/Area IV and Canoga Park Vanowen sites, together, with similar comments applied.

However, throughout the above referred Sections are statements such as found in: Ref 1-d, Section 4.5.4, referring to Stack Effluent Concentrations before 1959 *"No data are available*

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for the period before 1959",... and in Section 4.6.5, External Dose Before 1959, *"No data are available for the period before 1959"* and "*Environmental external doses from 1952 to 1955 for Downey and from 1954 to 1960 for the Canoga Park Vanowen Building are estimated"...*, and in Ref 1-e, in Section 5.3.1.1 *In Vitro* Urine Analysis, 1948 – 1957 *"Apparently, no bioassay program existed before August 1958."* And in Section 5.3.3 Fecal Sample Analysis *"Although fecal sampling was mentioned as both a routine and a special bioassay method in site documents, little detail has been found about the analytical methods used"...*

The nuclear activities at the SSFL, Area IV and those that were in the Vanowen building at SSFL/Area IV - Canoga Facility site were performed by technical staffs (that including the monitoring personnel) managed by a small core of Program Managers and Directors all reporting, at that period, to the same Division President, Dr. Chauncey Starr

Attachment A - F.3 Requests that attached report(s) from a health physicists or other individual...,

S. Cohen & Associates and Saliant, Inc. were contracted by the Advisory Board on Radiation and Worker Health (ABRWH) to conduct an independent review of (a) the NIOSH position regarding the establishment of a Special Exposure Cohort for the SSFL/Area IV site, and (b) the NIOSH recommendations and technical positions, as presented in the Ref 2 report, SEC-00093.

The report prepared by S. Cohen & Associates and Saliant, Inc., titled " ADVISORY BOARD ON RADIATION AND WORKER HEALTH, National Institute for Occupational Safety and Health, Review of the Santa Susana Field Laboratory (SSFL) Area IV Special Exposure Cohort (SEC) Petition-00093 and the NIOSH SEC Petition Evaluation Report, was prepared under contract to NIOSH, Contract No. 200-2004-03805 , Task Order No. 5 , SCA-SEC-TASK5-0066, dated January 2009 (i.e. Ref 2), which addressed Revision 00, of the SEC-00093 report (prior to Revision 01), substantially concurs with the Ref 3 NIOSH SEC -0093 report (Revision 01) in the formation of a Special Exposure Cohort group for SSFL/Area IV.

Specifically, in Ref 2, Section 5, Conclusions, on page 43, the following comments are written---

In paragraph 2—

> *"SC&A agrees with the findings in the SEC ER that the internal monitoring program was insufficiently robust to estimate exposures before January 1, 1959. Only limited amounts of internal personnel monitoring data for pre-1959 exposures were identified, which is consistent with NIOSH's findings that an SSFL routine bioassay program was not initiated until August 1958 (Kellehar 1966)".....*

In paragraph 3—

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"In addition, monitoring for internal exposure of SSFL workers was incomplete and poorly documented for most years of facility operation."

And in paragraph 4—

"The information in TBD-5 [i.e., Ref 1-e, ORAUT-TKBS-0038-5, Technical Basis Document: Energy Technology Engineering Center – Occupational Internal Dose, Rev. 00 (ORAUT 2006d)] *is unclear as to whether workers exposed during these early incidents were adequately monitored for internal exposure and, if workers were monitored, whether their exposure records exist. "*

S. Cohen & Associates and Saliant, Inc. address the SSFL/Area IV - Canoga Facility site in the Special Exposure Cohort report (SEC-00093), with regard to radiation monitoring in several statements.

In Ref 3, Section 5, Conclusions, on page 43, paragraph 1, the following comments are written---

"After a thorough review of SEC Petition-00093 (Ref 2) *and the large number of relevant/support documents, it is still unclear as to which of the four facilities* (i.e., SSFL/Area IV, Canoga, Downey, and De Soto facilities) *should be covered in the petition and the initial year of coverage, which is dependent on whether all four facilities are covered in the petition or if it is just Area IV of SSFL that is covered.*

And in Ref 3, on page 25 of Section 4.2.1 Areas Addressed by Petition, a further statement addresses the Canoga Facility site---

"The TBDs (i.e.,Refs 1-a through 1-f) *focus on Area IV of the Santa Susana Field Laboratory, but also address the Canoga, Downey, and De Soto facilities. Dose reconstructions that are prepared for employees of AI include work conducted at all four of these facilities. It is noted above that the AI Division of NAA operated all four of these facilities, and their internal and external dose monitoring programs were the same for all the facilities*". (Underlining added).

In Ref 3, Section 5 Conclusion, page 43, the following is written regarding two major facility incidents at the SSFL/Area IV (which addresses monitoring at North American Aviation in the 1950's and which is applicable to all North American Aviation facilities)---

There is a lack of information concerning two major facility incidents that had significant potential for internal or external exposure to personnel; the SRE coolant failure and the sodium burn pit. TBD-5 (i.e., Ref 1d) *does not specifically address radiological incidents that may have resulted in internal exposures to workers' that were unmonitored and, based on our review of claimant files, it does not appear that all workers who should have been badged were indeed badged. As noted, the poor track record of badging employees appropriately indicates a need for NIOSH to revisit the limitation for its*

proposed addition to the SEC class only to employees who were monitored. The information in TBD-5 (i.e., Ref 1d) *is unclear as to whether workers exposed during these early incidents were adequately monitored for internal exposure and, if workers were monitored, whether their exposure records exist.*

and also on page 44 of Ref 3, the following is added----

"SC&A questions the data and unsupported/unreferenced assumptions that were applied in order to reconstruct occupational environmental doses, due to insufficient environmental monitoring and data limitations. This includes inhalation intake estimates that are radionuclide-specific and the surrogate use of the time-integrated average yearly gross alpha/gross beta stack emissions corresponding to years 1971 thru 1999, which likely underestimate stack emissions for years 1954 through 1970. "

and the following, on page 44 of Ref 3, is also stated----

"In the absence of empirical data involving neutron spectra for reactors and Pu fuel storage facilities, the lack of dosimeter calibration methods, and the relative insensitivity of NTA film to neutrons with less than 500 keV, there remains an undefined level of uncertainty for recorded neutron doses. Therefore, the use of Y-12 data as surrogate values may not be appropriate. There is no discussion of neutron-to-photon ratios in the site profile; however, it is mentioned as an option for calculating thermal neutron exposure in the ER report. The ER indicates there are source term data available to bound low-energy photon dose; however, no specific information on source terms is provided. Furthermore, there is no consideration for dose from skin contamination incidents. Additional work is needed in this area to either better define the likely neutron dose or provide a plausible bound for the dose."

These last three comments from Ref 3 are highlighted here, not to address the 1959 reactor incidents, but rather to further detail the Ref 3 comments regarding radiation monitoring, as it existed at North American Aviation's facilities in the 1950's and early 1960's.

All of these comments directly reflect on the ability of anyone to establish, or bound, the radiation exposure doses, internal or external, to which North American Aviation employees at the SSFL/Area IV - Canoga Facility site may have been exposed.

Attachment A - F.4 Attached technical report(s), issued by an agency of the Executive Branch of Government

As previously stated in Attachment A – F.3/F.4 *"NIOSH* (from Ref 2) *cannot estimate internal exposures with sufficient accuracy during the period from 1955 through 1958....."* and therefore the Special Exposure Cohort group for the SSFL/Area IV has been established. This statement is from Ref 2, a report issued by NIOSH, an agency of the Executive Branch of the U. S. Government.

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This conclusion is amplified in several selected comments extracted from the Ref 2 report, SEC-00093. These are as follows----

In Section 6.1.1 Internal Urinalysis Data, on page 33, of Ref 2----

> *"NIOSH has identified only limited amounts of internal personnel monitoring data for pre-1959 exposures; this is consistent with its findings that a SSFL routine bioassay program was not initiated until August 1958 (Kellehar, 1966). Therefore, NIOSH has concluded that pre-1959 workers will generally not have bioassay data prior to August 1958 (except in rare cases)."*

And in Ref 2, Section 6.1.2 Lung, Whole-Body, and Other Types of Internal or Bioassay Data

> *"Routine lung-counting, using equipment and techniques specifically developed to measure lung deposits of uranium, did not start until 1968 (outside of the timeframe evaluated in this report)."* (underling added)

And in Ref 2, Section 7.1.1 Internal Monitoring Data Review

> *"The routine in vitro bioassay program was established in August 1958 (Kellehar, 1966). The practice at SSFL was to collect urine samples based on job assignments that required exposure to radioactive materials. Prior to August 1958, NIOSH has found only limited personnel bioassay data or associated internal monitoring-related information for the worker class being evaluated in this report. However, NIOSH does have access to original urinalysis results and other supporting program data for the period after the initiation of a bioassay program in August 1958."* (underling added)

And in Ref 2, Section 7.2 Internal Radiation Doses at SSFL-Area IV

> *"Workers were potentially exposed to these radionuclides during reactor operations as well as during shutdowns, modifications, and refueling. Dust containing radionuclides could be inhaled by individuals and then deposited in the respiratory tract. The dust would also settle on surfaces and become resuspended in the air, where it could again be inhaled or ingested by transfer from contaminated surfaces via hand-to-mouth. The majority of the exposures over the history of SSFL-Area IV operations are considered to be chronic in nature.*

and

> *"In addition to particulate matter, reactor operations also produced some short-lived gaseous (xenon- 133 and krypton-85) and volatile fission products (radioiodines). Workers could have inhaled this material, although generally there were systems designed to confine or absorb this material until it decayed or was disposed of as waste (Sapere Consulting, 2005)."*

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And in Ref 2, Section 7.2.1 Process-Related Internal Doses at SSFL-Area IV --- 7.2.1.1 Urinalysis Information and Available Data from Ref 2----

"Based on limited pre-1959 internal monitoring data and associated program or source term information, NIOSH has concluded that there is insufficient information to support establishing a bounding internal exposure scenario for the proposed worker class that worked in Area IV of the SSFL from 1955 through 1958."

And in Section 7.2.2 Ambient Environmental Internal Radiation Doses at SSFL-Area IV

"Ambient environmental air sampling data exist for the period evaluated in this report; however, no stack effluent concentration data are available for the period prior to 1965. The facilities operating during the pre-1965 period were mainly small reactor facilities"...

and

"The use of facility ambient air monitoring data for assessing internal radiation doses was evaluated for performing EEOICPA dose reconstructions. However, NIOSH has concluded that the ambient environmental method (described above) does not support a bounding internal exposure evaluation method for the pre-1959 time period, when the facility lacked a routine urinalysis program."

And from Section 7.2.4 Internal Dose Reconstruction Feasibility Conclusion of Ref 2----

"NIOSH has established that unmonitored intakes of radionuclides associated with reactor operations (and associated operations) may have occurred in Area IV of the SSFL prior to 1959 and that these exposures may have resulted in unmonitored doses to site workers and workers incidentally exposed in these facilities."
"NIOSH has also determined that there was no established routine bioassay program for Area IV of the SSFL prior to August 1958."

and

"There is insufficient information associated with the source terms for the operations during this timeframe to support developing a method to estimate or bound internal radiological exposures based on source term (or any currently available) information or data. For this reason, NIOSH has concluded that it cannot bound or reconstruct pre-1959 internal doses with sufficient accuracy for any member of the evaluated worker class.

Also from Ref 2, Section 7.3.2 Ambient Environmental External Radiation Doses at SSFL

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"NIOSH has determined that ambient environmental external dose information is not available during the period evaluated in this report (sufficient data are not available until the mid-1970s" (underlining added)

and

"The use of facility ambient external monitoring data for purposes of assessing external ambient environmental radiation doses was evaluated for purposes of performing EEOICPA dose reconstructions. However, NIOSH has concluded that the ambient environmental method (described above) does not support a bounding external exposure evaluation method for the 1955-1958 timeframe, in support of radiological dose reconstructions for the proposed worker class." (underlining added)

North American Aviation, through is Atomics International division managed and operated both the partial section of the SSFL/Area IB site and the Vanowen building at the SSFL/Area IV - Canoga Facility site that were used for nuclear operations.

Operations, including radiation monitoring, at the SSFL/Area IV and Canoga Facility site, as previously reviewed, were under the direction and supervision of the same division president, and were the same. Operations, monitoring, and monitoring deficiencies that existed at the SSFL/Area IV site also existed at the SSFL/Area IV - Canoga Facilities site. This fact is reflected throughout both the NIOSH-prepared SEC-0093 report (Ref 2) and the S. Cohen & Associates and Saliant, Inc (Ref 3) report, prepared for the "Advisory Board on Radiation & Worker Health Review". Re: On page 25 of the S. Cohen & Associates and Saliant, Inc. report (Ref 3), the following is written---- *"the AI Division of NAA operated all four of these facilities, and their internal and external dose monitoring programs were the same for all the facilities"*.

This Petition is presented with the request that NIOSH, the DOE and the DOL apply the same criteria (the criteria used in establishing the Special Exposure Cohort for all North American Aviation employees at the SSFL/Area IV site) to this Petition, and thus to recommend and establish a Special Exposure Cohort for all North American Aviation employees at the SSFL/Area IV - Canoga Facility site for the period from Nov. 15, 1955 to June 28, 1960.

Thank you.

[redacted]

July 23, 2009
date

(Note: All information provided in this petition (other then my work history, supervision names, and non-technical related work information or experiences) is based on information from NIOSH, DOL, DOE, North American Aviation and other published repots, and is not based on any classified information derived from my memory or other sources.)

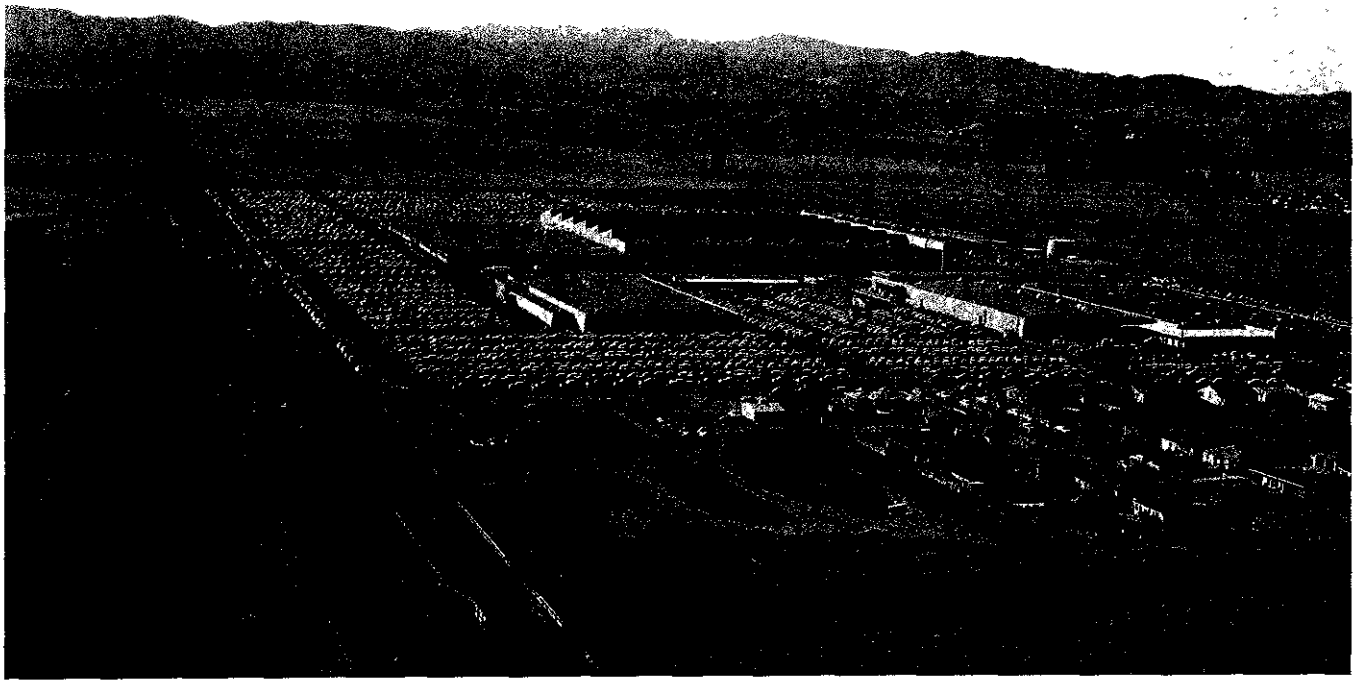

Figure A

SSFL/Area IV – Canoga Facility site

(aerial view looking south)

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References

Ref 1a ORAUT-TKBS-0038-1: "Atomics International – Introduction", Revision 001 titled dated 8/30/2006 (NIOSH report; copy not enclosed)

Ref 1b ORAUT-TKBS-0038-2: "Energy Technology Engineering Center (ETEC)—Site Description", Revision 00, titled dated 2/2/2006
(NIOSH report; copy not enclosed)

Ref 1c ORAUT-TKBS-0038-3: 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 Medical Dose, Revision 02, dated 10/3/2008
(NIOSH report; copy not enclosed)

Ref 1d ORAUT-TKBS-0038-4: "Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Van Owen Building), the Downey Facility, and the DeSoto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics International) – Occupational Environmental Dose", Revision: 01, Effective Date: 03/08/2007
(NIOSH report; copy not enclosed)

Ref 1e ORAUT-TKBS-0038-5: "Energy Technology Engineering Center – Occupational Internal Dose", Revision 00. dated 2/2/2006
(NIOSH report; copy not enclosed)

Ref 1f ORAUT-TKBS-0038-6: Atomics International – Occupational External Dose, Revision 01, dated 11/16/2006
(NIOSH report; copy not enclosed)

Ref 2. SEC Petition Evaluation Report, Petition SEC-00093, Report Rev 01 , Report Submittal Date: February 6, 2008
(NIOSH report; copy not enclosed)

Ref 3 Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program, Review of the Santa Susana Field Laboratory (SSFL)- Area IV Special Exposure Cohort (SEC) Petition-00093 and the NIOSH SEC Petition Evaluation Report", report No. SCA-SEC-TASK5-0066, dated January 30, 2009, and prepared by S. Cohen and Associates
(report prepared for NIOSH, copy enclosed)

Attachment A
Amplification of the statements made on the Special Exposure Cohort Petition - Form B: for the
Santa Susanna Field Laboratory (SSFL)/Area IV –Canoga Facility site

Ref 4 letter from the Atomic Energy Commission, dated June 28, 1960, granting North American Aviation permission to move the L-77 reactor from the Vanowen building to the DeSoto site.
(copy enclosed)

Ref 5 News article in the Ventura County Star, July 12, 2009
(copy enclosed)

Ref 6a Environmental Surreys, Quarterly Progress Report, A. A. Jarrett and J. N .Roth, Oct., Nov., Dec. 1955m, dated Mar 12, 1956
(available at: http://www.etec.energy.gov/Health-and-Safety/ASER.html, copy not enclosed)

Ref 6b Environmental Surreys, Quarterly Progress Report, A. A. Jarrett and J. N .Roth, Jan, Feb, Mar 1956, dated May 8, 1956
(available at: http://www.etec.energy.gov/Health-and-Safety/ASER.html, copy not enclosed)

Ref 6c Environmental Surreys, Quarterly Progress Report, A. A. Jarrett and J. N .Roth,, Apr., May., Jun 1965, dated Aug. 7, 1956
(available at: http://www.etec.energy.gov/Health-and-Safety/ASER.html, copy not enclosed)

Ref 6d Environmental Surreys, Rough Draft, Quarterly Progress Report, J. N .Roth, dated Nov. 15, 1956
(available at: http://www.etec.energy.gov/Health-and-Safety/ASER.html, copy not enclosed)

Ref 6e Environmental Monitoring, Annual Report 1959, Atomics International, dated June 24, 1960
(available at: http://www.etec.energy.gov/Health-and-Safety/ASER.html, copy not enclosed)

Ref 6f Environmental Monitoring Report 1960, Annual Survey, Atomics International,
(available at: http://www.etec.energy.gov/Health-and-Safety/ASER.html, copy not enclosed)

Ref 6g Environmental Monitoring Report, April 1, 1960 to June 30, 1960, Atomics International, Canoga Park
(available at: http://www.etec.energy.gov/Health-and-Safety/ASER.html, copy not enclosed)

Attachment A
Amplification of the statements made on the Special Exposure Cohort Petition - Form B: for the
Santa Susanna Field Laboratory (SSFL)/Area IV –Canoga Facility site

Ref 6h Environmental Monitoring Report, Oct. 1, 1960 to Dec. 30, 1960, Atomics International, Canoga Park
(available at: http://www.etec.energy.gov/Health-and-Safety/ASER.html, copy not enclosed)

Ref 6-I A Comprehensive Dose Reconstruction Methodology for Former Rocketdyne/Atomics International Radiation Workers, authored by John D Boice, et. al, and published in the Health Physics Journal, Nov 2005
(copy not enclosed; report copyright; available at)
http://www.boeing.com/aboutus/environment/santa_susana/factsheets/dose_reconstruction2006.pdf

Ref 7 United States Nuclear Regulatory Commission Memorandum, and Attachment 1, Subject: Rockwell International Site Visit, dated Jan. 29, 1996,.
(copy enclosed)

Attachment A
Amplification of the statements made on the Special Exposure Cohort Petition - Form B: for the
Santa Susanna Field Laboratory (SSFL)/Area IV –Canoga Facility site

Attachment A-1:
For completeness, the excerpts and summaries from the report---

"Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program, Review of the Santa Susana Field Laboratory (SSFL)- Area IV Special Exposure Cohort (SEC) Petition-00093 and the NIOSH SEC Petition Evaluation Report", Report no. SCA-SEC-TASK5-0066, dated January 30, 2009 Prepared by S. Cohen and Associates and Saliant, Inc,

and used in Attachment A, are shown as complete sections or sub-sections below---

Section 4.3.2 Monitoring for Internal Exposure of SSFL Workers was Incomplete and Poorly Documented for Most Years of Facility Operation

In Section 5.2 (p. 10) of TBD-5, the evaluation of the SSFL internal monitoring program is prefaced with the following statement:

> *Early 1960s AI documents describe **all** the elements of a **comprehensive** radiation safety program, including a laboratory with bioassay capability.* ... [Emphasis added.]

This statement, however, was tempered by numerous admissions in subsequent sections of the TBD. A sampling of statements suggesting deficiencies and data limitations include the following:

Page 13:

> *Specific radionuclides **could** be determined "where required" (Lang 1960). **Some** detail has been found on early urinalysis methods. In addition to the in-house laboratory capability, bioassay services were contracted to the following vendors:* [Eight vendors are listed.] *...Information on the periods during which ETEC used these laboratories was **not** found.* [Emphasis added.]

In addition to the eight contract laboratories, ETEC had its own **in-house** laboratory, which analyzed urine for uranium content by fluorometric method. Exposure to uranium may have existed in various states of enrichment up to 93%.

Page 14:

> *Due to its higher specific activity, EU activity **could** be determined by counting....*

*No specific information on sensitivities for the **in-house** laboratory was obtained....* [Emphasis added.]

Page 15 (Regarding thorium):

No details of early thorium analyses were recovered...

Page 15 (Urinalyses for period 1967–1974):

Partial documentation on bioassay methods from 1967 through 1974 was found. ...These documents are **believed** to refer to services offered by UST [one of the eight contract laboratories]. [Emphasis added.]

Page 17 (Urinalysis for period 1975–1988):

*The following analytical methods were taken from a series of annual reports.... The measurement "type" in parentheses appears in many personnel bioassay records. The detection limits should have improved over the years. However, a listing was **not** found. ...* [Emphasis added.]

Page 18 (On the method for analyzing mixed fission products):

*Mixed fission products were precipitated from a **basic** oxalate media. ... Alkali metals such as 137Cs did **not** precipitate. In addition, **volatile** fission products such as 1-131 were **lost**. ...* [Emphasis added.]

Page 19 (On in-vitro methods for individual radionuclides):

*Although fecal sampling was mentioned as both a routine and a special bioassay method in site documents, **little** detail has been found about the analytical methods used. ...* [Emphasis added.]

Page 20 (On the use of whole-body counting for monitoring workers):

*... whole-body counting for fission or activation products was apparently **not** part of the routine bioassay program at ETEC. Between 1975 and 1988, only 25 counts on 25 individuals were summarized in annual reports. ...All WBCs were reported positive for 137Cs. Ten counts were performed in 1977 and 15 were performed in 1979.* [Emphasis added.]

Page 20/21 (On the use of chest counting):

*In 1967, the first chest (lung) counts for uranium using a medical system were performed at UCLA. The 186-keV gamma ray from the decay of 235U was used to quantify the amount of EU in the lung ... Calibration of this system was **crude**;...* [Emphasis added.]

Starting in 1968, Helgeson Nuclear Services provided lung counting services. ... The results were reported in milligrams of 235U ± 2 sigma... By 1977, two 5-in.-diameter, thin-window phoswich detectors were used, ... [to detect U-235]

(SC&A notes that all chest measurements only quantified the amount or the activity of U-235. Without a firm understanding of the level of enrichment, the more important contribution of U-234 to total alpha activity cannot be determined.)

Page 25 (On solubility type, fraction activity, and particle size per facility):

> *In the absence of any measurements or studies, NIOSH guidance requires the use of default* ***solubility classes*** *and particle size values from the International Commission on Radiological Protection. ... With one exception, facility-specific solubility and particle size data for ETEC has* ***not*** *been found. Activity fractions were* ***not*** *available with the exception of those for limited fuel fabrication operations. ... Table 5-9 lists* [recommended/default] *this information* (emphasis added). [Our review of Table 5-9 indicates that to date, (1) a solubility class has not been assigned to all radionuclides, (2) activity fractions are lacking for several facilities, (3) activity fractions are based on inappropriate data, and (4) activity fractions fail to identify select radionuclides (e.g., Na-24, radioiodines)].

Section 4.3.3 Insufficient Correlation between Bioassay Data and Potential Exposures

Two sources (NIOSH 2008, ORAUT 2006e) state that there is sufficient bioassay and other supporting data available for 1959 and beyond to establish an upper bound for uranium, mixed fission products (MFPs), Po-210, plutonium, SR-90, tritium, and thorium. Of the 37 internal monitoring records available to SC&A, 78% were monitored for uranium, 62% for mixed fission products, 0% for polonium, 24% for plutonium, 5% for strontium, 14% for tritium, and 0% for thorium.

SC&A does not believe that these sources have clearly demonstrated a correlation between the bioassay data available and the potential exposures to specific radionuclides. They have not clearly defined for which workers each of the procedures were conducted, including gross alpha and gross beta. From a brief review of claimant files, it appears that monitoring was not routine for all workers handling radioactive material. Furthermore, detection limits for 1975–1988 are unavailable, and Table 5-9 in TBD-5 containing solubility type and fraction of activity is incomplete in many cases. Hence, it appears that there were significant limitations in the bioassay program in 1959, and perhaps for a few years beyond 1959.

Section 4.3.4 Missing Radionuclides in Bioassay Data The site profile indicates that bioassay data were available for gross alpha, gross beta, uranium, fission products, plutonium, thorium, Po-210, Sr-90, H-3, P-32, S-35, C-14, Pm-147, americium, and curium. Of the 37 internal monitoring records available to SC&A, the vast majority of monitoring was for uranium and mixed fission products; 78% and 62%, respectively. Fission products were monitored for 49% of the workers. Only a few monitoring records exist for the following radionuclides: 8% for cesium, 3% for beryllium, 3% for mercury, 3% for potassium, 0% for polonium, 24% for plutonium, 5% for strontium, 14% for

tritium, and 0% for thorium. Potential exposure to radionuclides such as U-233 and U-234 could have occurred during these operations, but it may not be possible to determine this, given the limitations of uranium monitoring (see below).

Section 4.3.6 Lack of Source Term Data on page 32

TBD-5 states the following:

Without bioassay or air sample data, the last resort is determination of airborne concentrations using source term evaluations (NIOSH 2002, p. 19). Data on the amount of dispersible material available does not appear to be available for ETEC.

Section 4.3.7 NIOSH's Interpretation of Reported Values by the Contract Laboratory Nuclear Science and Engineering Corp. (NSEC) may not be Correct

Section 5.3.1.2 (page 14) of TBD-5 attempts to clarify data reported by NSEC related to urinalyses for gross alpha, gross beta, and MFPs:

Gross Alpha

*Shepard (1959) gave a minimum measurable concentration of 7.5 dpm/L for gross alpha counting. NSEC gave its minimum measurable concentration as 0.2 cpm/mL (NSEC 1957). It is **assumed** that this is a **typographical error** and 0.2 **dpm/mL** was **intended**.* [Emphasis added.]

Gross Beta

*Shepard (1959) gave a minimum measurable concentration of 75 dpm/L for gross beta counting. NSEC gave its minimum measurable concentration as 1.0 cpm/mL (NSEC 1957). It is **assumed** that this is a **typographical error** and 1.0 dpm/mL was intended.* [Emphasis added.]

Mixed Fission Products

*... for beta activity with an approximate minimum detectable amount (MDA) of 60 dpm/**sample*** [is assumed] *(ORAU 2004, p. 27) ... NSEC gave its minimum measurable concentration as 2.0 **cpm**/mL (NSEC 1957). It is **assumed** that this is a **typographical error** and 2.0 dpm/mL was intended.* [Emphasis added

Gross alpha	7.5 dpm/l	0.2 cpm/ml or **200 cpm/l**
Gross beta	75 dpm/l	1 cpm/ml or **1,000 cpm/l**
MFP	60 dpm/l	2 cpm/ml or **2,000 cpm/l**

Section 4.3.8 Potential Difficulties Associated with Uranium Bioassay Data

Uranium at SSFL to which workers may have been exposed existed in various degrees of enrichment (i.e., 2% to 93%). Section 5.3 of TBD-5 discusses the two independent methods used to assess uranium in urine; the fluorometric method only identifies uranium concentrations in ug/ml, while the radiometric method assesses the gross alpha activity in dpm/l. Given the potentially wide range of specific activities of uranium defined by fluorometric urine data, all fluorometrically analyzed urine would also require a

concurrent radiometric evaluation of that sample in order for these data to be useful to dose reconstruction.
From information contained in Section 5.3 of the TBD, it is unclear whether urine samples were consistently analyzed by both fluorometric **and** radiometric methods. This is particularly evident from the internal monitoring records pre-1961, where there appears to be no distinction made between the types of urinalysis methods used. From 1961–1962, there was a transition period where uranium in general was monitored, as well as Uranium Radiometric (UR) and Uranium Fluoride (UF). After 1962, the type of urinalysis methods used was usually specified.
It is **not** unreasonable to assume that for the early years, concern for the chemical toxicity of uranium may have limited urine bioassay to the fluorometric method. If this assumption is true, the absence of concurrent radiometric analysis of urine samples would severely limit the value of early fluorometric data.

Thus, in the event that a fluorometric urine bioassay cannot be matched with a concurrent radiometric analysis, a claimant-favorable default value should be used that defines the enrichment level of uranium. NIOSH should further explore this issue, as it might apply to the post-1958 time period.

Section 4.3.9 There are Unanswered Questions Regarding the Completeness and Quality of Personnel Exposure Records

In Section 5.2 of the TBD, the following statements appear:
Page 10:

> *...Al established health and safety files on each employee that contained radiation exposure records, injury records, and other "pertinent" data (Lang undated, 1960). Today, personnel radiation exposure records are in the Radiation Safety Records Management System (RSRMS), which encompasses about **170 file cabinets**.* [Emphasis added.]

Page 12:

> *The bioassay records in the individual files generally consist of:*
> • *Individual Personnel Keysort Cards (Figure B-2, Attachment B), which were used to track the type, frequency, and week of sample collection. ... The forms can be **difficult to read due to the quality of the copies**, and dose reconstructors should refer to the forms listed below for urine and fecal data. This form **might** be the **only** place **in vivo*** [?] *data are listed.* [Emphasis added.]

Section 5.7 (page 23):

> *The bioassay results from ETEC and its predecessor organizations are **apparently not** available in a computerized format. The units used to report the results are **generally** included in the hard-copy reports. ...* [Emphasis added.]

Section 5.8 (page 23):

> ***No codes** have been found* [for excreta samples]. ...

These statements suggest that (1) all personnel records currently exist in hardcopy form only, and (2) records may be of poor quality, difficult to interpret, and incomplete. SC&A concludes that the use of these records for dose reconstruction will require a comprehensive assessment regarding the quality and completeness of records contained in the 170 file cabinets, and requires guidance to dose reconstructors for their interpretation/use.

Section 4.3.10 Use of SSFL Site Survey Data/Source Term cannot be Regarded as Useful Surrogate Data for Bioassay Data in Dose Reconstruction

In the In the absence of an individual's in-vitro/in-vivo bioassay data, the TBD provides the following information and guidance to dose reconstructors:

> *If bioassay data are **not** adequate to evaluate an individual's internal doses, dose reconstructors can use workplace monitoring data (NIOSH 2002). The following types of workplace data **might** be available for ETEC: breathing zone air samples, general area air samples, and surface contamination surveys. However, **these data are not likely to be in individual exposure records**. Data on respirator use are **not** likely to be available ... resuspension factors are **not** likely to be available.* [Emphasis added.]

Section 5.12 (page 30):

> *Without bioassay or air sample data, the last resort is determination of airborne concentrations using **source term** evaluations (NIOSH 2002, p. 19). Data on the amount of dispersible material available does **not** appear to be available for ETEC.* [Emphasis added.]

This "guidance" is deficient and places an unrealistic responsibility on the dose reconstructor because, at a minimum, the dose reconstructor will need to make judgments regarding (1) how to use general air sampling data when breathing zone data are not available or limited, and (2) what resuspension factors should be assigned. It is important that additional guidance be

Section 5.0 CONCLUSIONS

After a thorough review of SEC Petition-00093 and the large number of relevant/support documents, it is still unclear as to which of the four facilities should be covered in the petition and the initial year of coverage, which is dependent on whether all four facilities are covered in the petition or if it is just Area IV of SSFL that is covered. The list of covered sites in the DOE database is not consistent with the list of covered sites identified in the August 23, 2004, *Federal Register*. If only Area IV of SSFL is covered in the petition, it is not clear whether the initial date of coverage is 1953, 1954, or 1955. If it is determined that all four facilities will be included in the SEC Petition, the initial coverage date will need to be changed to 1947 or 1948. NIOSH and DOE should make this decision, based on further research.

Attachment A
Amplification of the statements made on the Special Exposure Cohort Petition - Form B: for the
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SC&A agrees with the findings in the SEC ER that the internal monitoring program was insufficiently robust to estimate exposures before January 1, 1959. Only limited amounts of internal personnel monitoring data for pre-1959 exposures were identified, which is consistent with NIOSH's findings that an SSFL routine bioassay program was not initiated until August 1958 (Kellehar 1966). Our review of the percentage of workers being monitored for internal exposure indicates that the percentage continued to increase after 1959, until it plateaued several years later. A determination needs to be made by NIOSH on whether the percentage of workers who were monitored in the several years after 1958 indicates a fully functioning internal monitoring program.

In addition, monitoring for internal exposure of SSFL workers was incomplete and poorly documented for most years of facility operation. These deficiencies and data limitations are stated throughout sections of the TBD. For 1959 and beyond, SC&A does not believe that NIOSH has clearly demonstrated a correlation between the bioassay data available and the potential exposures to specific radionuclides.

There is a lack of information concerning two major facility incidents that had significant potential for internal or external exposure to personnel; the SRE coolant failure and the sodium burn pit. TBD-5 does not specifically address radiological incidents that may have resulted in internal exposures to workers' that were unmonitored and, based on our review of claimant files, it does not appear that all workers who should have been badged were indeed badged. As noted, the poor track record of badging employees appropriately indicates a need for NIOSH to revisit the limitation for its proposed addition to the SEC class only to employees who were monitored. The information in TBD-5 is unclear as to whether workers exposed during these early incidents were adequately monitored for internal exposure and, if workers were monitored, whether their exposure records exist.

SC&A questions the data and unsupported/unreferenced assumptions that were applied in order to reconstruct occupational environmental doses, due to insufficient environmental monitoring and data limitations. This includes inhalation intake estimates that are radionuclide-specific and the surrogate use of the time-integrated average yearly gross alpha/gross beta stack emissions corresponding to years 1971 thru 1999, which likely underestimate stack emissions for years 1954 through 1970. There are also conflicting reports concerning the exposure to onsite water supply wells. This issue should be re-evaluated to determine if this exposure route can be properly assessed in earlier years and, if so, how to assess this exposure.

In the absence of empirical data involving neutron spectra for reactors and Pu fuel storage facilities, the lack of dosimeter calibration methods, and the relative insensitivity of NTA film to neutrons with less than 500 keV, there remains an undefined level of uncertainty for recorded neutron doses. Therefore, the use of Y-12 data as surrogate values may not be appropriate. There is no discussion of neutron-to-photon ratios in the site profile; however, it is mentioned as an option for calculating thermal neutron exposure in the ER report. The ER indicates there are source term data available to bound low-energy photon

dose; however, no specific information on source terms is provided. Furthermore, there is no consideration for dose from skin contamination incidents. Additional work is needed in this area to either better define the likely neutron dose or provide a plausible bound for the dose.

REF. 3

Draft

ADVISORY BOARD ON

RADIATION AND WORKER HEALTH

National Institute for Occupational Safety and Health

Review of the Santa Susana Field Laboratory (SSFL) Area IV Special Exposure Cohort (SEC) Petition-00093 and the NIOSH SEC Petition Evaluation Report

Contract No. 200-2004-03805
Task Order No. 5
SCA-SEC-TASK5-0066

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January 2009

Disclaimer

This document is made available in accordance with the unanimous desire of the Advisory Board on Radiation and Worker Health (ABRWH) to maintain all possible openness in its deliberations. However, the ABRWH and its contractor, SC&A, caution the reader that at the time of its release, this report is pre-decisional and has not been reviewed by the Board for factual accuracy or applicability within the requirements of 42 CFR 82. This implies that once reviewed by the ABRWH, the Board's position may differ from the report's conclusions. Thus, the reader should be cautioned that this report is for information only and that premature interpretations regarding its conclusions are unwarranted.

S. COHEN & ASSOCIATES: ***Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program***	Document No. SCA-SEC-TASK5-0066 Effective Date: Draft — January 30, 2009 Revision No.
Review of the Santa Susana Field Laboratory (SSFL)-Area IV Special Exposure Cohort (SEC) Petition-00093 and the NIOSH SEC Petition Evaluation Report	Page 2 of 54
Task Manager: _____ Date: _____ Gregory P. Beronja	Supersedes:
Project Manager: _____ Date: _____ John Mauro, PhD, CHP	

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ABBREVIATIONS AND ACRONYMS

ABRWH or the Board	Advisory Board on Radiation and Worker Health
AEC	Atomic Energy Commission
AERD	Atomic Energy Research Development
AWE	Atomic Weapons Employer
AI	*Atomics International*
ATR	Advanced Test Reactor
BE	Beryllium
CFR	Code of Federal Regulations
Ci	Curie
cpm	Counts per minute
D&D	Decontamination and Decommissioning
DOE	Department of Energy
DOELAP	Department of Energy Laboratory Accreditation Program
dpm	Disintegrations per minute
EEOICPA	Energy Employees Occupational Illness Compensation Program Act of 2000
EPA	Environmental Protection Agency
ER	Evaluation Report
ETEC	Energy Technology Engineering Center
EU	Enriched Uranium
FR	*Federal Register*
FWSP	Federal Work Study Program
HEPA	High Efficiency Particulate Air
HHS	Health and Human Services
ISF	Interim Storage Facility
keV	Kilo Electron Volt
L	Liter
LMEC	Liquid Metal Engineering Center
LMFBR	Liquid Metal Fast-Breeder Reactor
LMIC	Liquid Metal Information Center
LMR	Liquid Metal Reactor

MDA	Minimum Detectable Activity
MDL	Minimum Detection Limit
MeV	Mega Electron Volt
MFP	Mixed Fission Product
mL	Milliliter
MPBB	Maximum Possible Body Burden
Mr	Millirem
NAA	North American Aviation
NIOSH	National Institute for Occupational Safety and Health
NOCTS	NIOSH OCAS Claims Tracking System
NSEC	Nuclear Science and Engineering Corporation
NTA	Neutron Track Emulsion Type A
OCAS	Office of Compensation Analysis and Support
ORAU	Oak Ridge Associated Universities
ORAUT	Oak Ridge Associated Universities Team
pCi	pico Curie
r	Rem
R&D	Research and Development
REIRS	Radiation Exposure Information Reporting System
Rem	roentgen equivalent man
RI	Rockwell International
RMDF	Radioactive Material Disposal Facility
RSRMS	Radiation Safety Records Management System
SC&A, Inc.	S. Cohen and Associates
SEC	Special Exposure Cohort
SRDB	Site Research Database
SRE	Sodium Reactor Experiment
SNAP	Systems for Nuclear Auxiliary Power
SSFL	Santa Susana Field Laboratory
TBD	Technical Basis Document
UCLA	University of California Los Angeles
UF	Uranium Fluoride

UR	Uranium Radiometric
W	Watt
WB	Whole Body

1.0 INTRODUCTION

1.1 SCOPE AND PURPOSE OF SEC REVIEW

During the meeting of the Advisory Board on Radiation and Worker Health (the Board) held in Redondo Beach, California, on September 4, 2008, S. Cohen & Associates (SC&A) was directed by the Board to perform a "paper" review of the Santa Susana Field Laboratory (SSFL) Special Exposure Cohort (SEC) Petition-00093 and the NIOSH SEC Petition Evaluation Report (ER) for said petition.

The scope of this review addresses specific issues of concern raised in the petition and NIOSH's response to these concerns, as given in the ER. SC&A reviewed hundreds of documents that were considered relevant to the petition. Documents reviewed include the following:

- Documents that were referenced and/or enclosed in the petition
- Documents referenced/cited in the ER and site profile
- Documents contained in the NIOSH Site Research Query Database

The purpose of this review is to provide the Board with an independent assessment of issues and concerns that surround the petition and NIOSH's response and proposed methods for accommodating these issues/concerns. Findings identified in our review are expected to provide the Board with a **preliminary** overview of potential issues that may impact the feasibility of dose assessment. Following a formal, multi-step resolution process, any unresolved findings may then be used by the Board for determining whether radiation doses can be estimated with sufficient accuracy, as defined in 42 CFR §83.13(c)(1). In addition, since this review was limited to a paper study, there will likely be a need to follow up this report with a site visit, interviews with claimants and petitioners, and the retrieval and review of additional documents, in accordance with Board-approved procedures for the review of SEC petitions and associated evaluation reports. It is for this reason that this report is referred to as "preliminary" and as a "paper study."

1.2 TECHNICAL APPROACH AND REVIEW CRITERIA

The approach used by SC&A to perform this review follows the protocols described in the draft report prepared by SC&A entitled, *Board Procedures for Review of Special Exposure Cohort Petitions and Petition Evaluation Reports,* Revision 1 (SC&A 2006a), and the *Report to the Working Group on Special Exposure Cohort Petition Review* (SC&A 2006b). The latter is a set of draft guidelines prepared by a Board-designated working group for evaluation of SEC petitions performed by NIOSH and the Board. The former is a set of draft procedures prepared by SC&A and approved by the Board for use by SC&A on an interim basis (ABRWH 2006, p. 132). The procedures are designed to help ensure compliance with Title 42, Part 83, of the *Code of Federal Regulations* (42 CFR 83) and implement the guidelines provided in the report of the working group.

Key review criteria identified in the report of the working group include the following:

- Timeliness
- Fairness
- Understandability
- Consistency
- Credibility and validity of the dataset, including pedigree of the data, methods used to acquire the data, relationship to other sources of information, and internal consistency
- Representativeness and completeness of the exposure data with respect to the area of the facility, the time period of exposure, the types of workers, and processes covered by the data

The working group guidelines also recommend that NIOSH include in its SEC evaluation a demonstration that it is feasible to reconstruct individual doses for the cohort, including sample dose reconstructions.

SC&A's implementation of the SEC Review process includes the following steps:

(1) Conduct a critical review of the petition and relevant reports, as well as documents and data that are enclosed and/or referenced in the petition/reports.

(2) Identify additional issues/concerns that emerged from SC&A's document review, which are independent of those stated in the petition.

(3) As part of the SEC review, develop a preliminary technical position for issues identified in the petition, as well as SC&A's independent findings.

SC&A's draft report with its preliminary findings will subsequently undergo a multi-step resolution process, including interviews with site workers and others who can provide insights into the issues of concern. Resolution includes a transparent review and discussion of draft findings with members of the Board's working group, petitioners, claimants, and interested members of the public. This resolution process is intended to ensure that each finding is evaluated on its technical basis in a fair and impartial manner. A final report will then be issued to the full Board for deliberation and a final recommendation.

1.3 ORGANIZATION OF THE REPORT

Following this introduction, Section 2.0 of this report provides summary data contained in the SSFL Site Profile. The site profile specifies relevant background information and methods to be used by NIOSH for the reconstruction of internal and external doses, and includes brief site profile summaries of materials and quantities processed, facility descriptions, and proposed methods for dose reconstruction.

Section 3.0 of this report summarizes specific concerns and issues raised in the SEC Petition-00093, as well as NIOSH's ER of the petition. In the ER, NIOSH provided responses to the petition's concerns, along with the conclusion that dose reconstruction is not feasible for SSFL workers for the years 1955 through 1958.

As a result of our review of the petition, NIOSH's evaluation of the petition, the SSFL Site Profile, and other documents, SC&A identified a total of five major findings (that in some cases are supported by more detailed findings), which are cited in Section 4.0 of this report. A discussion is provided for each finding that serves to explain the technical basis for our concern.

- Subsection 4.1: Which areas (Area IV, Canoga Park, DeSoto, and Downey) should be considered in the SEC Petition and when did operations begin at Area IV
- Subsection 4.2: Concern whether the internal monitoring program was sufficiently robust to estimate exposures before and after January 1, 1959
- Subsection 4.3: Lack of information related to the potential exposures associated with facility "incidents" (Sodium Reactor Experiment, Sodium Burn Pit, etc.)
- Subsection 4.4: Lack of information on the environmental exposures (surrogate data, drinking water, etc.)
- Subsection 4.5: Justification for assignment of external dose estimates is not provided and there is no coworker model for external exposures (personnel records are also of concern)

Section 5.0 provides concluding comments regarding the impacts of our findings on dose reconstruction for SSFL workers.

2.0 KEY INFORMATION AND DATA PRESENTED IN THE SSFL SITE PROFILE

The most current site profile for the Santa Susana Field Laboratory (SSFL) consists of six Technical Basis Documents (TBDs) that were issued at various times (see References for specific dates). These TBDs will be referenced throughout this report and include the following:

- ORAUT-TKBS-0038-1: Introduction
- ORAUT-TKBS-0038-2: Site Description
- ORAUT-TKBS-0038-3: Occupational Medical Dose
- ORAUT-TKBS-0038-4: Occupational Environmental Dose
- ORAUT-TKBS-0038-5: Occupational Internal Dose
- ORAUT-TKBS-0038-6: Occupational External Dose

Throughout this report, individual TBDs are referenced simply by number. For example, ORAUT-TKBS-0038-1 will be identified as TBD-1. Collectively, the six TBDs of the site profile are intended to provide core information, data, and guidance that are intended to assist in the dose reconstruction of individual workers who may have been exposed to internal and external occupational radiation at SSFL as stated in ORAUT-TKBS-0038-1:

> *. . . The purpose of this document is to provide a site profile that contains technical basis information for evaluation of the total occupational dose for EEOICPA claimants who were employed at the Atomics International (AI) facility as described above.*

2.1 PRINCIPAL OPERATIONS

SSFL consists of a total of 2,850 acres and is located in the Simi Hills of Ventura County, approximately 30 miles northwest of downtown Los Angeles, California. Based on ownership and operations, SSFL is divided into four administrative and operational portions—Area I, Area II, Area III, and Area IV. DOE operations are conducted in a 290-acre westernmost administrative and operational portion designated as Area IV.

SSFL was initially established in 1947 by North American Aviation (NAA) to meet the requirements for a field test laboratory to static-fire large rocket engines; however, it also met NAA's need for a nuclear research facility. As a result, Area IV was established in 1953 at SSFL as a nuclear research and development (R&D) facility. Since then, SSFL has housed both nuclear development and rocket development groups, although in distinct and separate locations. Atomic Energy Research Development (AERD) also conducted operations in SSFL-Area IV. In December 1955, the nuclear development and rocket development groups were transformed into separate divisions—Atomics International (AI) and Rocketdyne.

Two distinct AI groups were housed in Area IV and supported by DOE. One focused on development of civilian nuclear power, and the other was a center of excellence for research and testing of non-nuclear components related to liquid metals. These two groups were referred to as AI and Liquid Metal Engineering Center (LMEC), respectively. Nuclear R&D activities in

Area IV increased rapidly from 1953 into the late 1960s, and then began to decline. AI was eventually merged into Rocketdyne in 1984 as a result of this decline.

The LMEC was created in 1966 as a government-owned and contractor-operated organization; its purpose was to provide development and non-nuclear testing of Liquid Metal Reactor (LMR) components and to establish the Liquid Metal Information Center (LMIC) for the Atomic Energy Commission's (AEC's) Liquid Metal Fast-Breeder Reactor (LMFBR) program. The LMEC was renamed Energy Technology Engineering Center (ETEC) in 1978 to reflect DOE's desire to broaden its mission beyond the LMFBR program.

Several corporate mergers and organizational changes occurred over the years. In 1967, NAA merged with Rockwell Standard to become North American Rockwell. In 1973, the corporate name changed to Rockwell International (RI). Rockwell International with AI and Rocketdyne continued to exist as independent divisions until 1984, when AI was absorbed by the Rocketdyne division. The Boeing Company purchased RI in 1996, and Rocketdyne is now a division of Boeing.

Before the remaining research activities ended in 1998, three primary types of operations were conducted at Area IV: (1) development and testing of nuclear reactors, (2) nuclear support operations, and (3) non-nuclear energy R&D.

2.2 DEVELOPMENT AND TESTING OF NUCLEAR REACTORS

Between 1953 and 1980, several nuclear reactors were built, tested, and operated in Area IV. These included both nuclear reactors and critical test assemblies. Nuclear reactor programs focused on the development and operation of homogeneous water boiler-type reactors, sodium-cooled graphite-moderated reactors, and uranium-zirconium hydride reactors.

2.2.1 Homogeneous Water Boiler Reactors

The water boiler reactors were operated in Buildings 4073 and 4093. The water boiler reactors used a 93% enriched uranyl sulfate solution held in a critical configuration in a spherical vessel. Rather than actually boil, the neutron and gamma flux caused radiolytic decomposition of water into hydrogen and oxygen in the form of tiny bubbles, which gave the impression of boiling. Area IV contained two water boiler reactors.

2.2.2 Sodium-Cooled Graphite-Moderated Reactors

The Sodium Reactor Experiment (SRE) facility consisted of 12 structures, including the reactor building, office buildings, and support structures. Eight structures were directly involved in operations with radioactive materials:

(1) Reactor Building (Building 4143)
(2) Component Storage Building (Building 4041)
(3) Temporary Hot Waste Storage Building (Building 4686)
(4) Site Service Building (Building 4163)

(5) Cold Trap Vault (Building 4695)
(6) Liquid Radioactive Waste Vault (Building 4653)
(7) Interim Radioactive Waste Storage Area (Area 4654)
(8) Intermediate Contaminated Storage Area (Area 4689)

2.2.3 Systems for Nuclear Auxiliary Power Reactors

The Systems for Nuclear Auxiliary Power (SNAP) program operated from 1956 to 1971 to support the development and testing of small reactors designed to provide power for research missions in space. The SNAP reactors were uranium-zirconium hydride reactors that used fully enriched (93%) uranium dispersed in fuel rods containing zirconium hydride. Seven SNAP reactors were tested and operated in Buildings 4010, 4024, 4028, and 4059.

2.3 CRITICAL TEST FACILITIES

Several programs used critical test facilities (i.e., low-power reactors) in Area IV. Use of these low-power reactors began in 1954, and continued until 1974. The critical test facilities included SNAP development test facilities, which were housed in Buildings 4373, 4012, 4019, and 4024. Critical test facilities supporting the development of civilian nuclear power included Buildings 4009 and 4100.

2.4 NUCLEAR SUPPORT OPERATIONS

Starting in 1956, several operations were conducted in Area IV to support nuclear programs. These included the manufacture, management, and disassembly of fuel for reactor operations, as well as the operation of nuclear waste management facilities for offsite disposal.

2.4.1 Reactor Fuel Manufacturing

As part of the nuclear reactor development work performed for the government, three different reactor fuel manufacturing operations occurred at the SSFL in Buildings 4003, 4055, and 4064. The first operation was the assembly of fuel elements for the SRE, the second was a plutonium fuel manufacturing facility, and the third was a uranium carbide fuel pilot plant. There was also a Fuel Storage Facility, used to store the Special Nuclear Materials (enriched uranium and plutonium) used to make the fuels.

2.4.2 Disassembly and Examination of Reactors and Used Reactor Fuel Assemblies

During reactor test operations, it was often necessary to examine reactor fuel assemblies and other test specimens to determine how they were performing. This involved handling and examining highly radioactive items, for which the Hot Lab operated in Building 4020 from 1959 to 1990. The Hot Lab was a 16,000-ft^2 facility containing four large hot cells with remote manipulators and cranes, a mock-up area, an operating area, and decontamination areas. Construction was completed in 1959, and the facility was used until 1990.

2.4.3 Fabrication, Use, and Storage of Radioactive Sources

Operations at SSFL required many instruments for detecting and measuring radioactivity, and these instruments were calibrated periodically using known quantities and types of radioactivity called sources, which were sealed containers that included small measured quantities of radioisotopes. Sources were also used for some forms of radiography, irradiation testing, and other applications. Sources were manufactured in the Hot Lab at SSFL, and used in various facilities at SSFL and elsewhere. Approximately 140,000 Ci of radioactive material (primarily Pm-147) were fabricated into sources at the Hot Lab. They were stored in secured locations and used under carefully controlled conditions.

2.4.4 Preparation of Radioactive Material for Disposal

The operation of nuclear reactors generates radioactive waste and other radioactive material that must be disposed of offsite. Other operations at the SSFL (fuel fabrication, reactor and fuel examination, etc.) also generated radioactive waste. Radioactive waste was prepared for disposal at the Radioactive Material Disposal Facility (RMDF) with support at the Interim Storage Facility (ISF) in Building 4654.

2.4.5 Research on Reprocessing Used Reactor Fuel

The Hot Cave in the Engineering Test Building supported licensing of nuclear fuel reprocessing. The used fuel assemblies from nuclear reactors contain unused fissionable material, fissionable transuranic products (mainly plutonium), and fission products. Rockwell developed a process to make a partial separation of used fuel, removing part of the fission products so that the material could be used again as reactor fuel. The experiments used up to one kilogram quantities of unirradiated uranium and thorium, and up to 100-g quantities of highly irradiated materials.

2.4.6 Operation of Particle Accelerators

Rockwell operated a Van de Graaff generator in Building 4030, bombarding tritium targets with deuterons to produce neutrons. A second Van de Graaff generator was operated for neutron activation of materials.

2.4.7 Research Using Radioisotopes

Some of the research at the SSFL required the use of special radioisotopes. For these tests, small quantities of specially prepared radioisotopes were brought to the SSFL, used in laboratories under carefully controlled conditions, and then either returned to the vendor or stored safely when reuse was required.

2.4.8 Miscellaneous Operations

Two of the facilities at SSFL, the Conservation Yard and the Sodium Disposal Facility (also referred to as sodium burn pit), were not intended for use with radioactive materials, but both

were inadvertently contaminated. The site profile states that both areas have been remediated and that no residual contamination has been detected.

2.5 OTHER RELEVANT FACILITIES

There are three other operations that are addressed in the site profile; the Downey facility, the Canoga Park facility, and the De Soto facility. Each of these facilities is described below. NIOSH considers these facilities as individual covered areas and does not include them in SEC Petition-00093. This issue will be further reviewed below.

2.5.1 Downey

The Downey facility, located in Downey, California, included AEC-funded activities performed in a small portion of a large building from 1947–1955. The AEC activities included mainly paper studies, R&D, and engineering studies. The R&D activities involved the use of a 2-MeV Van de Graaff generator, a small-scale radiochemical laboratory, a neutron counting room, and a construction area with a small 0.5 W teaching reactor.

2.5.2 Canoga Park

Activities at the Canoga Park, California, facility occurred in the Vanowen Building from approximately 1954–1960. Activities that had been performed at the Downey facility were moved to the Canoga Park facility at the end of 1955. The primary activities performed at the Vanowen Building included design, development, and operation of small aqueous fuel reactors; fuel development; and radiochemistry, and beryllium machining is believed to have occurred.

2.5.3 De Soto

Radiological operations occurred at the De Soto facility from 1959 to the mid-1990s. Nuclear fuel material and other radioactive materials were used in Buildings 101 and 104 (referred to as 001 and 004, respectively, prior to 1984) from 1959–1983. Building 104 was used at a much-reduced level until the mid-1990s. The nuclear operations conducted in these buildings included the Advanced Test Reactor (ATR) fuel fabrication and supporting activities; a Gamma Radiation Facility; and a mass spectroscopy (Helium Laboratory).

2.6 RADIONUCLIDES OF CONCERN

Workers at SSFL were engaged in many process operations and maintenance activities that had the potential for external and internal exposures to a host of radionuclides shown in Table 2-3 of TBD-2.

3.0 OVERVIEW OF THE SEC PETITION-00093 AND NIOSH'S EVALUATION REPORT

3.1 SEC PETITION-00093

SEC Petition-00093 qualified on October 19, 2007. The petition requested that NIOSH consider the following class: "All employees who worked in all areas of SSFL-Area IV during the time period from 1955 to the present (which incorporated the post-1987 remediation period)."

The petition provided information and affidavit statements in support of the petitioner's belief that accurate dose reconstruction over time is impossible for the SSFL-Area IV workers in question. NIOSH deemed the following information and affidavit statements sufficient to qualify SEC-00093 for evaluation:

> *As identified in Item F.1 of the SEC-00093 Form B and discussed in the July 30, 2007 call, the petitioner discussed the sodium burn pit, the lack of internal monitoring data, and indicated that no records were kept. The petitioner also discussed a Tiger Team report indicating that the report detailed "inadequate air monitoring" and that "no internal monitoring was done."*

The information and statements regarding the lack of pre-1959 internal monitoring data qualified the petition for further consideration by NIOSH, the Advisory Board on Radiation and Worker Health, and the Department of Health and Human Services. NIOSH determined that the time period from 1955 to 1965 should qualify for the purposes of the SEC petition evaluation, which includes the employment period in the original SEC-00093 petition.

Additional or more specific information that was included in the petition, but not mentioned above, includes the following:

- Faulty HEPA filters associated with the radiation storage buildings
- Improper dosimeter badges
- No record of radionuclides released during the partial meltdown of the SRE
- Evidence of spills incompletely documented
- Monitoring wells placed upgradient of the site
- No soil or water sampling for tritium and a general lack of characterization of the site
- Radiological survey showing tons of radioactive waste stored in boxes by Building 143—high levels of Cs-137 and Co-60

A summary of the key elements defined in SEC-00093 include the following:

- Issue #1: SRE Incident and Release of Core Gases. The basis for this issue being identified was a concern that monitoring records do not exist for this incident and that there was a release of core gases.

- Issue #2: Radiation Badges. This issue was based on a Tiger Team report indicating "inadequate radiation badges."

- Issue #3: Tritium Plumes. The petitioner was concerned that there may have been employee exposure to the *tritium plumes* through the consumption of drinking water.

- Issue #4: Uranium Fires. The petitioner references many uranium fires and cites two incidents of a sodium explosion, and it appears to express concern that there was insufficient or no monitoring associated with these and similar incidents.

- Issue #5: Air Monitoring. The petitioner was concerned that there was insufficient air monitoring, and NIOSH agrees with this prior to 1958.

- Issue #6: The Sodium Burn Pit. The concern with the pit is that there was no monitoring of the pit and no records were maintained.

3.2 SEC PETITION EVALUATION REPORT

On February 6, 2008, NIOSH issued its SEC Petition Evaluation Report (ER) for SEC-00093. Section 1.0 of the ER states that this report evaluated ". . . the feasibility of reconstructing doses for **all** employees who worked in any area of Santa Susana Field Laboratory-Area IV during the time period from January 1, 1955 to December 31, 1965 . . ." [Emphasis added.]

Under 42 CFR § 83.13(c)(1), the feasibility to reconstruct doses includes the following:

> *. . . radiation doses [that] can be estimated with sufficient accuracy if NIOSH has established that it has access to sufficient information to estimate* ***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 dose of members of the class more precisely than an estimate of the maximum radiation dose.* [Emphasis added.]

The ER responded to specific concerns and issues raised in the SEC Petition, as summarized above in Section 3.1, and concluded the following:

> *. . . Based on its full research, NIOSH modified the petitioner-requested class to define a single class of employees for which NIOSH cannot estimate radiation doses with sufficient accuracy. The NIOSH-proposed class includes all employees of the Department of Energy (DOE), its predecessor agencies, and DOE contractors and subcontractors* ***who were monitored*** *while working in any area of Area IV of the Santa Susana Field Laboratory for a number of work days aggregating at least 250 work days from January 1, 1955 through December 31, 1958, or in combination with work days within the parameters established for one or more other classes of employees in the SEC.* [Emphasis added.]

The ER (p. 11) states the "NIOSH-proposed class includes all employees who were monitored or should have been monitored for internal radiological exposures while working in all areas of Area IV."

While the original petition requested that all employees be considered, NIOSH has restricted the employees included in the class to either those who were monitored or should have been monitored. This inconsistency needs to be addressed and further instruction should be provided as to who is covered.

Furthermore, the actual proposed addition to the class restricts the addition to those employees who were actually monitored, rather than to the potentially broader class of those "who were monitored or should have been monitored." NIOSH normally includes this broader definition in its SEC class additions, and it is unclear why NIOSH has proposed a narrower addition to the SEC class in this case. Specifically, while the practice of issuing badges to workers who entered controlled areas is documented for the most part, the issue of environmental doses and doses due to exposure to the sodium burn pit and other areas outside buildings needs to be taken into account in the class definition.

Data and information employed by NIOSH in its evaluation are cited in Section 4.0 of the ER. The recommendation to approve the SEC status of this modified class was based on NIOSH's conclusion that it could not estimate internal exposures with sufficient accuracy during the period from 1955 through 1958 (which is a period NIOSH has stated as having limited internal monitoring data). NIOSH states that this timeframe corresponds with the date after which an established bioassay program existed at SSFL and after which sufficient internal monitoring has been identified.

Sections 5.0 and 6.0 of the ER provide summary descriptions of SSFL processes, SSFL monitoring practices, and available monitoring data. These data closely parallel information contained in the six TBDs that define the SSFL Site Profile and provide the technical basis for Section 7.0 of the ER.

While Sections 7.1, 7.2, and 7.3 of the ER address the generic feasibility of internal and external dose reconstruction for SSFL workers, Section 7.4 addresses specific issues and concerns identified in the SEC petition, as summarized below.

3.3 NIOSH'S RESPONSE TO MAJOR ISSUES RAISED IN SEC-00093

3.3.1 Responses to Six Issues Identified in the SEC Petition and During Discussions with the Petitioner

Response to Issue #1: SRE Incident and Release of Core Gases

NIOSH states that several documents were reviewed in the preparation of the ER (Lochbaum 2006; Hart 1962) beyond what was reviewed as part of the site profile. It should be noted that there are at least two key documents (AI 1959 and 1961) that were prepared related to this incident that were not reviewed as part of the site profile or ER.

NIOSH concludes the following based on the reports reviewed:

> *Although there is not a consensus on the exact amount of gaseous radioactive materials released to the environment following the incident, all pertinent scientific reports conclude that a significant amount of fission products were released into the primary sodium coolant, with a percentage of that inventory being released to the reactor's cover system, and subsequently released into the atmosphere through reactor building vent systems and from gaseous storage tanks. The type and range of releases to the environment following the fuel damage run from less than 1 Ci of iodine-131 (Christian, 2005) to a conservative upper bound estimate of approximately 3000 Ci of iodine-131 (Lochbaum, 2006). Based on documented stack releases during the incident, AI concluded that since no iodine-131 was detected in cover gas, only about 28 Ci of the noble gases krypton-85 and xenon-133 were released from the stacks to the environment (Rutherford, 2005).*

Based on their review of claims in NOCTS, NIOSH concluded that personnel monitoring exists for members of the proposed class (both internal monitoring and external monitoring) during the timeframe of the SRE event. NIOSH also notes that some air monitoring measurements from the reactor area and stack monitoring also exist.

Section 4.4.2 of this report presents our concerns related to the robustness of the internal monitoring of staff who may have worked in the SRE area. The potential that all staff may not have been properly monitored, combined with the seriousness of this event, suggests that it may be necessary to develop an exposure model for this incident or conclude that exposures cannot be properly evaluated.

Response to Issue #2: Radiation Badges

NIOSH's response to this issue is captured in the following statement:

> *The Tiger Team Report cited by the petitioner does not state that the dosimeters were inadequate, but that they were not Department of Energy Laboratory Accreditation Program (DOELAP) accredited, and it specifically focuses on the D&D period versus the period being evaluated in this report. As it relates to the program being discussed in the Tiger Team report, it was common practice (and is noted as an option in Section 7 of the DOELAP Administrative Standard DOE-STD-1111-98) for smaller programs to be exempted from DOELAP accreditation, contingent upon using a National Voluntary Laboratory Accreditation Program (NVLAP)-accredited commercial service (DOE, 2006). However, this is pertinent only beginning in 1986 when the DOELAP requirements were implemented. Therefore, as discussed previously, the period cited in the petition is after the period of the evaluation and does not impact this evaluation report.*

We concur with NIOSH's response, assuming the petitioner was not referring to some other concern than the adequacy of the badges. As noted, SC&A has not interviewed the petitioners for this preliminary report.

Response to Issue #3: Tritium Plumes

NIOSH states that tritium has never been detected (>1,000 pCi/l) in any of the water supply wells. They further state that the primary supply wells (WS-5, WS-6, WS-12, and WS-13) were in Areas I, II, and III at SSFL, while one well (WS-7) was in Area IV and contributed a small percentage of the water supply. NIOSH has proposed to bound this exposure by assuming that workers consumed water from a shallow monitoring well that has had the highest tritium concentration. NIOSH points out that this well has never been a source of drinking water and is downgradient of the source of tritium (Building 4010). NIOSH also stated in the evaluation report that since 1991, the mean concentration of tritium in this well has been 2,940 pCi/l. Through some modeling and migration and decay assumptions, NIOSH concluded that workers could have consumed water with 30,000 pCi/l of tritium in the 1950s and 1960s.

The above assumptions seem to be claimant favorable, except for the fact that more recent Boeing reports (Boeing 2003, 2004, 2005, and 2006) have documented tritium concentrations as high as 117,000 pCi/l in the monitoring wells (not the drinking water wells). Therefore, the above modeling should be reviewed in light of this more recent information. Concentrations for the period January 1, 1959, to December 31, 1965, need to be provided or inferred by a scientifically defensible method in order to estimate tritium dose for this period.

Response to Issue #4: Uranium Fires

NIOSH has concluded that there are data available for the various uranium fires that would allow dose estimates to be bounded and, based on our review of this information (Alexander 1967a, b, c, and d; Badger 1960 and 1961; Begley 1976; Klostermann 1961; Loba 1959, 1960, 1961a, 1961b, 1962, and 1970; Oldfield 1961; Mooers 1959a and 1959b, 1960, and 1961 a, b and c; Owens 1978; Rudkin 1964 a, b and c; Stephenson 1961, 1962, 1963a, and 1963b; Weber 1963; Young 1960 and 1965), we concur with this conclusion.

Response to Issue #5: Air Monitoring

NIOSH has concurred that there is a lack of area air monitoring for the period at SSFL-Area IV prior to 1958, which impacts the feasibility of estimating internal radiation doses with sufficient accuracy for the proposed worker class during that time period. After 1958, NIOSH will base its dose reconstructions primarily on bioassay data.

Our discussion on the adequacy of the bioassay program prior to and after January 1, 1959, is presented below in Section 4.3

Response to Issue #6: The Sodium Burn Pit

NIOSH concludes that while there may have been radiological contamination at the Sodium Burn Pit, the following facts appear to support a low exposure and ability to bound dose estimates:

- It appears contaminant levels were low (56 pCi/g maximum) related to radioactive contamination (principally cesium-137), and that contaminants were primarily in the lower pond.
- Contamination was not identified in areas outside the ponds.
- The Sodium Burn Pit was an outdoor area not continuously occupied, nor continuously used.
- Because the pit was not an operations area, exposures for individuals that may have intermittently occupied the Sodium Burn Pit would have been lower than exposures for individuals who performed operations work with source materials that were delivered to this location.
- Radiological exposure controls were in place (e.g., workers were required to maintain a safe distance from the pits, including lined and unlined pits/ponds), because of the violent reactions that could occur if sodium or potassium made contact with the water.
- Bioassay results were available for affected and/or associated members of the proposed class, including worst-case exposure scenarios for the proposed worker class.

This issue is discussed in Section 4.3.

3.3.2 Other Issues

Two other issues were identified by NIOSH in preparing the ER. The first issue dealt with the identification of workers with blank radiation exposure record sheets in their file (a sheet with no entries). The second issue dealt with the monitoring of firemen from other sites who got involved with fires or events at SSFL Area IV.

Response to "Other" Issue #1

NIOSH discovered through an interview with a current Radiation Safety Officer at SSFL that all individuals were issued a blank record sheet in his/her file called a "blue card." If an individual entered into a "controlled" area, they were required to have a film badge and any exposure was entered into their file. This practice was corroborated by NIOSH through random personnel record reviews and through other reviews (Boice et al. 2006a and Boice et al. 2006b).

SC&A acknowledges this practice.

Response to "Other" Issue #2

NIOSH learned through interviews and reviews of dosimetry information that firemen typically wore film badges when working in areas with the potential for radiological exposures. One person interviewed mentioned that firemen wore badges at all times. However, one fireman did not have monitoring records in his file. The SEC Petition ER concludes the following:

> *As previously discussed and stated, the availability of personnel records for monitored individuals supports NIOSH's ability to reconstruct dose with sufficient accuracy for those proposed worker class members. Because the available data also includes a representation of the maximum potential exposures (a bounding exposure scenario) for the proposed worker class, NIOSH contends that this supports the ability to bound the associated dose for all members of the proposed worker class, including dose associated with the exposure scenarios presented by/for these firemen.*

SC&A is in agreement with the above statements.

3.4 NIOSH'S CONCLUSIONS

The ER concluded that, based on the limited pre-1959 internal monitoring data and associated program or source information, there is insufficient information to support establishing a bounding internal exposure scenario for the proposed worker class that worked in Area IV of the SSFL from 1955 through 1958. NIOSH has identified post-1958 radiological internal monitoring program data and the original monitoring data for individuals working in the highest-exposure areas at Area IV, and therefore has concluded that doses can be bounded for the class evaluated for the period from 1959 through 1965.

4.0 PRELIMINARY FINDINGS ASSOCIATED WITH THE SEC PETITION

4.1 OVERVIEW

This section of the SEC review process identifies discrete issues of concern that may adversely affect the ability to estimate SSFL worker exposures. Findings presented below are grouped as follows:

- Section 4.1: Which areas (Area IV, Canoga Park, DeSoto, and Downey) should be considered in the SEC Petition and when did operations begin at Area IV
- Section 4.2: Concern whether the internal monitoring program was sufficiently robust to estimate exposures before and after January 1, 1959
- Section 4.3: Lack of information related to the facility "incidents" (SRE, Sodium Burn Pit, etc.)
- Section 4.4: Lack of information on the environmental exposures (surrogate data, drinking water, etc.)
- Section 4.5: Justification for assignment of external dose estimates is not provided, and there is no coworker model for external exposures (personnel records are also of concern)

4.2 AREAS CONSIDERED IN THE SEC PETITION AND COVERAGE DATES

4.2.1 Areas Addressed by Petition

The petitioner submitted SEC Petition Form B to the NIOSH Office of Compensation Analysis and Support (OCAS) on June 22, 2007. The petition referenced the employer as Atomics International, and the following locations were noted as being relevant to the petition:

- SSFL Buildings 059, 010, and 143
- DeSoto 101
- The Burn Pit
- Santa Susana Field Laboratory

However, the petitioner submitted a revised Form B on November 16, 2007, in which the specific SSFL buildings, DeSoto 101, and Burn Pit were removed from the list of locations. It appears the petitioner was asked to remove these other operations, since the petition should focus on the DOE facility or AWE facility ("covered" facility) at which the class worked as per 42 CFR Part 83.9(c)(1)(i).

Periodically, DOE publishes a list of facilities "covered" under EEOICPA. The latest publication of these sites was on August 23, 2004 [Federal Register/Vol. 69, No. 162/Monday, August 23, 2004 (pp. 51825-51831)]. There are two sites shown on this list that could apply to

the facilities covered in the site profile; Atomics International in Los Angeles County, which is shown as a BE DOE (Beryllium and DOE) facility, and Energy Technology Engineering Center (ETEC), Santa Susana, Area IV. There are no listings for the associated facilities operated by AI in Canoga Park, De Soto, or Downey.

DOE has developed a database of the covered sites, which is accessible through the web site, http://www.hss.energy.gov/healthsafety/FWSP/Advocacy/faclist/findfacility.cfm. This database includes the following "covered" facilities:

- Area IV of the Santa Susana Field Laboratory, which is shown as a DOE facility with the operator, North American Aviation (NAA).
- Atomics International (shown as Beryllium Vendor and with the locations of Los Angeles and Ventura Counties) and includes, but is not necessarily limited to, the following locations; Area IV of the SSFL, portions of the Downey facility, the Vanowen Building at the Canoga facility, and the De Soto facility. The description notes that the AI Division of NAA is a statutory beryllium vendor under the EEOICPA, but that the company also worked with radioactive materials under contract with the Atomic Energy Commission (AEC) at numerous locations. (It should be noted, as stated above, that the AI site is shown as a BE DOE facility in the most recent *Federal Register* notice).
- Canoga Avenue Facility, which is shown as a DOE facility with the operator, NAA.
- De Soto Avenue Facility, which is shown as a DOE facility with the operator, NAA.
- Downey Facility, which is shown as a DOE facility with the operator, NAA.

Therefore, the list of covered sites in the DOE database is not consistent with the list of covered sites identified in the August 23, 2004, *Federal Register*.

The nomenclature related to these facilities is further confused by the document titles of the six Technical Basis Documents (TBDs) identified below, where various facility names are used in the titles.

- ORAUT-TKBS-0038-1, *Technical Basis Document: Atomics International – Introduction*, Rev. 01 (ORAUT 2006a)
- ORAUT-TKBS-0038-2, *Technical Basis Document: Energy Technology Engineering Center – Site Description*, Rev. 00 (ORAUT 2006b)
- ORAUT-TKBS-0038-3, *Technical Basis Document: Atomics International – Occupational Medical Dose*, Vol. 3, Rev. 00 (Atomics International TBD, 2006a, ORAUT 2006c)
- ORAUT-TKBS-0038-4, *Technical Basis Document: 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 the Energy Technology*

Engineering Center [ETEC] or Atomics International) – Occupational Environmental Dose, Rev. 01 (ORAUT 2007)

- ORAUT-TKBS-0038-5, *Technical Basis Document: Energy Technology Engineering Center – Occupational Internal Dose*, Rev. 00 (ORAUT 2006d)
- ORAUT-TKBS-0038-6, *Technical Basis Document: Atomics International – Occupational External Dosimetry*, Rev. 01 (ORAUT 2006e)

The TBDs focus on Area IV of the Santa Susana Field Laboratory, but also address the Canoga, Downey, and De Soto facilities. Dose reconstructions that are prepared for employees of AI include work conducted at all four of these facilities. It is noted above that the AI Division of NAA operated all four of these facilities, and their internal and external dose monitoring programs were the same for all the facilities.

In addition, TBD-1 (p. 6) states, "The name Atomics International (AI) is used to represent all [all meaning the four facilities; Area IV, Downey, Canoga Avenue, and De Soto Avenue] of them unless more specific location information is warranted." Therefore, when the petition refers to the facility as AI and it is shown as a covered DOE facility, it is easy to understand why there would be some confusion as to what locations are covered.

Given the above, we believe NIOSH should re-assess the SEC Petition being only applicable to Area IV at SSFL.

4.2.2 Coverage Dates

The initial date of coverage is dependent on whether all four facilities are covered in the petition, or if just Area IV of SSFL is covered.

If all four facilities are covered in the petition, the initial year of coverage should be 1947 or 1948. TBD-2 (p. 9) states, "The SSFL was initially established by North American Aviation (NAA) in 1947 to meet the requirements for a field test laboratory to static-fire large rocket engines, but it also met the NAA's need for a nuclear research facility." The first year of coverage shown for the Downey facility in the DOE database is 1948, which is also noted as the first year of coverage in TBD-1 (ORAUT 2006a) (p. 6). TBD-2 (p. 27) discusses AEC-funded activities taking place at Downey between 1948 and 1955.

If only Area IV of SSFL is covered in the petition, it is not clear whether the initial date of coverage is 1953, 1954, or 1955. The initial date of coverage for Area IV is shown as 1955 in 42 CFR Part 83.9 and the DOE "covered facilities" database. However, there are conflicting references in the TBDs as to when operations began at Area IV. TBD-2 (p. 9) states, "Area IV was established at the SSFL in 1953 as a nuclear research and development facility." Later in this same document on the same page, it is stated that "Nuclear R&D activities in Area IV increased rapidly from 1953 into the late 1960s, then declined." Figure 2-3 in TBD-2 also shows that Area IV was established in 1953 to provide nuclear-related research. TBD-2 (p. 13) states, "Between 1954 and 1980, several nuclear reactors were built, tested, and operated in Area IV."

Given the above, we believe NIOSH should re-assess the time periods of interest to the SEC Petition.

4.3 ADEQUACY OF THE INTERNAL MONITORING PROGRAM

4.3.1 Overview of Internal Monitoring Program

SC&A evaluated internal monitoring data from 136 claimant files with dose reconstruction overviews. Our evaluation included identifying the number of workers that were monitored in a given year. The results of this evaluation are presented graphically below. The percentage of workers monitored and the total number monitored are shown in Figures 4.3.1-1 and 4.3.1-2 for the period of 1955–1995 and 1956–1966, respectively.[1] The conclusions we have drawn in evaluating this information are presented below.

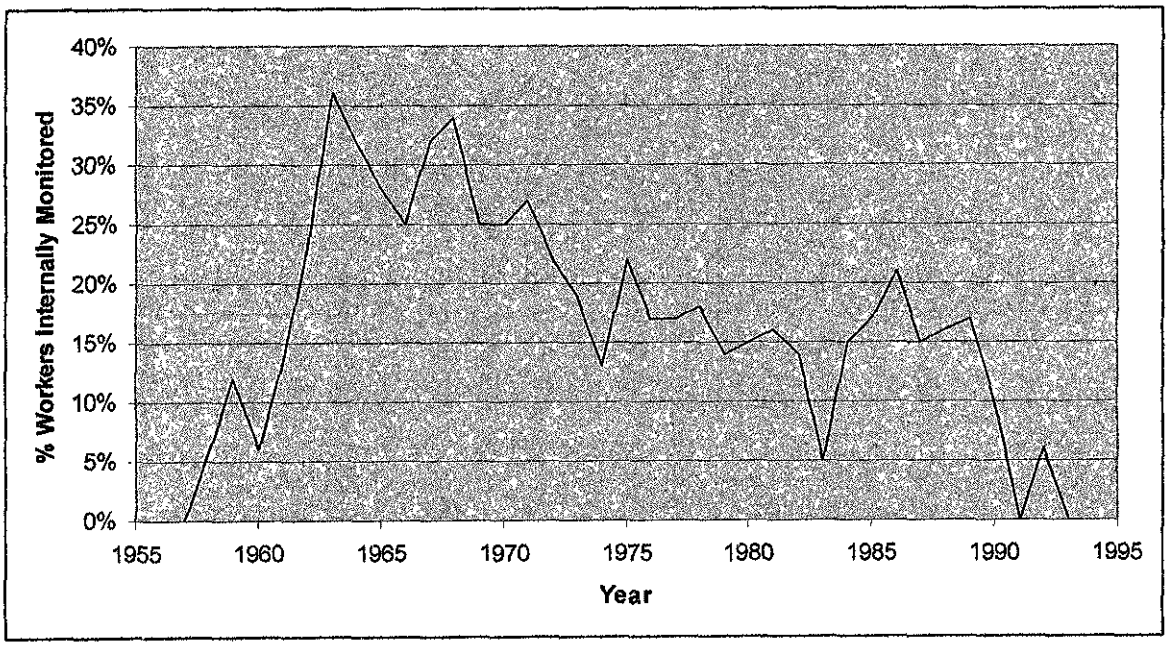

Figure 4.3.1-1: Percentage of Workers Monitored, 1955–1995

[1] Figures showing the actual number of workers internally monitored were redacted given Privacy Act concerns.

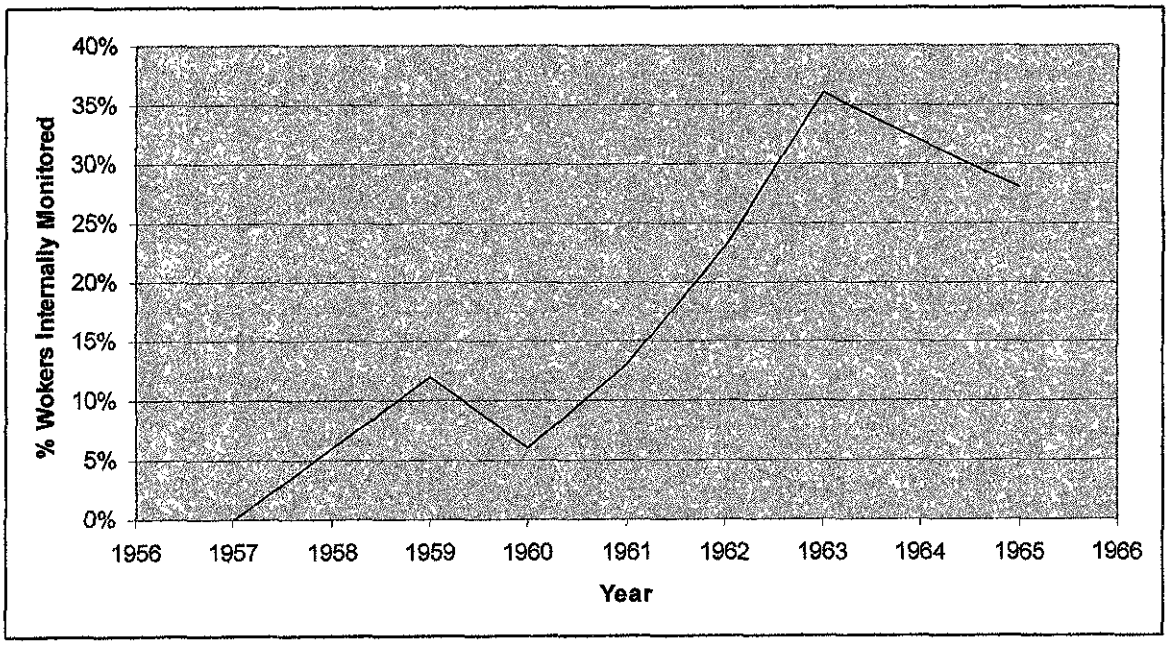

Figure 4.3.1-2: Percentage of Workers Monitored Internally from 1956–1966

4.3.1.1 1948–1958

TBD-5 describes the internal dosimetry (bioassay) program at SSFL, with key excerpts presented below. As part of the ER, NIOSH located personal and area monitoring data in the NIOSH Site Research Database (SRDB) and in its NIOSH OCAS Claims Tracking System (NOCTS), which have been used to estimate doses to individual employees in the proposed class. NIOSH identified only limited amounts of internal personnel monitoring data for pre-1959 exposures, which is consistent with its finding that an SSFL routine bioassay program was not initiated until August 1958 (Kellehar 1966).

The figures above indicate that there was essentially no internal monitoring taking place prior to 1959, which is consistent with NIOSH's findings in the SEC ER.

4.3.1.2 1959–1965

Entry into the bioassay program was based on job assignment, but monitoring procedures were generally invariable across occupations. However, firefighters appeared to be monitored more frequently than other workers. By the early 1960s, the bioassay program "normally" consisted of urinalysis for personnel whose work assignments involved "potential exposure to radioactive materials." The frequency of sampling during the 1960s was slightly higher than in any other time period and varied from one to four per year, depending on the nature of the employee's work, past exposure history, etc. Special bioassay sampling, consisting of more frequent urine testing, was in place very early (1960), but "only when gross internal contamination" was suspected (Hart 1979).

The figures above indicate that while the number of personnel that were internally monitored was increasing during this period, it was not until roughly 1963 when the percentage of workers monitored "somewhat" stabilized above 25%. Hence, there is some question whether the bioassay data collected and analyzed from 1959 through 1963 was sufficient for internal dose reconstruction or to develop a coworker model for internal dose reconstruction.

4.3.1.3 1966–2004

In 1970, standards for bioassay sampling were published (Staszesky 1970). Work in areas where unencapsulated radioactive material was present required baseline and termination urine samples. A new baseline could be required for a change in job assignment. For new operations, a "pilot" bioassay program consisting of weekly urine samples could be required until a pattern was established. Regular work in these areas required a quarterly routine urine sample, but monthly samples could be required in a case of high exposure potential. Periodic fecal samples and in-vivo counts could also be required. Employees who periodically performed work in these areas were subject to semiannual urine samples. Personnel who frequently entered these areas, but did not perform hands-on work, such as project engineers, industrial engineers, etc., provided annual routine urine samples.

SC&A has observed no cases where workers had a significant increase in the monitoring frequency after 1970. This is consistent with the data, which show that overall internal monitoring frequencies did not change over time (Figures 4.3.1.3-1 and 4.3.1.3-2).
By the mid-1970s, the definition of who was included in the routine bioassay monitoring program had changed to "personnel whose work assignments potentially expose them to respirable-sized radioactive aerosols" (Hart 1979). By the late 1980s, the criterion was "personnel whose work assignments potentially expose them to radioactive aerosols" (Tuttle 1989). Quarterly urine sampling was the norm through the 1980s (Hart 1979, 1980a, 1980b, and 1980c; Eggleston 1983 and 1984; Tuttle 1985, 1986a, 1986b, 1986c, 1988a, 1988b, and 1989).

In the mid-1970s, fecal sampling was used, but "only when gross internal contamination" was suspected (Hart 1979). Using the concept of a Maximum Possible Body Burden (MPBB), an excretion rate was determined by radionuclide that would indicate that one MPBB had been received. For several years prior to 1968, the policy was to restrict employees from work in potential airborne areas until their body burden was less than 25% of the MPBB (Alexander 1968a). Starting in January 1968, ETEC imposed a restriction from work in areas with potential airborne exposure (or in some cases, from all radiation areas) if the bioassay results indicated the receipt of 50% or more of the MPBB. The restriction remained in place until two consecutive bioassay samples indicated that the remaining deposition was less than 25% of the MPBB (Staszesky 1970).

The figures above indicate that the internal monitoring seems to have stabilized during this period and decreased in later years as operations ceased.

4.3.2 Monitoring for Internal Exposure of SSFL Workers was Incomplete and Poorly Documented for Most Years of Facility Operation

In Section 5.2 (p. 10) of TBD-5, the evaluation of the SSFL internal monitoring program is prefaced with the following statement:

> *Early 1960s AI documents describe **all** the elements of a **comprehensive** radiation safety program, including a laboratory with bioassay capability. ...* [Emphasis added.]

This statement, however, was tempered by numerous admissions in subsequent sections of the TBD. A sampling of statements suggesting deficiencies and data limitations include the following:

Page 13:

> *Specific radionuclides **could** be determined "where required" (Lang 1960). **Some** detail has been found on early urinalysis methods. In addition to the in-house laboratory capability, bioassay services were contracted to the following vendors:* [Eight vendors are listed.]
>
> *...Information on the periods during which ETEC used these laboratories was **not** found.* [Emphasis added.]

In addition to the eight contract laboratories, ETEC had its own **in-house** laboratory, which analyzed urine for uranium content by fluorometric method. Exposure to uranium may have existed in various states of enrichment up to 93%.

Page 14:

> *Due to its higher specific activity, EU activity **could** be determined by counting....*
>
> *No specific information on sensitivities for the **in-house** laboratory was obtained....* [Emphasis added.]

Page 15 (Regarding thorium):

> *No details of early thorium analyses were recovered...*

Page 15 (Urinalyses for period 1967–1974):

> ***Partial** documentation on bioassay methods from 1967 through 1974 was found. ...These documents are **believed** to refer to services offered by UST* [one of the eight contract laboratories]. [Emphasis added.]

Page 17 (Urinalysis for period 1975–1988):

*The following analytical methods were taken from a series of annual reports.... The measurement "type" in parentheses appears in many personnel bioassay records. The detection limits should have improved over the years. However, a listing was **not** found.* ... [Emphasis added.]

Page 18 (On the method for analyzing mixed fission products):

*Mixed fission products were precipitated from a **basic** oxalate media. ... Alkali metals such as ^{137}Cs did **not** precipitate. In addition, **volatile** fission products such as 1-131 were **lost**.* ... [Emphasis added.]

Page 19 (On in-vitro methods for individual radionuclides):

*Although fecal sampling was mentioned as both a routine and a special bioassay method in site documents, **little** detail has been found about the analytical methods used.* ... [Emphasis added.]

Page 20 (On the use of whole-body counting for monitoring workers):

*... whole-body counting for fission or activation products was apparently **not** part of the routine bioassay program at ETEC. Between 1975 and 1988, only 25 counts on 25 individuals were summarized in annual reports. ...All WBCs were reported positive for ^{137}Cs. Ten counts were performed in 1977 and 15 were performed in 1979.* [Emphasis added.]

Page 20/21 (On the use of chest counting):

*In 1967, the first chest (lung) counts for uranium using a medical system were performed at UCLA. The 186-keV gamma ray from the decay of ^{235}U was used to quantify the amount of EU in the lung ... Calibration of this system was **crude**;...* [Emphasis added.]

Starting in 1968, Helgeson Nuclear Services provided lung counting services. ... The results were reported in milligrams of $^{235}U \pm 2$ sigma...

By 1977, two 5-in.-diameter, thin-window phoswich detectors were used, ... [to detect U-235]

(SC&A notes that all chest measurements only quantified the amount or the activity of U-235. Without a firm understanding of the level of enrichment, the more important contribution of U-234 to total alpha activity cannot be determined.)

Page 25 (On solubility type, fraction activity, and particle size per facility):

> *In the absence of any measurements or studies, NIOSH guidance requires the use of default* ***solubility classes*** *and particle size values from the International Commission on Radiological Protection. ... With one exception, facility-specific solubility and particle size data for ETEC has* ***not*** *been found. Activity fractions were* ***not*** *available with the exception of those for limited fuel fabrication operations. ... Table 5-9 lists* [recommended/default] *this information* (emphasis added). [Our review of Table 5-9 indicates that to date, (1) a solubility class has not been assigned to all radionuclides, (2) activity fractions are lacking for several facilities, (3) activity fractions are based on inappropriate data, and (4) activity fractions fail to identify select radionuclides (e.g., Na-24, radioiodines)].

4.3.3 Insufficient Correlation between Bioassay Data and Potential Exposures to Specific Radionuclides

Two sources (NIOSH 2008, ORAUT 2006e) state that there is sufficient bioassay and other supporting data available for 1959 and beyond to establish an upper bound for uranium, mixed fission products (MFPs), Po-210, plutonium, SR-90, tritium, and thorium. Of the 37 internal monitoring records available to SC&A, 78% were monitored for uranium, 62% for mixed fission products, 0% for polonium, 24% for plutonium, 5% for strontium, 14% for tritium, and 0% for thorium.

SC&A does not believe that these sources have clearly demonstrated a correlation between the bioassay data available and the potential exposures to specific radionuclides. They have not clearly defined for which workers each of the procedures were conducted, including gross alpha and gross beta. From a brief review of claimant files, it appears that monitoring was not routine for all workers handling radioactive material. Furthermore, detection limits for 1975–1988 are unavailable, and Table 5-9 in TBD-5 containing solubility type and fraction of activity is incomplete in many cases. Hence, it appears that there were significant limitations in the bioassay program in 1959, and perhaps for a few years beyond 1959.

4.3.4 Missing Radionuclides in Bioassay Data

The site profile indicates that bioassay data were available for gross alpha, gross beta, uranium, fission products, plutonium, thorium, Po-210, Sr-90, H-3, P-32, S-35, C-14, Pm-147, americium, and curium. Of the 37 internal monitoring records available to SC&A, the vast majority of monitoring was for uranium and mixed fission products; 78% and 62%, respectively. Fission products were monitored for 49% of the workers. Only a few monitoring records exist for the following radionuclides: 8% for cesium, 3% for beryllium, 3% for mercury, 3% for potassium, 0% for polonium, 24% for plutonium, 5% for strontium, 14% for tritium, and 0% for thorium. Potential exposure to radionuclides such as U-233 and U-234 could have occurred during these operations, but it may not be possible to determine this, given the limitations of uranium monitoring (see below).

4.3.5 No Coworker Model

The site profile has not cited an internal coworker model as necessary, and the document does not address the use of a coworker model for those individuals potentially exposed but not monitored. A review of some of the claimant files indicates that some workers, who it appears should have been monitored, were not monitored, and those workers who were monitored were not monitored on a routine basis. In many cases, the dose reconstruction reports rely on guidance that has been developed for internal dose determinations based on other site information, rather than relying on site information. A coworker model would allow for more precise determinations of the doses the SSFL workers received. It is unclear whether there are data for coworker models for all the relevant radionuclides, especially for the early years through 1961/1962.

4.3.6 Lack of Source Term Data

TBD-5 states the following:

> *Without bioassay or air sample data, the last resort is determination of airborne concentrations using source term evaluations (NIOSH 2002, p. 19). Data on the amount of dispersible material available does not appear to be available for ETEC.*

4.3.7 NIOSH's Interpretation of Reported Values by the Contract Laboratory Nuclear Science and Engineering Corp. (NSEC) may not be Correct

Section 5.3.1.2 (page 14) of TBD-5 attempts to clarify data reported by NSEC related to urinalyses for gross alpha, gross beta, and MFPs:

> ***Gross Alpha***
> *Shepard (1959) gave a minimum measurable concentration of 7.5 dpm/L for gross alpha counting. NSEC gave its minimum measurable concentration as 0.2 cpm/mL (NSEC 1957). It is* ***assumed*** *that this is a* ***typographical error*** *and 0.2* ***dpm/mL*** *was* ***intended.*** [Emphasis added.]
>
> ***Gross Beta***
> *Shepard (1959) gave a minimum measurable concentration of 75 dpm/L for gross beta counting. NSEC gave its minimum measurable concentration as 1.0 cpm/mL (NSEC 1957). It is* ***assumed*** *that this is a* ***typographical error*** *and 1.0 dpm/mL was intended.* [Emphasis added.]
>
> ***Mixed Fission Products***
> *... for beta activity with an approximate minimum detectable amount (MDA) of 60 dpm/****sample*** [is assumed] *(ORAU 2004, p. 27) ... NSEC gave its minimum measurable concentration as 2.0* ***cpm/mL*** *(NSEC 1957). It is* ***assumed*** *that this is a* ***typographical error*** *and 2.0 dpm/mL was intended.* [Emphasis added.]

The unsupported assumption that in all three cases a "typographical error" was, in fact, made may not be correct, given the discrepancies between the values reported by NSEC relative to those of Shepard:

	Shepard 1959	NSEC
Gross alpha	7.5 dpm/l	0.2 cpm/ml or **200 cpm/l**
Gross beta	75 dpm/l	1 cpm/ml or **1,000 cpm/l**
MFP	60 dpm/l	2 cpm/ml or **2,000 cpm/l**

If, in fact, the NSEC data were correctly reported in the units of cpm/ml, and adjusted for yield(s) and counting efficiencies, MDA values (redefined in dpm/l) are likely to more than double. Such large differences are hard to explain and raise questions about the credibility of bioassay data provided by contract laboratories as a whole. Since this concern applies to the time period post-1958, it brings into question NIOSH's ability to perform internal dose reconstructions post-1958. This issue needs further investigation.

4.3.8 Potential Difficulties Associated with Uranium Bioassay Data

Uranium at SSFL to which workers may have been exposed existed in various degrees of enrichment (i.e., 2% to 93%). Section 5.3 of TBD-5 discusses the two independent methods used to assess uranium in urine; the fluorometric method only identifies uranium concentrations in ug/ml, while the radiometric method assesses the gross alpha activity in dpm/l. Given the potentially wide range of specific activities of uranium defined by fluorometric urine data, all fluorometrically analyzed urine would also require a **concurrent** radiometric evaluation of that sample in order for these data to be useful to dose reconstruction.

From information contained in Section 5.3 of the TBD, it is unclear whether urine samples were consistently analyzed by both fluorometric **and** radiometric methods. This is particularly evident from the internal monitoring records pre-1961, where there appears to be no distinction made between the types of urinalysis methods used. From 1961–1962, there was a transition period where uranium in general was monitored, as well as Uranium Radiometric (UR) and Uranium Fluoride (UF). After 1962, the type of urinalysis methods used was usually specified.

It is **not** unreasonable to assume that for the early years, concern for the chemical toxicity of uranium may have limited urine bioassay to the fluorometric method. If this assumption is true, the absence of concurrent radiometric analysis of urine samples would severely limit the value of early fluorometric data.

Thus, in the event that a fluorometric urine bioassay cannot be matched with a concurrent radiometric analysis, a claimant-favorable default value should be used that defines the enrichment level of uranium. NIOSH should further explore this issue, as it might apply to the post-1958 time period.

4.3.9 There are Unanswered Questions Regarding the Completeness and Quality of Personnel Exposure Records

In Section 5.2 of the TBD, the following statements appear:
Page 10:

> *...AI established health and safety files on each employee that contained radiation exposure records, injury records, and other "pertinent" data (Lang undated, 1960). Today, personnel radiation exposure records are in the Radiation Safety Records Management System (RSRMS), which encompasses about **170 file cabinets**.* [Emphasis added.]

Page 12:

> *The bioassay records in the individual files generally consist of:*
>
> - *Individual Personnel Keysort Cards (Figure B-2, Attachment B), which were used to track the type, frequency, and week of sample collection. ... The forms can be **difficult to read due to the quality of the copies**, and dose reconstructors should refer to the forms listed below for urine and fecal data. This form **might** be the **only** place **in vivo*** [?] *data are listed.* [Emphasis added.]

Section 5.7 (page 23):

> *The bioassay results from ETEC and its predecessor organizations are **apparently not** available in a computerized format. The units used to report the results are **generally** included in the hard-copy reports. ...* [Emphasis added.]

Section 5.8 (page 23):

> ***No codes** have been found* [for excreta samples]. ...

These statements suggest that (1) all personnel records currently exist in hardcopy form only, and (2) records may be of poor quality, difficult to interpret, and incomplete.

SC&A concludes that the use of these records for dose reconstruction will require a comprehensive assessment regarding the quality and completeness of records contained in the 170 file cabinets, and requires guidance to dose reconstructors for their interpretation/use.

4.3.10 Use of SSFL Site Survey Data/Source Term cannot be Regarded as Useful Surrogate Data for Bioassay Data in Dose Reconstruction

In the absence of an individual's in-vitro/in-vivo bioassay data, the TBD provides the following information and guidance to dose reconstructors:

Section 5.11 (page 26):

> *If bioassay data are **not** adequate to evaluate an individual's internal doses, dose reconstructors can use workplace monitoring data (NIOSH 2002). The following types of workplace data **might** be available for ETEC: breathing zone air samples, general area air samples, and surface contamination surveys. However, **these data are not likely to be in individual exposure records**. Data on respirator use are **not** likely to be available ... resuspension factors are **not** likely to be available.* [Emphasis added.]

Section 5.12 (page 30):

> *Without bioassay or air sample data, the last resort is determination of airborne concentrations using **source term** evaluations (NIOSH 2002, p. 19). Data on the amount of dispersible material available does **not** appear to be available for ETEC.* [Emphasis added.]

This "guidance" is deficient and places an unrealistic responsibility on the dose reconstructor because, at a minimum, the dose reconstructor will need to make judgments regarding (1) how to use general air sampling data when breathing zone data are not available or limited, and (2) what resuspension factors should be assigned. It is important that additional guidance be provided that ensures that claimant-favorable assumptions are applied in a consistent manner.

4.4 LACK OF INFORMATION WITH CERTAIN FACILITY INCIDENTS

4.4.1 Overview

Table 2-6 in TBD-2 presents major site incidents that had significant potential for internal or external exposure to personnel. The two primary incidents of concern are the SRE and the Sodium Burn Pit.

4.4.2 Sodium Reactor Experiment Coolant Failure

TBD-2 contains a discussion of the SRE coolant failure in Section 2.2.1.1.2 and in Table 2-6. Section 2.2.1.1.2 provides very little information on the incident, and does not discuss any potential exposure information. Table 2-6 (30 pages after Section 2.2.1.1.2) provides more detail on the incident, but does not provide any worker exposure information. There is information in Table 2-6 about exposure being negligible for nearby residents (a maximum theoretical calculated dose of 0.06 rem to someone living in Susana Knolls, the nearest residential area at the time), but does not present exposure information for workers.

Based on our review of claimant files, it does not appear that all workers who should have been monitored were monitored. NIOSH (Hughes 2008) provided SC&A with a spreadsheet containing information on claimants who worked at Area IV in 1959, and whether they were internally or externally monitored. The key finding from this spreadsheet (the spreadsheet cannot be provided given Privacy Act concerns) is that 42% of those claimants, who were

"radiation workers", were not internally monitored while all radiation workers were externally monitored.[2] If these radiation workers did indeed work in the SRE area, the lack of internal monitoring would be a concern, given the program was supposed to be fully functional in 1959.

Atomics International prepared two reports on this incident; a report titled *SRE Fuel Element Damage, An Interim Report (NAA-SR-4488)—November 15, 1959* (AI 1959), and a second report titled, *SRE Fuel Element Damage, Final Report (NAA-SR-4488 (suppl)—1961* (AI 1961).

The interim report (AI 1959) contains important information related to this incident that is not in the site profile. Examples of this information include the following:

- *During this occasion, specifically, in October 1958, the maximum radiation levels in the general area of the moderator coolant pump were reported to be about 50 Mr/hr (October 14). Below shield blocks 1 and 2, the radiation level was about 21 mr/hr (on October 11).* (p. IV-C-9)
- *Radiation levels measured on April 18, 1959 varied from 50 to 420 mr/hr. ...Additional measurements made 5 days later (a total of 17 days after shutdown) indicated no significant decay.* (p. IV-C-10) [Table IV-C-6 includes radiation levels in the Gamma Facility on various dates in August, September, and October of 1959. The measured radiation levels peaked on August 12 (2.9 r/hr) and decreased to 0.7 r/hr on October 5.]
- *Cold trapping was started during run 14. However, radiation measurements could not start until August 8 (due to the radiation hazard from the high radiation levels of Na^{24}), at which time the dose rate, extrapolated to near the surface, was about 70 r/hr. It is possible that initial cold-trap dose rates, had they been measured, would have yielded significantly higher values.* (p. IV-C-12) [The radiation rates at the cold trap, shown in Table IV-C-7, range from 63 r/hr on August 8, 1959, to 50 r/hr, with a peak of 81 r/hr on August 13.]
- *Following the termination of run 14, the fuel handling cask was used to inspect the fuel elements in the reactor. ... Operations directed towards removal of these slugs resulted in occasional radiation levels as high as 1000 r/hr at 1 ft. from the slugs. However, the maximum total exposure received by operations personnel during these cask operations did not exceed 1 rem in a single week.* (p. IV-C-22). [The basis for this last statement was not provided in the report, and the number of personnel exposed was also not presented.]

The final report (AI 1961) also contains information related to potential worker exposure. Examples of this information include the following:

- *This report discusses the distribution and management of the fission products during the recovery operations. During the recovery effort the objectives*

[2] Percentages rather than absolute numbers have been provided given Privacy Act concerns.

were: (1) To limit personnel exposure to an average dosage rate of 1.25 rem/quarter (5 rem/yr). (p. III-19)

- *Throughout the recovery effort the radiation exposure to each individual was limited to less than 5 rem/yr. It was occasionally necessary to permit the weekly exposure for some key individuals to reach 600 mrem per week, in which case the individual was not exposed to radiation during the following week. Such exposures required a special permit, and only 30 permits were issued. For the 150 persons directly involved in the work, the average exposure was 2 rem/yr.*

This information is pertinent to reconstructing both external and internal exposures associated with this incident.

4.4.3 The Sodium Burn Pit

The sodium burn pit was built to clean nonradioactive metallic sodium and NaK from various scrap test components. Contamination was identified in the sodium burn pit in 1978, at which time monitoring of the area began and continued until 1983. Prior to 1978, no radioactivity was expected in this area, thus raising questions whether individuals involved in these activities would be considered for internal monitoring. It is unclear when the radioactive contamination was introduced to the burn pit or how far back in time the potential exposure to radiation exists. Given the violent nature of the operation, it would be expected that this operation would have generated an airborne hazard. Since the sodium burn pit was not expected to result in radiation exposures, there was no routine monitoring. But this does not mean that routine exposure can be ruled out. Additional information should be gathered on this site to demonstrate that unmonitored workers are not likely to have received sufficient dose to be of concern, or a model should be developed to bound the exposures that could have been received.

The TBD also does not consider exposure to contaminated soil that has resulted from spills and other incidental releases. For example, a review by a U.S. Environmental Protection Agency (EPA) official in 1989 (Dempsey 1989) identified Building 064, the Special Nuclear Materials Storage Area, that had been contaminated as a result of a spill. This EPA official also had concerns about the validity of some, if not all, of their environmental data:

> *In the Rocketdyne procedure, soils are heated in a muffle furnace for 8 hours at 500°C. Several problems were identified: first, this temperature is sufficient to volatilize most man-made radionuclides of concern, including cesium-137 and strontium-90. Second, from the Rocketdyne procedure, soil is sieved through a coors crucible to obtain uniform particle size.... This procedure is a screening method at best and is not an accurate quantitative procedure.*

TBD-5 does not specifically address radiological incidents that may have resulted in internal exposures to workers' that were unmonitored.

Based on information provided in TBD-5, it is unclear (1) whether workers exposed during these early incidents were adequately monitored for internal exposure, and (2) if workers were, in fact, monitored, whether their exposure records exist. A particular concern involves the potential exposures associated with the SRE. Worker exposures may have included a complex mixture of highly enriched uranium, actinides, MFPs, and various activation products, including large amounts of Na-24.

4.5 LACK OF INFORMATION ON THE ENVIRONMENTAL EXPOSURES

4.5.1 Overview

Occupational environmental dose refers to radiation exposures received by workers while onsite but outside the SSFL facilities from facility discharges to the atmosphere, ambient external radiation originating in the facilities, and inadvertent ingestion of site-generated radionuclides. The environmental monitoring program was established at Area IV in May 1954, before construction of the first radiological facility, with emphasis on soil, vegetation, and water sampling.

TBD-4 provides guidance and data for assigning occupational environmental doses for Area IV, and the Downey, Canoga, and De Soto sites that make up SSFL, for all years, starting with 1954 through 1999. Due to insufficient environmental monitoring/data limitations, the TBD relied on the following data and applied the following assumptions in order to provide the dose reconstructor the means to estimate inhalation intakes that are radionuclide-specific and for all years of facility operations.

> *Average annual gross alpha/gross beta concentrations in facility stack emissions were the basis for estimating potential worker environmental **inhalation** intakes. Most of the available SSFL **stack** emission data include annual average gross alpha and gross beta concentrations at the **stack point of release**. Years with data vary by facility, but gross alpha/gross beta concentration information is available for **most** years between **1971** and **1999**. ...*
>
> *...Identification of **specific radionuclides** released from various facilities in stack emissions are available ... from **1988** to **1999** and were used to characterize radionuclide emissions for **all** years. ...*
>
> *...In years where data were not available, stack concentrations were assumed to be the **average yearly** gross alpha and gross beta concentrations in stack effluents from years **1971** to **1999**, for which data were available.*
>
> *...Furthermore, the average percentage that each identified radionuclide contributed to the gross alpha or gross beta concentration determined from **1988** to **1999** data was applied to each of these years to make radionuclide-specific stack concentration estimates....*

> *...Because the stack effluent concentrations were 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.* [Emphasis added.]

4.5.2 Surrogate Use of the Time-integrated Average Yearly Gross Alpha/Gross Beta Stack Emission Corresponding to Years 1971 to 1999

The surrogate use of the time-integrated average yearly gross alpha/gross beta stack emissions corresponding to years 1971 to 1999 (when stack measurements were taken) is likely to underestimate stack emissions for years 1954 through 1970. SC&A's conclusion is supported by the steady reduction in facility operations over time, as illustrated in Figure 4.5.2-1. For example, nuclear reactor programs were essentially phased out in the early 1970s.

Sections 4.6.4, 4.6.5, and 4.6.6 of TBD-4 acknowledge the lack of external dose rate monitoring data prior to 1974, and provide unsupported/unreferenced assumptions that were used to derive annual external dose estimates for a **restricted** number of facilities, as given in Table 4-4 of the TBD.

4.5.3 Exposure to Onsite Water Supply Wells

The SEC ER states that onsite water supply wells were the primary water source from 1949 to 1964, which differs from Section 4.7 of TBD-4, which states, "Potable water is not a source of occupational radioactive material at SSFL, because the SSFL facilities used either bottled water from an off-site vendor (Moore et al. 1962) or the city water supply." In addition, other references (Winzer 1980 and 1981; Curphey 1983) indicate that well water was a source of drinking water into the 1980s.

Although the ER stated that the drinking water supply wells did not have elevated levels of tritium (>1,000 pCi/l) (concern with tritium given current tritium plume on site), the ER has tried to bound any contamination that may have existed onsite by assuming the onsite supply wells were contaminated with tritium at a concentration of 30,000 pCi/l. More recent Boeing reports (Boeing 2003, 2004, 2005, and 2006) have documented tritium concentrations as high as 117,000 pCi/L in the monitoring wells (not the drinking water wells). Therefore, this issue should be re-evaluated to determine if this exposure route can be properly assessed in earlier years, and if so, how to assess this exposure.

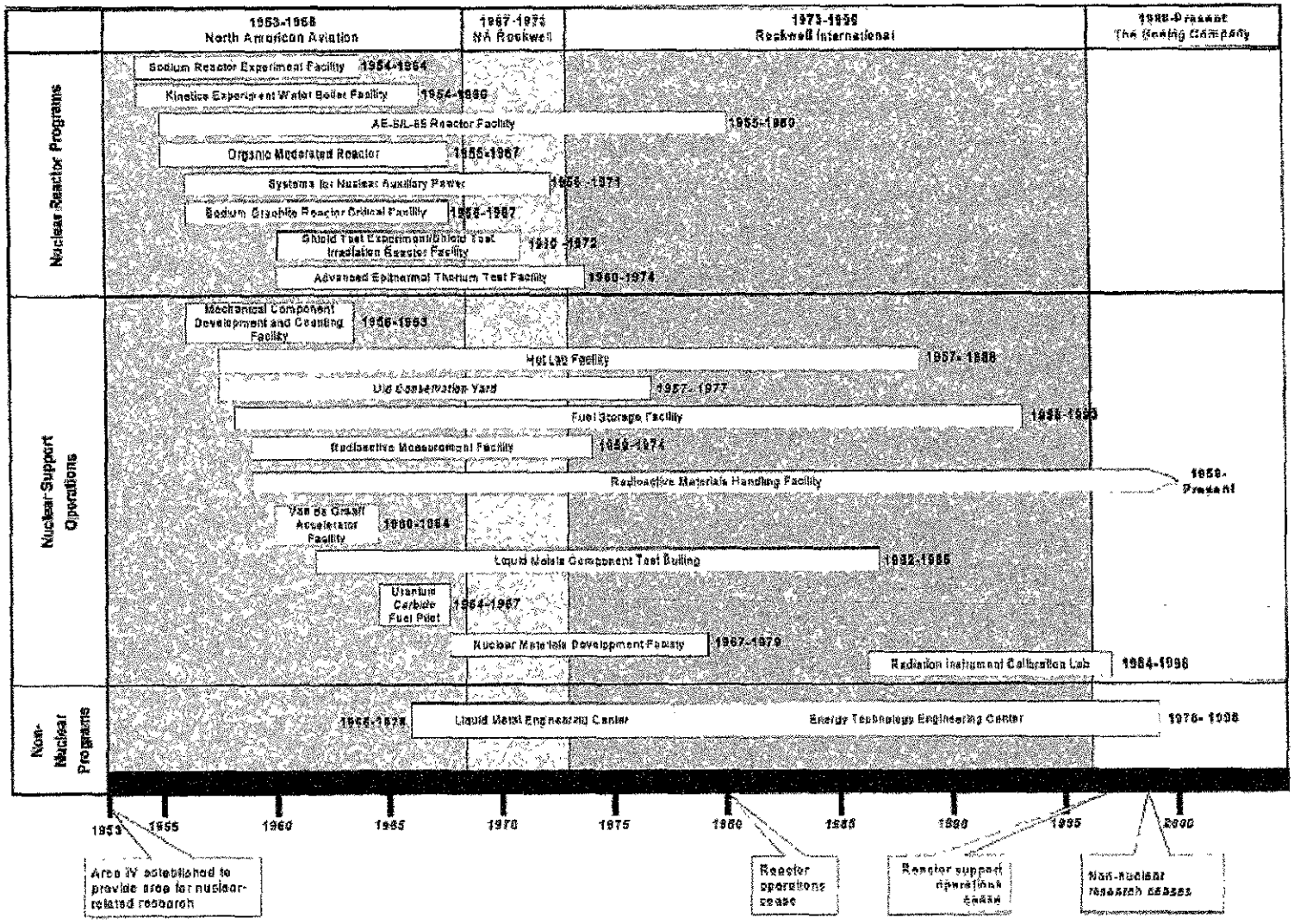

Figure 4.5.3-1: Summary of Area IV Activities

4.6 ASSIGNMENT OF EXTERNAL DOSE

TBD-6 contains documentation to assist in the evaluation of occupational external doses from processes that occurred at SSFL. An objective of this document is to provide supporting technical data using claimant-favorable assumptions to evaluate occupational external doses that can be reasonably associated with worker radiation exposures. This document addresses the evaluation of unmonitored and monitored worker exposure, missed dose, and the bias and uncertainty associated with the monitoring of external dose.

4.6.1 No Coworker Model

TBD-6 has not cited an external coworker model approach as necessary, and the document does not address the use of a coworker model for those individuals potentially exposed but not monitored. It appears that individuals may have been unknowingly exposed. An October 22, 1962, memorandum from F.H. Badger[3] to the Health and Safety File regarding "Health and Safety Observations at RMDF" states that, "Routine smear surveys have repeatedly revealed significant contamination or radiation dose rates in areas usually thought to be free of radioactive material." One of the examples provided was a 4 Rad/hr capsule lying in an area thought to be uncontaminated.

In addition, in an April 1991 Tiger Team Assessment, the DOE noted several issues with the external radiation dosimetry program. The report, as an example, noted that "In 1989 and 1990, extremity doses were not added in to exposure records or reported to the Radiation Exposure Information Reporting System (REIRS)."

Based on the poor track record of badging employees appropriately, the conclusion of no monitoring being equal to no work in a radiation area does not seem to be justified. The dose reconstructor should be able to look at a job title and determine potential exposure, and then be linked to a coworker model. This issue is also relevant to how NIOSH has defined the SEC from 1955 to 1958, which at present does not include employees who "should have been monitored," but is limited to employees who were monitored. This SC&A conclusion indicates a need for NIOSH to revisit the limitation.

4.6.2 Workers Were Unlikely to Have Been Monitored for Thermal Neutrons

As stated in Section 6.2 of TBD-6, "...Both fast and **thermal** neutrons were **measured** and **recorded** as whole-body (WB) dose in rem" (emphasis added). This statement is contradicted in Section 6.4, where it states, "...It is assumed that the dose recorded was the result of **fast** neutron exposure" (emphasis added).

The second statement is likely to be correct, since the common practice at DOE facilities was to assess NTA film for tracks produced by proton recoil. It is unlikely that NTA dosimeters were modified and calibrated for tract analysis of **thermal** neutrons. [Tracks in emulsions exposed to

[3] F.H. Badger was employed by Atomics International. His title was Analyst, Health Physics, Senior Health and Safety Operations.

thermal neutrons may be produced by nitrogen in the gelatin that captures a thermal neutron and releases a 0.58 MeV proton–N^{14}(n, p) C^{14}.]

In the absence of empirical data involving neutron spectra for reactors and Pu fuel storage facilities, the lack of dosimeter calibration methods, and the relative insensitivity of NTA film to neutrons with less than 500 keV (or as much as 1 MeV), there remains an undefined level of uncertainty for recorded neutron doses. Therefore, the use of Y-12 data as surrogate values may not be appropriate.

TBD-6 assumes that the NTA film effectively measured all neutron exposure received at AI, and does not consider correction factors for the insensitivity of NTA to neutrons at energies below 500 keV. Actual neutron energy spectrum data are limited to a few facilities (i.e., SRE). There is no discussion of neutron-to-photon ratios in the site profile; however, it is mentioned as an option for calculating thermal neutron exposure in the ER report.

4.6.3 Dosimeter Response to Low-Energy Photons

TBD-6 does not discuss issues associated with the response of dosimeters to low-energy photons. There are statements to the effect that the dosimeter was similar in design to the Hanford dosimeter. The Hanford dosimeter applied a correction factor for exposure of plutonium facility workers to compensate for badge shortcomings. The ER indicates there are source term data available to bound low-energy photon dose; however, no specific information on source term is provided. Furthermore, there is no consideration for dose from skin contamination incidents.

5.0 CONCLUSIONS

After a thorough review of SEC Petition-00093 and the large number of relevant/support documents, it is still unclear as to which of the four facilities should be covered in the petition and the initial year of coverage, which is dependent on whether all four facilities are covered in the petition or if it is just Area IV of SSFL that is covered. The list of covered sites in the DOE database is not consistent with the list of covered sites identified in the August 23, 2004, *Federal Register*. If only Area IV of SSFL is covered in the petition, it is not clear whether the initial date of coverage is 1953, 1954, or 1955. If it is determined that all four facilities will be included in the SEC Petition, the initial coverage date will need to be changed to 1947 or 1948. NIOSH and DOE should make this decision, based on further research.

SC&A agrees with the findings in the SEC ER that the internal monitoring program was insufficiently robust to estimate exposures before January 1, 1959. Only limited amounts of internal personnel monitoring data for pre-1959 exposures were identified, which is consistent with NIOSH's findings that an SSFL routine bioassay program was not initiated until August 1958 (Kellehar 1966). Our review of the percentage of workers being monitored for internal exposure indicates that the percentage continued to increase after 1959, until it plateaued several years later. A determination needs to be made by NIOSH on whether the percentage of workers who were monitored in the several years after 1958 indicates a fully functioning internal monitoring program.

In addition, monitoring for internal exposure of SSFL workers was incomplete and poorly documented for most years of facility operation. These deficiencies and data limitations are stated throughout sections of the TBD. For 1959 and beyond, SC&A does not believe that NIOSH has clearly demonstrated a correlation between the bioassay data available and the potential exposures to specific radionuclides.

There is a lack of information concerning two major facility incidents that had significant potential for internal or external exposure to personnel; the SRE coolant failure and the sodium burn pit. TBD-5 does not specifically address radiological incidents that may have resulted in internal exposures to workers' that were unmonitored and, based on our review of claimant files, it does not appear that all workers who should have been badged were indeed badged. As noted, the poor track record of badging employees appropriately indicates a need for NIOSH to revisit the limitation for its proposed addition to the SEC class only to employees who were monitored. The information in TBD-5 is unclear as to whether workers exposed during these early incidents were adequately monitored for internal exposure and, if workers were monitored, whether their exposure records exist.

SC&A questions the data and unsupported/unreferenced assumptions that were applied in order to reconstruct occupational environmental doses, due to insufficient environmental monitoring and data limitations. This includes inhalation intake estimates that are radionuclide-specific and the surrogate use of the time-integrated average yearly gross alpha/gross beta stack emissions corresponding to years 1971 thru 1999, which likely underestimate stack emissions for years 1954 through 1970. There are also conflicting reports concerning the exposure to onsite water

supply wells. This issue should be re-evaluated to determine if this exposure route can be properly assessed in earlier years and, if so, how to assess this exposure.

In the absence of empirical data involving neutron spectra for reactors and Pu fuel storage facilities, the lack of dosimeter calibration methods, and the relative insensitivity of NTA film to neutrons with less than 500 keV, there remains an undefined level of uncertainty for recorded neutron doses. Therefore, the use of Y-12 data as surrogate values may not be appropriate. There is no discussion of neutron-to-photon ratios in the site profile; however, it is mentioned as an option for calculating thermal neutron exposure in the ER report. The ER indicates there are source term data available to bound low-energy photon dose; however, no specific information on source terms is provided. Furthermore, there is no consideration for dose from skin contamination incidents. Additional work is needed in this area to either better define the likely neutron dose or provide a plausible bound for the dose.

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APPENDIX A: PETITIONER/WORKER INTERVIEW

To be provided at a later date.

REF. 4

Attachment 6

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JUN 28 1960

- copies to those concerned?
- In any event, make sure operating limitations are called to attention of those concerned

Atomics International
A Division of North American
Aviation, Inc.
P. O. Box 309
Canoga Park, California

Attention: Mr. T. F. Humphrey, Director
Contract Administration

Gentlemen:

Transmitted herewith is Amendment No. 1 to your Facility License No. R-40. The amendment authorizes North American Aviation, Inc. to possess and operate the 10 watt (thermal) nuclear research reactor designated as the "L-77" at a new location at the Company's DeSoto facility in Canoga Park, California, as requested in its applications for license amendments dated February 8, 1960 and March 29, 1960.

Also enclosed is a related notice which has been submitted to the Office of the Federal Register for filing and publication.

Sincerely yours,

A. F. Humphrey

Director
Division of Licensing and Regulation

Enclosures:
1. Amendment No. 1 to License No. R-40
2. Notice to Office of the Federal Register

Air Mail

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CONTRACTS & PROCUREMENT

DIST: Circ, PF
DIST: 7-1-60 rr/gz

UNITED STATES ATOMIC ENERGY COMMISSION

DOCKET NO. 50-94

NORTH AMERICAN AVIATION, INC.

NOTICE OF ISSUANCE OF UTILIZATION FACILITY LICENSE AMENDMENT

Please take notice that the Atomic Energy Commission has issued Amendment No. 1, set forth below, to License No. R-40. The amendment authorizes North American Aviation, Inc. to possess and operate the 10 watt (thermal) nuclear research reactor designated as the "L-77" at a new location at the DeSoto facility of North American Aviation, Inc., in Canoga Park, California as requested in its applications for license amendments dated February 8, 1960 and March 29, 1960. Prior public notice of the proposed issuance of this amendment was published in the Federal Register on June 10, 1960, 25 FR 5192

In accordance with the Commission's "Rules of Practice" (10 CFR 2) the Commission will direct the holding of a formal hearing on the matter of the issuance of the license amendment upon receipt of a request therefor from the licensee or an intervener within thirty days after issuance of the license amendment. Petitions for leave to intervene or requests for formal hearing shall be filed by mailing a copy to the Office of the Secretary, Atomic Energy Commission, Washington 25, D. C., or by delivery of a copy in person to the Office of the Secretary, Germantown, Maryland, or the AEC's Public Document Room, 1717 H Street, Washington, D. C. For further details see (1) the applications for license amendments dated February 8, 1960 and March 29, 1960, submitted by North American Aviation, Inc. and (2) a hazards analysis

of the proposed operation prepared by the Hazards Evaluation Branch of the Division of Licensing and Regulation, both on file at the AEC's Public Document Room. A copy of item (2) above may be obtained at the AEC's Public Document Room or upon request addressed to the Atomic Energy Commission, Washington 25, D. C., Attention: Director, Division of Licensing and Regulation.

FOR THE ATOMIC ENERGY COMMISSION

H. L. Price
Director
Division of Licensing & Regulation

Dated at Germantown, Maryland
this 28th day of June, 1960.

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

NORTH AMERICAN AVIATION, INC.

DOCKET NO. 50-94

AMENDMENT TO UTILIZATION FACILITY LICENSE

License No. R-40
Amendment No. 1

License No. R-40 is revised in its entirety to read as follows:

1. The Atomic Energy Commission (hereinafter "the Commission") finds that:

   A. The solution-type 10 watt nuclear research reactor authorized for construction by Construction Permit CPRR-54 issued to North American Aviation, Inc., has been constructed in accordance with the specifications contained in the application;

   B. There is reasonable assurance that the reactor can be operated without endangering the health and safety of the public;

   C. North American Aviation, Inc., is technically and financially qualified to operate the reactor;

   D. Issuance of a license to possess and operate the reactor will not be inimical to the common defense and security or to the health and safety of the public;

   E. North American Aviation, Inc., has submitted proof of financial protection which satisfies the requirements of Commission regulations which are currently in effect.

2. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses North American Aviation, Inc:

A. Pursuant to Section 104c of the Act and Title 10, CFR, Chapter 1, Part 50, "Licensing of Production and Utilization Facilities" to possess and operate as a utilization facility the nuclear research reactor designated below;

B. Pursuant to the Act and Title 10, CFR, Chapter 1, Part 70, "Special Nuclear Material", to possess and use 1.5 kilograms of contained uranium-235 as fuel for operation of the reactor;

C. Pursuant to the Act and Title 10, CFR, Chapter 1, Part 30, "Licensing of Byproduct Material" to possess but not to separate such byproduct material as may be produced in the operation of the reactor.

3. This license applies to the reactor which is owned by North American Aviation, Inc., and located at Canoga Park, California, and described in North American Aviation, Inc.'s application dated January 20, 1958, and amendments thereto dated March 26, 1958, April 15, 1958, September 25, 1959, February 8, 1960, and March 29, 1960, (herein referred to as "the application"). The reactor is of the solution-type, is moderated by light water and uses as fuel a solution of uranyl sulfate containing uranium enriched to 20% or more in the isotope uranium-235. It is designed to operate at a thermal power level of ten (10) watts and is designated by North American Aviation, Inc., as the "L-77" reactor.

4. This license shall be deemed to contain and be subject to the conditions specified in Section 50.54 of Part 50; is subject to all applicable provisions of the Act and rules, regulations and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

a. Operating Restrictions

(1) North American Aviation, Inc., shall operate the facility in accordance with the application.

(2) North American Aviation, Inc., shall not operate the reactor at a power level in excess of 10 watts (thermal)

(3) Materials having a reactivity value in excess of 0.5% may not be inserted into the exposure tubes.

b. Records

In addition to those otherwise required under this license and applicable regulations, North American Aviation, Inc., shall keep the following records:

(1) Reactor operating records, including power levels.

(2) Records showing radioactivity released or discharged into the air or water beyond the effective control of North American Aviation, Inc., as measured at the point of such release or discharge

(3) Records of emergency scrams, including reasons for emergency shutdowns

c. Reports

North American Aviation, Inc., shall immediately report to the Commission any indication or occurrence of a possible unsafe condition relating to the operation of the reactor.

5. This license is effective as of the date of issuance and shall expire at midnight May 16, 1978.

FOR THE ATOMIC ENERGY COMMISSION

H.L. Price
Director
Division of Licensing & Regulation

Date of Issuance: JUN 28 1960

VenturaCountyStar

REF 5

'59 nuclear reactor accident remains vivid for former Santa Susana Field Laboratory worker

Field lab meltdown | 50 years later delayed reaction

By Teresa Rochester
Sunday, July 12, 2009

Something was wrong. John Pace saw it in the men's faces, heard the anxiety in their voices and felt the nervous excitement in the nuclear reactor control room at the sprawling Santa Susana Field Laboratory. "I knew something had happened," said Pace, then a 20-year-old Moorpark resident working as a reactor trainee at the Sodium Reactor Experiment in the hills of eastern Ventura County.

At 6:25 p.m. on July 13, 1959, the experimental reactor's power went out of control, forcing a manual emergency shutdown after an automatic shutdown failed to kick in. It was the beginning of a partial meltdown, a rarity in U.S. history.

For 13 days, officials turned the damaged reactor on and off despite high radiation levels, more emergency shutdowns, and the release of radioactive gases into the air. In some cases, the readings exceeded monitoring instruments' capacity to measure them.

Workers at the reactor, operated by Atomics International, would discover that 13 out of 43 fuel elements were damaged during that period as portions of steel tube encasements melted into the uranium alloy fuel rods.

"The key to the excitement was they barely got the thing shut down before going critical and having an explosion," Pace said in a recent interview, recalling the events of that night 50 years ago. "They just felt so good that they were still alive and they got it shut down."

Pace was handed a roll of tape to keep radiation from seeping out of the reactor room and told to get to work. He sealed and double-checked doorways and other openings leading from the reactor area to nearby offices. A rookie tasked with learning on the job, Pace had received his security clearance and accepted the job only four months earlier.

For the next 49 years, Pace honored the top-secret nature of the work at the reactor, which was used in physics experiments and intermittently generated electricity for the town of Moorpark.

In recent years, knowledge of what occurred that summer has weighed heavily on the retiree's shoulders.

His reluctance to speak out began to wane when he saw a TV documentary about the little-known partial nuclear meltdown. Pace watched himself working on the reactor in vintage film, recorded for training purposes in fall 1959 and featured in the History Channel's "Modern Marvels" episode about California's first partial meltdown.

Moved to bear witness

Along with the televised account of the incident, Pace was moved by recent news reports of workers sickened by exposure to chemical and radioactive exposure at the Cold War-era facility, workers who faced difficulties or were rejected when they applied for a federal government compensation program because they lacked the needed proof of their employment and work assignments.

Pace's recollections dovetail with many of the accounts found in documents from that era, and he has come forward with them as state and federal agencies and the company involved are negotiating a further cleanup.

He remembers records being thrown out back after the reactor building was contaminated in August 1959. The paperwork landed in a heap behind the building, along with office furniture and other debris, Pace said.

But some events he witnessed were not recorded in Atomics International's internal reports on the incident.

"I see these stories, and it just hurts me inside to know these families are hurting so bad for information," Pace said in a recent interview, referring to former workers and their families. "It's a very important thing to me. I'm up in my 70s, and I'd like to get all these things documented so there are more true stories — truer stories — instead of some of the speculation."

Pace has lived for the past 16 years in Rexburg, Idaho, with his wife, Geneva, whom he married in the summer of the meltdown.

He acknowledges his accounts are limited to what he witnessed and heard as he helped scrub radiation from walls with soap and water, among other tasks during the summer and fall of 1959. The passage of time has muted his recollection of some details, but other images and conversations are etched into his memory.

It's true, Pace said, that workers from Rocketdyne, Atomics International's sister division that conducted rocket engine tests at the lab, were brought over to help with the cleanup. To record exposure to radiation, they wore film badges that were checked every night. Once they reached a certain level, the worker was banned from the reactor site for 30 days.

SRE workers were often told not to wear their badges, he said.

An improvised cleanup

It's also true, Pace said of a story that seems more lore than fact, that women's sanitary napkins were used to wipe down contaminated surfaces with cleansers gathered from around the 2,850-acre Field Laboratory after the meltdown. The absorbent material was more effective and longer lasting than sponges. A secretary suggested using them, he said.

"It was brilliant," Pace said. "When we were done we'd throw it in a plastic bag and throw it out back."

It's likewise true, Pace said, that radioactive gases were released. The night of the surge, the men — dressed in nothing more protective than cotton coveralls — worried about venting "hot" gases into the air.

"The big thing on their mind was which way the wind was blowing," Pace said. "They released that (gas) and it went out over the San Fernando Valley where all their children and families were, and they couldn't say a thing about it because it was top secret."

For decades, the partial meltdown was shrouded in secrecy, its details first revealed in internal company documents unearthed in 1979 by UCLA students in the wake of the meltdown at the Three Mile Island nuclear power plant near Middleton, Pa., in March of that year. The same year, Rocketdyne, which outlived

Atomics International, confirmed the event.

Questions persist today about the extent of damage caused by the meltdown on workers, those living in the shadows of the facility and the environment.

One scientist hired by defendants in a suit against the facility's owner described the disaster as likely releasing 15 to 260 times more radiation than Three Mile Island. The claim was rebuttted by a researcher for Boeing and the U.S. Department of Energy, whose predecessor agency had partnered with Atomics International on the development of 10 small reactors, including the SRE, at the Field Lab. Other incidents, more minor, occurred with some of the other reactors.

Health studies have arrived at contradictory conclusions. Those living around and working at the lab have higher cancer rates, according to some. Others determined that workers were not more prone to cancers.

Late notice limits study

Scientists' efforts to reach conclusions were partially hampered by limited information about the incident at the high-security site, researchers say.

Five weeks passed before Atomics International acknowledged something had happened on the hill.

By then, removal of the 13 damaged fuel bundles was under way. Efforts to dislodge a jammed fuel element went awry, the company conceded. That action contaminated the building, and decontamination had started, Pace said.

The incident and the high radiation exposure in the reactor room and its exhaust stack are recorded in the company's reports. But the company's Aug. 29, 1959, press statement ignored the event and the power surge and downplayed what happened to the fuel in the reactor's core. It claimed only a single fuel bundle was damaged.

"The fuel element damage is not an indication of unsafe reactor conditions," the statement read. "No release of radioactive materials to the plant or its environs occurred and operating personnel were not exposed to harmful conditions."

An interim report on the surge and meltdown would later conclude that no radiological hazard was present in the reactor areas. The same report, published Nov. 15, 1959, detailed high levels of radiation in the reactor building and stated reactor gases were released twice — on July 15 and July 22.

Reactor gases were released frequently during the two weeks after the surge, Pace said. Every time the reactor was brought up to power and then shut off, radioactive gases were released, often without being held in holding tanks to diminish their radioactivity, he said.

More firsthand accounts sought

Gregg Dempsey, a senior science advisor with the U.S. Environmental Protection Agency, met Pace in December 2008 and found his recollections valuable. Dempsey is a key member of a team conducting a study to determine radiation levels at the Field Laboratory. He would like to find more people who worked there.

"He was very aware of what was going on around him because he was expected to learn it," Dempsey said of Pace. "The reason I enjoyed talking to him is his memory of his time there was so sharp."

Pace returned to the Field Laboratory last winter for the first time in more than 49 years, accompanied by Dempsey, local activists and a Boeing representative.

In an area that now is mostly open field, Pace described where buildings once stood. He pinpointed the slope where the old weather equipment once sat. It was his job to gather weather data and determine which way the wind was blowing.

Standing on the slope's crest, Pace looked at Simi Valley and Moorpark and saw that the once-small towns surrounded by open fields and citrus groves were now full-grown cities spreading across the valley floor.

"It was a little spooky going back there," Pace said later. "Up at the hill I could remember where I used to walk around. Spooky because there was supposed to be more there. I could see it in my mind and see what it was. It was like looking at a ghost."

New program, an eager apprentice

Construction on the Sodium Reactor Experiment began in April 1955. The reactor was part of a program by Atomics International and the U.S. Atomic Energy Commission to develop a sodium-cooled reactor that could be employed for civilian uses. It also was used in experiments.

"It was different," Pace said. "It wasn't like going to a reactor today that is set for making electricity. Each day I went to work it was a different experiment or they were trying different types of fuel, seeing what type of fuel would work the best under different circumstances."

Pace, who grew up in Northridge and graduated from Reseda High School, had moved to Moorpark with his family in 1958. He'd grown up around his father's auto body and paint business and was well-versed in mechanics.

Newly engaged, he applied for the trainee position at Atomics International with the help of a family friend and started work in March 1959. He and Geneva married several months later and bought a house in Thousand Oaks. He was laid off in November of that year.

"I enjoyed what I was doing," Pace said. "It was quite an honor to work there in those days, for somebody at my age to have that kind of work there, especially if you didn't have an education."

Pace called the period "a different time." The Korean conflict had ended, but the Cold War persisted as Soviet leader Nikita Khrushchev threatened nuclear war and the United States honed its nuclear defense.

Calm without, trouble within

Security was tight at the Field Laboratory. Driving up Black Canyon Road on July 13, 1959, everything appeared to be in its place. The guard at the lab's front gate gave no indication anything was amiss, Pace said.

For the next four months, work revolved around the power surge and meltdown. Without precedent to set their course, SRE officials proceeded to diagnose and fix problems through trial and error.

The damage was caused when a chemical used to cool the pumps that pushed the heat-absorbing sodium around the fuel bundles leaked into the sodium. The mix caused a gummy substance that blocked the sodium flow, causing the fuel to run hot and meld with the steel tubes that encased it. Similar leaks had previously occurred.

The sodium in the reactor was drained and removed in large drums and taken to an open-air burn pit, Pace said.

Laura Rainey, a senior engineering geologist with the state Department of Toxic Substances Control, was struck by Pace's description of the types of waste and debris generated by the meltdown and its aftermath.

"That was a very important day," Rainey said about meeting Pace during his December visit. "The thing I value most is he brings the human side to the history."

Wrong button uncovers the danger

Removing the damaged rods, some of which were stuck in place, proved daunting. By Aug. 2, six of the fuel elements had been removed from the subterranean reactor floor, according to Atomics International reports.

On that day, a protective cask was lowered into the reactor to encircle and remove another damaged rod. As the cask was pulled up, the fuel rod broke apart. A portion remained in the reactor core, the other half lodged in the cask.

"It was such a shock to the operator, he panicked," Pace said. "He pushed the wrong button to stop it to see what had happened."

Pushing the wrong button, he added, "lifted the lead shield off the floor that protected against radiation leaking out of the reactor core."

With the shield up, the whole building was contaminated. The panicked worker ran and "signaled with the alarm for everyone to get out of the building," Pace said, adding that another worker volunteered to re-enter the reactor room to lower the shield.

The building and surrounding area were off-limits for two weeks.

Pace acknowledges he did not observe that event, and learned of it from his supervisor, who instructed Pace not to come to work. Workers were let back in two weeks later, and Pace helped clean up the contamination, washing down walls and floors and throwing out office equipment.

The reports do not mention the shield being opened but mention high levels of contamination and note that some time was spent refining another cask and testing it. A test run took place on Sept. 22.

Containing the problem brings risk

Another fuel rod also broke off in a cask on a day when Pace was present, as he watched workers raise and lower the transporter trying to pull the fuel rod into the protective cask, he said.

Workers peered under the lead shield to see if the fuel rod had cleared the top of the subterranean reactor. Every time the lead shield was up, the reactor room was exposed, Pace said.

In one of the most recognizable photographs from the SRE incident, Pace is pictured peering into a hole. He said he is not looking to the reactor core but rather looking into a piece of equipment used to remove broken pieces of fuel, to see if it was properly aligned.

In another photo, Pace and other workers are turning a giant spoked circle atop the reactor core. The men were trying to rotate the reactor lid so a large lead plug could be positioned over fuel rods so they could be

removed, Pace said.

"With the seal broken on the lid of the reactor, it released radioactive contamination that had to be cleaned up," he wrote in pencil on a copy of the photograph.

Pace believes the exposure to contamination caused his health problems and those of other workers. He was diagnosed with a precancerous skin condition and has trouble with his lungs.

He and Geneva were unable to conceive children for seven years after he left the Field Lab. In 1966, his doctor diagnosed him with temporary sterility, which he links to the reactor, and his wife had a number of miscarriages before giving birth to their three children.

He doubts report on exposure

While visiting the lab last winter, Phil Rutherford, manager of health, safety and radiation services for the Boeing Co., said he showed Pace his "dosimetry report," which documents how much radiation a person has been exposed to. Pace's report showed "a minor level of exposure."

Pace said that several years ago he heard there was such a report, but he puts no faith in it because the records are incomplete, because some were lost and workers' exposure wasn't always recorded because film badges weren't always worn.

"We didn't wear our badges there all the time," Pace said, adding that supervisors would tell the workers not to wear them. "That's what they wanted."

Pace said he understands that officials today are limited in their understanding of what happened to the documents available to them.

"I have no ill feelings towards them because they were not there," Pace said of officials today. "They can only go on the records they have."

He said he was motivated to speak up to add to the public's knowledge about the events, which some researchers have blamed for possibly hundreds of cancer cases among workers and people who lived near the hill.

"It's a cleansing feeling to get it out of you and be able to speak about it," Pace said. "It relieves a lot of pressure, but it's a scary thing also."

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

REF. 7

January 29, 1996

MEMORANDUM TO: Michael F. Weber, Chief
Low-Level Waste and Decommissioning Projects Branch
Division of Waste Management/NMSS

FROM: Ross A. Scarano, Director
Division of Nuclear Materials Safety

SUBJECT: ROCKWELL INTERNATIONAL SITE VISIT

As you are aware, Oak Ridge Associated Universities (ORAU) recently reviewed 59 terminated research and test reactor license docket files. ORAU concluded that 30 files did not contain sufficient decommissioning and disposition information. One of the 30 files was Docket 50-50, License R-19.

License R-19 was issued to Atomics International, a Division of North American Aviation, for the L-47 reactor. This reactor operated between 1957-1958 at a Atomics International facility located in Canoga Park, California. The facility is now controlled by Rockwell International.

In an attempt to gather more information about the reactor, a member of our staff, Mr. Robert Evans, visited Rockwell International on November 15-16, 1995. In summary, the where-abouts of the reactor were not identified although disposition information was located for some of the reactor fuel. Also, the former reactor room was visited and surveyed for radioactive contamination and none was identified.

Records obtained during the site visit consist mainly of documents related to the license application and early operational records. Little disposition or decommissioning information was identified for this reactor although some radiological and environmental records were found for the building that housed the reactor.

In addition, several individuals (including W. L. Fisher, former NRC Region IV Branch Chief) who worked with the reactor were interviewed and none could recall what happened to the reactor.

Atomics International and its predecessors operated many unique reactors for decades in and around Canoga Park. The facility had a well-defined waste disposal program. The reactor was most likely properly disposed of in the late 1950's through Atomic International's normal waste processing and disposal programs.

Attachment 1 provides additional information about the history of the reactor and the site visit. Affixed to Attachments 2 through 4 are copies of documentation that were found in Rockwell's files. Attachment 5 is a copy of the ORAU review of Docket File 50-50. We recommend that the information be added to the NRC's archive file for Docket No. 50-50.

No further action is planned by the Region for this license file unless NMSS recommends or requests that additional action be taken.

If you have any questions concerning this memorandum or its enclosures, please call Ms. Linda L. Howell of my staff at (817) 860-8213.

Attachments:
As stated

ATTACHMENT 1

License No.: R-19

Docket No.: 50-50

Licensee Name: Atomics International
A Division of North American Aviation, Inc.

License Active: August 5, 1957 - June 30, 1958

Business Address: P.O. Box 309
Canoga Park, California

Location: Reactor Room
Vanowen Facility
21600 Vanowen Street
Canoga Park, California

Activity: Operation of the 5-Watt Model L-47 Research Reactor

Background Information

Atomics International was formed as a Division of North American Aviation, Inc., in 1955. During the late 1950's, Atomics International performed a number of atomic energy-related activities. Under contract to the Atomic Energy Commission (AEC) since 1948, North American Aviation/Atomics International developed several prototype reactors, including sodium and organic moderated reactors. Other projects in progress during the 1957-1958 time frame included research into the SNAP-II satellite power system and the Project Pluto ramjet engine. In addition, Atomics International fabricated and installed several research reactors.

(In 1966, North American Aviation merged with Rockwell-Standard to form North American Rockwell. The corporation's name was subsequently changed to Rockwell International. Rockwell still has one NRC-licensed site in Canoga Park, the Rockwell International Hot Laboratory under License SNM-21.)

During December 1956-January 1957, Atomics International apparently submitted three applications to the AEC to construct, manufacture, possess, and use a 5-watt nuclear research reactor. Atomics International wanted to construct a prototype reactor, the Model L-47, for demonstration, experimentation, and sales purposes. (A complete copy of the application package dated January 10, 1957, was obtained from Rockwell International's files; a partial copy of the December 7, 1956, application package was obtained; the application package dated January 24, 1957, that was referenced in the construction permit could not be located.)

Construction Permit No. CPRR-14 was issued on August 2, 1957 (the license for this reactor erroneously stated that the Permit was issued on July 2, 1957), to North American Aviation for construction of the 5-watt (thermal) utilization facility. The facility was a "homogeneous solution-type reactor utilizing highly enriched uranyl sulfate as fuel in distilled light water."

The Model L-47 laboratory reactor was considered by some to be a "poor man's reactor;" the original name of the reactor was the "Penny Ante." This model was quickly replaced with the more popular, and more powerful model, the 10-watt Model L-77.

The L-47 reactor was installed in the Reactor Room of the Vanowen Building in Canoga Park. The operating license No. R-19 was issued on August 5, 1957. Records indicate that the L-47 reactor began operating on August 29, 1957, and operated for 73 watt-hours in 1957 (operations data was not located for 1958).

On May 26, 1958, the AEC was informed that the licensee had "dismantled its L-47 laboratory reactor and placed it in storage." In addition, the licensee requested that the AEC terminate the R-19 license. The reactor was placed into storage because the licensee thought that the reactor might be reused at a later date. Regardless, License R-19 was terminated by the AEC on June 30, 1958.

Records were identified that stated that the recommended amount of fuel to be purchased for the reactor was 2000 grams of fully enriched uranium-235 in the form of uranyl sulfate. The amount of fuel actually purchased was not clearly identified. Records also indicate that the remaining L-47 reactor fuel (201 grams) was transferred to the Armour Research Foundation in June 1958.

In mid-1958, North American Aviation replaced the L-47 reactor with an L-77 reactor (License No. R-40, issued May 17, 1958; Docket 50-94). This second reactor was located in the same Reactor Room of the Vanowen facility as the L-47 reactor. The L-77 reactor operated at the Vanowen facility until February 1960.

On March 29, 1960, Atomics International requested that license No. R-40 be revised to allow them to relocate the L-77 reactor from the Vanowen facility to their new Desoto facility, Laboratory Building 004, in Canoga Park. Construction Permit No. CPRR-54 was issued on June 27, 1960, which authorized the transfer to take place. The revised operating license was issued the next day. The L-77 reactor was permanently shut down in September 1974.

Rockwell International Site Visit

On November 15, 1995, the former Reactor Room (Room 914 on older facility maps, current maps identify the area as Room 554) of the Vanowen Building was toured. The NRC inspector was escorted by the Radiation Protection/Health Physics Services Manager for Rockwell International/Rocketdyne. The area was being used as office space for an adjacent warehouse at the time of the visit. A Ludlum Model 19 microR meter was used to scan the area for radioactive materials. No readings above background were identified in or around the former Reactor Room.

A records review was performed during the site visit. A limited amount of decommissioning records were identified for the Vanowen site. Unfortunately, records indicating the where-abouts of the L-47 reactor were not identified. In addition, the Radiation Protection/Health Physics Services Manager was not aware of any additional records related to the L-47 reactor.

Several former employees of Atomics International were interviewed, including W. L. Fisher, former Branch Chief of the Nuclear Materials Licensing Branch in Region IV. None could recall the final disposition of the L-47 reactor.

Records were located that indicated that Atomics International had a well defined radioactive waste handling and disposal program, including a method of disposing of spent reactor fuel. Atomics International most likely disposed of the reactor and the spent fuel through their normal waste disposal channels in compliance with AEC regulations in effect at the time.

Summary

Additional information related to the L-47 reactor, Docket File 50-50, was obtained during the site visit. This information included limited amounts of construction, operation, environmental monitoring, and decommissioning records. Unfortunately, records associated with the disposal of the L-47 reactor were not located. Records were identified that provided disposition information for some of the reactor fuel.

The former Reactor Room was toured and was found to be free of radioactive materials which indicated that the area had been successfully remediated by either Atomics International or Rockwell International in the past.