

To: Santa Susana Field Laboratory Work Group  
From: SC&A, Inc.  
Date: June 10, 2019  
Subject: Review and Characterization of Boeing Incident Database for SEC-00246

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## Introduction and background

During the Advisory Board on Radiation Worker Health (Advisory Board) meeting held in Redondo Beach, CA, on December 13, 2018, Core Advocacy for Nuclear and Aerospace Workers provided thumb drives containing a collection of incident files to the Santa Susana Field Laboratory (SSFL) Work Group, the National Institute for Occupational Safety and Health (NIOSH), and SC&A. The collection of incident files contained on the thumb drive is titled, “BOEING\_INCIDENT\_FOIA,” and is referred to as “the Boeing incident database” or simply “the database” in this memorandum.<sup>1</sup> After the Advisory Board meeting, SC&A was tasked with reviewing those incident files in the context of Special Exposure Cohort (SEC)-00235 and SEC-00246. SC&A’s evaluation of relevant incidents for SEC-00235 is contained in the SC&A report, “Review of Remaining Internal Dose Topics Related to the Evaluation of SEC-00235 at the Santa Susana Field Laboratory” (SC&A 2019), and is not discussed further here. This memorandum represents SC&A’s evaluation of the database in the context of SEC-00246 at De Soto (1965–1995). Specifically, the database was evaluated for evidence of potential exposure to thorium and/or americium at De Soto.

## Characterization of Boeing incident database

The incident files contained in the database can generally be characterized as two separate types: radiological incident reports (784 total) and unusual occurrence reports (486 total). SC&A’s sampling of the latter category concluded that these types of records did not refer to events where radiological exposure was a possibility. Therefore, SC&A’s review focuses solely on the category of radiological incident reports.

A general characterization of the 784 radiological incident files can be found in Table 1. As seen in the table, 95 incident reports contained in the database are related to De Soto during the period of interest (~12 percent). The majority of incidents (~79 percent) were not relevant because they referred to locations other than De Soto (i.e., SSFL, Canoga, Downey, Vanowen Building, and other offsite locations) or to incidents that occurred prior to 1965 and, as such, are covered by SEC-00168. The remaining files contained in the database were either repeats of other incident

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<sup>1</sup> After the Advisory Board meeting, NIOSH uploaded these incident files to the ABRWH internal server.

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reports (4.5 percent), were blank incident files indicating that the incident number was not used (0.5 percent), or were missing the incident report (4.0 percent).

*Table 1. General characterization of radiological incident documentation in database*

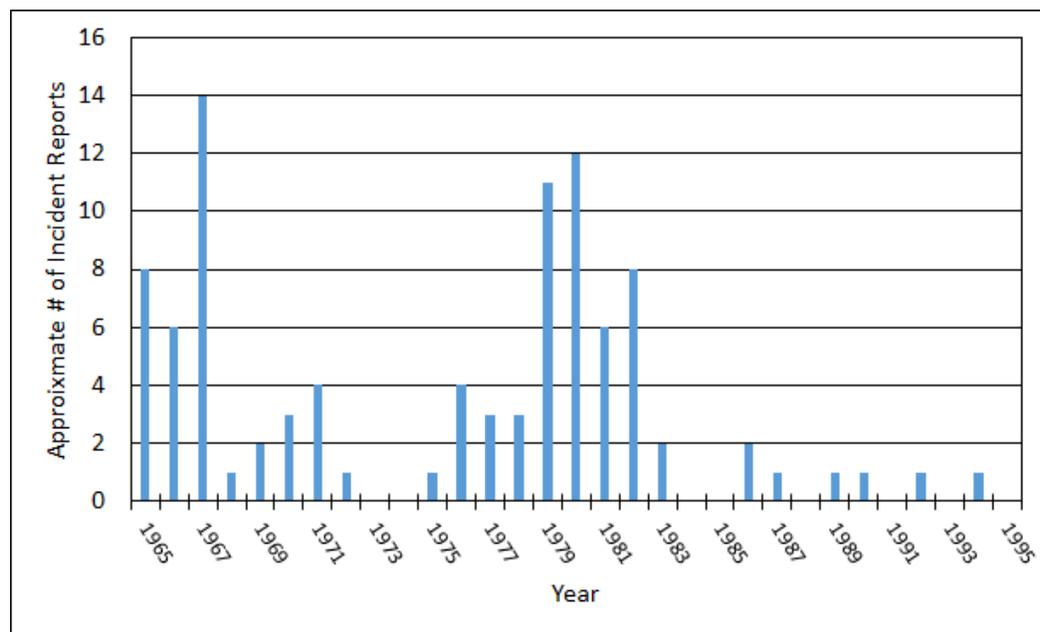
<b>Incident report type</b>	<b>Total reports (%)</b>
Incidents occurring at De Soto post-1964	95 (12.1%)
Incidents not occurring at De Soto post-1964	334 (42.6%)
Incidents prior to 1965	286 (36.5%)
Repeats of other incident reports	35 (4.5%)
Incident report is missing*	30 (3.8%)
Incident report file not used/blank	4 (0.5%)
<b>Total</b>	<b>784 (100.0%)</b>

\* Three of the 30 missing reports related to De Soto during the period of interest.

Although some of the incident reports were missing, an index of the incident database (Rockwell International 1994) contains a list of each incident report number and supplies the date, general location, and a shortened sentence describing the incident. Based on this index, SC&A determined that 3 of the 30 missing reports related to De Soto during the period of interest. Though information on these three incidents is limited, they are included in the analysis specific to De Soto discussed below.

Figure 1 shows the distribution of De Soto radiological incident reports by year from 1965 to 1995. The number of radiological incidents at De Soto decreased markedly in the early 1980s, which generally corresponds to the decommissioning of Building 1, which housed the majority of the De Soto nuclear fuel fabrication operations. The reason for an apparent decrease in incident reporting from 1972 to 1975 is not known at this time.

Figure 1. Number of radiological incident reports for the De Soto Facility by year



SC&A categorized each of the 98 identified incidents at De Soto into six general categories; a description of each category follows:

- Category 1. Uranium Contamination Incident: incident resulted in the detectable release of contamination outside of the intended enclosure, such as a glovebox, and represents a potential internal exposure source.
- Category 2. Uranium—No Spread of Contamination: incident involved uranium but did not result in any detectable spread of contamination outside of the intended enclosure. The most common examples observed were uranium fires contained within a glovebox or other sealed location.
- Category 3. Other Identified Contamination Incident: incident involved the spread of detectable contamination outside of the intended enclosure, and the primary radionuclide(s) were identified in the follow-up investigation.
- Category 4. Other Incident—No Contamination: incident did not involve an internal exposure hazard. Such incidents included radiography (x-ray) overexposures, lost film badges, faulty alarms, misplaced sources, general worker complaints, and material custody issues.
- Category 5. Other Unidentified Contamination Incident: incidents in which gross beta, gamma, and/or alpha contamination was detected; however, the specific radionuclides involved were not identified in followup investigations.
- Category 6. Decladding of Fuel Elements: incident report specifically mentioned the decladding of a fuel element at a De Soto facility.

Table 2 shows the number of incident reports in each of SC&A’s six categories. Also included in Table 2 is the frequency in which each incident resulted in internal monitoring<sup>2</sup> for the individuals involved. As seen in the table, the majority of radiological incident reports were associated with uranium events (Categories 1 and 2). Category 3 incidents involved the following identified radionuclides: iodine-131, strontium-90, cesium-137, cobalt-60, calcium-45, and manganese-54. However, none of the incidents involved americium or thorium. Nearly one-third of the incident reports involved events in which there was either no potential for the spread of contamination or none was detected in followup surveys (Category 4). These first four categories represent 90 percent of the relevant incident documentation for the De Soto SEC-00246 period but do not indicate internal exposure potential to americium or thorium that would render dose reconstruction infeasible.

*Table 2. SC&A categorization of De Soto incidents during SEC-00246 period (1965–1995)*

SC&A incident report category	Number of reports	Internal monitoring requested (% of report category)	No internal monitoring requested (% of report category)	Unknown (% of report category)	Internal monitoring not applicable (% of report category)
1. Uranium Contamination Incident	43	26 (60.5%)	10 (23.3%)	7 (16.3%)	0 (0.0%)
2. Uranium—No Spread of Contamination	9	2 (22.2%)	3 (33.3%)	2 (22.2%)	2 (22.2%)
3. Other Identified Contamination Incident	6	2 (33.3%)	3 (50.0%)	1 (16.7%)	0 (0.0%)
4. Other Incident—No Contamination	30	0 (0.0%)	0 (0.0%)	0 (0.0%)	30 (100.0%)
5. Other Unidentified Contamination Incident	8	1 (12.5%)	3 (37.5%)	4 (50.0%)	0 (0.0%)
6. Decladding of Fuel Elements	2	1 (50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)

Category 5 incidents represent contamination events in which the primary contaminant is not identified in the available documentation; therefore, it is not clear if the incident could have involved americium or thorium. These eight incidents are summarized in Table 3. Without further information pertaining to these incidents, it is not possible to know the specific source of exposure. As noted in Tables 2 and 3, followup internal monitoring is often not discussed as part of the incident.

<sup>2</sup> In this analysis, internal monitoring includes urinalysis, fecal sampling, or whole body count/lung scan results and does not include personal surveys, smears, or nasal swipes.

Table 3. De Soto incident reports describing unidentified contamination (Category 5)

Incident report identifier *	Year of incident	Brief description of incident
a-0163	1986	The incident occurred in room 411-64 of building 4 at De Soto when low-level radioactive contamination, mixed with mercury, leaked onto the floor during a cutting operation of a drain line. A radiation survey of the area found fixed contamination below the drain line but no loose contamination. The tools used in the cutting operation were decontaminated and cleaned. A checklist associated with the incident response indicated bioassay was not required.
a-0419	1966	The full incident report for this event is currently missing. However, the Energy Technology Engineering Center Master Index (Rockwell International 1994) indicates an employee had a ██████████ lodged in their hand while working in a ██████████ in building █. As the full incident report is currently not available, there is no other information pertaining to the material that was being handled nor any indication of followup internal monitoring.
a-0611	1967	A fire occurred while cutting into a ██████████ for ██████████ in building █. The original ██████████ workers, as well as the ██████████ workers involved in the fire suppression, were contaminated on their ██████████. All energy employees (EEs) involved were scheduled to submit bioassay results. The results of the bioassay sampling is not provided in the incident report.
a-0614	1967	While exiting building █, an EE noticed “a ██████████ of ██████████” that had been left under a ██████████ at ██████████. Health Physics smeared the area and determined that the material and the area under the ██████████ were contaminated. No other information pertaining to the levels or type of contamination is provided, nor is any followup internal monitoring indicated. The immediate area was covered with plastic until the contaminated material could be disposed of and the ██████████ replaced. The incident report concludes by asking if the employees of ██████████ are fully instructed in handling radioactive materials.
a-0623	1967	Maintenance workers were removing vacuum exhaust lines in room 111-10 of building 1 when sparks were observed. Approximately 4.5 quarts of black powder were scraped from the ductwork exhaust lines and placed in a criticality safe configuration before being sent to the vault for further analysis. This incident is summarized in a periodic health physics report rather than an individual report specific to the incident. The summary does not contain any further information about the nature of the material or followup internal monitoring. It is possible that the black powder in question was uranium dioxide rather than thorium oxide, which is generally lighter in color.

Incident report identifier *	Year of incident	Brief description of incident
a-0626	1967	Elevated air-sampling results were identified in the Powder Room of building 1 at De Soto ( $5 \times 10^{-9}$ $\mu\text{Ci/cc}$ ); followup high-volume air samples showed airborne contamination levels of $5 \times 10^{-11}$ $\mu\text{Ci/cc}$ . The document states that the contamination was found throughout the room, but the type of radioactivity is not specifically identified. Personnel were evacuated until decontamination was effected. This incident is summarized in a periodic health physics report rather than an individual report specific to the incident. The summary does not contain any further information about the nature of the material or followup internal monitoring.
a-0628	1967	A fire occurred during the modification of radioactive ductwork above the furnace room (room 119-33A in building 1). Subsequent smears of the area found contamination below the duct; however, nasal smears of the workers involved were negative. There was no indication of followup internal monitoring in the incident report.
a-0646	1980	While maintenance was being performed on a set of fume hoods, a worker became contaminated when they [REDACTED] into a [REDACTED]. The worker was decontaminated without any indication of followup internal monitoring. The incident report did not specify the type of contamination.

\* Identifiers are associated with incident report numbers in the Boeing incident database.

Based on the information provided for the Category 5 incidents described in Table 3, SC&A did not identify evidence that the incidents with unknown contamination were likely to involve americium or thorium.

The final incident category (Category 6) is the most important because it relates to SEC-00246, as the decladding of fuel elements (if irradiated) could represent a feasible source of internal exposure potential to transuranic material such as americium. Two incidents were identified among the 98 relevant De Soto incident reports that indicated possible decladding activities. These two incidents are described as follows:

- Report Identifier a-0492 (Atomics International 1965):
  - Incident occurred in [REDACTED] 1965 at location [REDACTED].
  - From Rockwell International 1994, p. 19: “Employee was cutting and grinding on irradiated component in clean lab.” The location is given as “[REDACTED].”
  - From Atomics International 1965, p. 1: “Unknown quantities of grindings from irradiated element were generated by [name redacted], Dept. [REDACTED], allegedly without [EE’s] knowledge of the potential spread of contamination.”
  - EE immediately submitted a bioassay sample (type is unspecified), with results listed as no detectable activity.
- Report Identifier a-0654 (Rockwell International 1975):
  - Incident occurred in November 1975 in Building 1 at De Soto.

- From Rockwell International 1975, p. 1: “an EBR-II fuel element with xenon tag gas was inadvertently included in a batch of elements for destructive inspection and was stripped of its cladding at about 11:00 a.m. This released the tag gas to the working atmosphere.”
- Exposure was estimated to the release of krypton-85, which was comingled with the nonradioactive xenon gas. It is not clear if the fuel element that underwent decladding had been irradiated.

## Conclusion

SC&A’s review of the Boeing incident database did not find any direct references to internal exposure from americium or thorium among the 98 documented radiological events at De Soto starting in 1965. Not surprisingly, most of the incidents involved uranium operations, which was the primary fuel fabrication mission occurring during the SEC-00246 period. However, SC&A did identify two incidents that describe the decladding of fuel elements occurring at De Soto.

An incident occurring in 1975 involved the decladding of an Experimental Breeder Reactor-II (EBR-II) fuel element. However, it is not clear from the documentation whether the element had been irradiated. Therefore, it is not clear whether an internal exposure potential to transuranic material could have existed. It is possible that the site was performing destructive testing on unirradiated elements prior to acceptance of the fabricated fuel by the customer (in this specific case, Argonne National Laboratory-West).

However, the decladding incident described in January of 1965 specifically describes “cutting and grinding on irradiated component in clean lab” (Rockwell International 1994, p. 19). SC&A recognizes that this incident occurred in the first month of the SEC-00246 period and that the incident database did not identify any similar events at later times. However, it is also a realistic possibility that this incident may only have been reported because it took place in a clean laboratory in building 5 (generally considered a nonradiological area). Other such operations may have gone undocumented in the hot laboratory or other areas of De Soto if they were considered routine by the health and safety staff.

## References

- Atomics International. (1965, February 11). *Incident report* [Incident file no. a-0492].
- Rockwell International. (December 12, 1975). *Decladding of gas-tagged EBR-II fuel element* [Incident file no. A0654]. Retrieved from SRDB Ref. ID 19690
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