NIOSH Response to SC&A Review of SEC-00246 De Soto Avenue Facility Evaluation Report

Response to Findings and Observations

National Institute for Occupational Safety and Health

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Prepared by: Monica Harrison-Maples
Oak Ridge Associated Universities Team

Reviewed by: Lara Hughes, PhD, CHP
Division of Compensation Analysis and Support

INTRODUCTION

In December 2018, Sanford Cohen and Associates, the Technical Support Contractor to the Advisory Board on Radiation and Worker Health (SC&A) delivered a draft report, Review of the NIOSH Evaluation Report for SEC-00246 at the De Soto Facility (SCA-TR-2018-SEC006, Rev.0), presenting four findings and six observations related to the NIOSH SEC evaluation report of the SEC-00246 petition. The evaluation reviewed the feasibility of reconstruction of potential internal exposures to americium and thorium at the De Soto facility from 1965 through the end of 1995. This reports contains the first set of NIOSH responses to the SC&A findings.

FINDING 1: GAPS IN DOCUMENTATION

SC&A identified significant temporal gaps in four key types of documents available in the SRDB: health physics logbooks, tagged area entry permits, routine smear surveys, and general air sampling reports. The disposition of additional documents of this type is not known at this time.

NIOSH Response (Finding 1):

NIOSH uses a documented hierarchy of data to reconstruct internal (and external) dose. That hierarchy proceeds from individual dosimetry data to workplace monitoring data and finally to source term data for the facility [OCAS-IG-002 Rev 00]. Individual dosimetry data can generally be categorized as bioassay data, personal monitoring data collected in the workplace, in that order of primacy. The four document types listed by SC&A are defined as primary records for data pedigree purposes because of the background, history, and origin of the documents.

For SEC evaluations, NIOSH typically focuses on the capture of high-level documents, such as annual reports, annual summaries, and operational histories to supplement bioassay data and develop a full understanding of exposure scenario conditions. The high-level documents captured and the data contained within them was assessed for value in developing dose reconstructions during the De Soto SEC evaluation. NIOSH has not attempted to search out all logbooks, Tagged Area Entry Permits (TAEPs), routine smear surveys and general air sampling reports, but rather, have collected such information as it is identified. NIOSH did not identify a specific concern during the evaluation that is likely to be resolved through a review of additional logbooks. While logbooks and access records, such as TAEPs, are generally supportive documentation, they are not required documentation for dose reconstruction. A review of the SRDB holdings shows no indication that operations occurred that would allow internal exposures to americium and no indication that operations occurred which would have had a thorium exposure concern beyond the bounding thorium approach presented in the SEC-00246 evaluation report.

NIOSH agrees that these gaps in supplemental documentation identified by SC&A are valuable areas for targeted data capture in the event of a specific concern and will consider a focus on such documents for any future data capture efforts.

FINDING 2: CONTAMINATED CONTAINER

SC&A did not identify any activities involving the handling of decladded spent nuclear fuel that may have presented an internal exposure potential to Am-241. However, at least one reference indicates that a contaminated container used to clean sodium from decladded fuel had been discovered in a hood area in Building 1 at De Soto. Unless the decladded fuel was fresh fuel undergoing decladding, the fuel would be expected to have been irradiated, and thus would likely contain americium.

NIOSH Response (Finding 2):

The finding relates to a log book entry from 3/11/1965 [Entry 1030, 1965]. The entry reads: "Smear survey of hood in the NW corner of 1110-80 indicated a maximum of 1.8×10^3 dpm/100 cm^2 alpha and 6×10^3 dpm/100 cm^2 beta in a long thin tray used to clean Na from decladded fuel. The nomenclature identifying the room appears to be in Building 001 (other entries from the same day refer to room 1110-65 and Room 1110-62 which is the Powder Room). At Area IV, SSFL, reactors such as the SRE, the SNAP 8 Experimental Reactor (S8ER), and the SNAP 8 Development Reactor (S8DR) used an alloy of sodium (Na) and potassium (K) coolant (NaK). The report Metallurgical Aspects of SRE Fuel Element Damage Episode [Ballif, 1961] briefly describes examinations and two special tests made with both damaged and undamaged fuel elements from the SRE, performed in hot cells, to determine causative factors of the fuel damage. NIOSH reviewed references showing that the SRE had specially designed hot cells to clean fuel assemblies, and to examine the fuel using cameras. Inert atmosphere conditions were required when working in containment with NaK to prevent fires. Sodium is pyrophoric at or below 130° F and is highly reactive when exposed to water or dry air [Handbook V3, 1978]. NaK will spontaneously ignite in air much more easily than sodium and is considered somewhat more hazardous than sodium [Handbook V3, 1978]. The SRE-engineered safety controls were a designed part of the reactor facility because of the hazardous nature of sodium-bearing materials. The logbook entry specifies sodium (Na) as the material cleaned from the decladded fuel in the tray, rather than NaK. This makes it unlikely that the fuel referenced in the logbook entry came from one of the sodium-cooled reactors at SSFL. While there is no direct evidence that reactor fuel material was or was not cleaned in the hood, the pyrophoric nature of sodium makes it unlikely that this type of fuel material was cleaned of sodium in a hood which is not a contained area with a controlled atmosphere. This indicates the cleaning likely occurred elsewhere.

As noted in the finding, if the fuel had been irradiated, it is likely it would have contained americium from the decay of plutonium produced by activation during reactor operation. It seems unlikely that the radiation hazard associated with irradiated fuel from any reactor would be unknown or not handled with the care associated with highly radioactive material. A tray used during the cleaning of irradiated fuel would be considered potentially contaminated, and would not likely be removed from a shielded, contained condition to a hood area. It is therefore more likely that the fuel that was cleaned was unirradiated fuel. That would be more consistent with the level of contamination reported as well.

NIOSH's research suggests a possible source of unirradiated reactor fuel requiring removal of sodium. Following a fuel damaging incident in the SRE in 1959, Atomics International investigated reactor fuel cladding failure. Multiple experiments were conducted to investigate the mode of failure, including experiments performed on unirradiated reactor fuel [Daniel, 1959]. In summary, the log book notation describes a contaminated container, found in a hood. The purpose of the container is described as: "to clean Na from decladded fuel." The entry makes no mention of decladding operations occurring in the hood area and gives no information about where the decladding operation took place. The entry gives no indication if it was fuel in the form of an element/assembly or a sample of fuel material, although the description of the tray as long and thin implies the former. The entry describes sodium rather than NaK, so the fuel material seems to have come from an operation or experiment other than one of the reactors that used NaK as a coolant material. This would include scenarios such as testing the response of cladding to physical stress conditions to determine a possible cause of cladding failure. If the nuclear fuel material cleaned in the tray was not irradiated prior to cleaning, there would be no reason to assume americium fission product as a component of the fuel material or part of the contamination. The amount of contamination and the location of the contaminated tray in a hood implies the fuel material was unirradiated fuel.

NIOSH has researched the incident database provided by Boeing and has been unsuccessful in finding further documentation to corroborate or provide more detailed information about this event in the Building 104 hood.

FINDING 3: MASS SPEC LAB DRAIN CONTAMINATION

While SC&A did not observe any documentation directly indicating the handling of unencapsulated americium source material, evidence from at least one document suggests that a 1988 survey of floor drains in the laboratory area identified Am-241 contamination. Such contamination would not be expected unless unencapsulated americium was used at some point during laboratory activities.

NIOSH Response (Finding 3):

Building 104 at the De Soto facility was home to a number of analytical laboratories that supported nuclear-related activities and conducted radiochemistry analyses. One of the facilities was the Mass Spec laboratory, which used a high precision helium mass spectrometer to analyze milligram sized metallic specimens, irradiated in test reactors across the nation, to study the effects of helium embrittlement and neutron dosimetry. According to the document "Final Report for Decontamination & Decommissioning of the De Soto 104 Helium Mass Spectrometer Laboratory" [Stelman, 1999] specimens were vaporized and the amount of helium present in the effluent gas was analyzed. In the process, the mass spectrometer, the associated vacuum system, and the HEPA exhaust system were contaminated with small amounts of activation products from the irradiated specimens (typically Co-60 and Mn-54 from neutron activated steel). Some contamination of laboratory fume hoods and machine tools likely occurred during the handling and preparation of samples. The Mass Spec Lab was connected to the Building 104 industrial radioactive water drain system. During remediation of the other radiological laboratories in Bldg.

104 during the 1980s, the radioactive drain system was removed back to the Mass Spec Lab perimeter. The radioactive drains within the perimeter of the Mass Spec Lab were sealed and isolated to prevent further use [Stelman, 1999].

Hand-written editorial notes referenced in the finding read: "The presence of 49 pCi Am-241 was in 49 gm of soil drain sample". The notes indicate there was no recorded release of plutonium or americium. The notes are edits to an unknown report and are included in a NIOSH available file with survey maps and routine radiation survey reports [Surveys, 1997]. There are no markings to indicate the source of the original document or the author of the handwritten edits. NIOSH researched facility environmental reports, annual reviews of radiological controls, survey reports, licensing documentation, occurrence reports, and activity reports in an effort to verify the hand-written notes, and found no additional information that could be used to definitively identify the 1988 survey reference or any other associated references. NIOSH was able to identify a document (Boeing, 2003) which includes a citation in the list of references that is likely the 1988 survey. That document states, "The presence of Am-241 in drain sample IW-25 is unexplained. There was no recorded release of plutonium or americium in the labs in DS104. The sample showed approximately 400 pCi in 49 grams of scale scraped from the drain [emphasis added]" [Rocketdyne, 1988]. The 1988 survey date, the similarity of the wording and the reference to the drain sample indicate this document is the likely source for the edit notes, though the activity of the americium is significantly more than what was indicated in the handwritten notes cited in the finding. These samples were analyzed by gamma spectroscopy. The 1988 survey supported the decontamination and demolition of the ground floor of Building 104, including removal of most of the drain-lines that served the radioactive labs, to permit renovation of the area [Tuttle, 1989]. The concentration of Am-241 was listed as 400 pCi in 49 grams of scale, which corresponds to 8.2 pCi/gram of scale scraped from the Building 104 industrial waste return drains.

Am-241 was also detected in a drain trench soil sample in 1998. The document: "Draft Docket for the Release of Mass Spectroscopy Laboratory (Building 104)" [Stelman, 1999] includes a description of trench sampling and a summary of the analysis results. A single result in the quantitative soil measurements of piping trenches [Liddy, 1998] was 0.03 pCi/gm Am-241. The minimum detectable activity (MDA) was 0.061 pCi/gm and the soil guideline release limit for Am-241 was 5.44 pCi/gm [Liddy, 1998].

In trying to identify a possible source of Am-241 contamination in the drain lines, NIOSH reviewed the Boeing incident report files. Several incident reports were identified for that time period, but none indicated Am-241 as the relevant radionuclide.

In summary, Am-241 was detected at low levels in the scale scraped from the industrial waste drain line in 1988. The amount detected was well below the EPA soil decontamination limit of 30 pCi/g. In 1998, the non-functional remnants of the industrial drain and cooling water return line under the Mass Spec Lab were excavated and a soil sample from the excavation indicated Am-241 but at a level less than the MDA. NIOSH reviewed radiological surveys, environmental reports, and incident reports but found no record of an americium release into the waste drains.

At this point, the source of the sample is unknown, but it is plausible that it is a result of an analytical sample spill of some sort. Building 104 housed radiochemistry labs, which performed analysis on radioactive samples which could have included fission products and transuranics. Radiochemical analysis involves samples large enough to provide statistically accurate analyses. Analytical sample quantities are not usually available in sufficient quantity to be readily dispersed for inhalation by workers, especially in light of hood enclosures, ventilation controls, and administrative controls. The low levels of americium detected and the complete lack of operational history referring to americium in Building 104 do support the conclusion that americium was not a radionuclide of concern during the 1965-1995 period at De Soto Building 104 and did not pose a potential internal exposure hazard to workers.

FINDING 4: FORMER WORKER INTERVIEWS

Only two interviews are documented in the SRDB as a result of NIOSH's SEC-00246 evaluation, and only one of those two interviews involves a worker at De Soto prior to 1991. A third interview occurred in November 2018 after NIOSH issued its evaluation of SEC-00246 and was performed by SC&A in conjunction with NIOSH and CORE Advocacy. This interview has not yet been finalized.

NIOSH Response (Finding 4):

NIOSH has contacted its contractor, ATL, to follow up with the suggested NOCTS interviewees suggested in SC&A's report. A notice was sent to DOE, who contacted the contractor who did the DOE interviews in the 2010/2011 timeframe. A letter was sent by DOE, attempting to contact the selected persons and asking if they are willing to be interviewed. Additional interviewees were identified by ATL and five additional interviews were completed in May, 2019. Interview transcripts will be available in the SRDB once they have been finalized.

ABRWH IDENTIFIED FINDING: ENVIRONMENTAL STACK RELEASES

The ABRWH asked for clarification on the assertion from the petitioner that the mention of Am and Th in the stack analyses reported at De Soto in the 1990s confirms that De Soto processed Am and Th.

NIOSH Response (ABRWH Finding):

The environmental TBD for Area IV/De Soto discusses radionuclide-specific gross alpha and gross beta stack emissions only for 1988-1999. For the De Soto facility, the only stack emission data available is for Building 004, Hot Analytical Chemistry, a facility related to operations of the Mass Spectroscopy Laboratory, which analyzed small samples of activated materials. It ceased operations in 1995. Table 4-1 in the TBD indicates that Americium and Thorium were analyzed in the effluents during this period. The exhaust through the stacks was filtered through HEPA filters, before being discharged to the atmosphere. Exhaust air samples were counted for gross alpha and beta activity on a weekly basis until 1990, when Rocketdyne began sending airborne effluent samples for radionuclide specific analysis as a result of concern expressed by

the public and the media. The annual environmental reports contain analysis results for a consistent set of radioisotopes reported for the RMHF, the Hot Lab and De Soto 104, indicating that the samples were sent for analysis to a vendor under one contract.

Americium measurement results were reported in 1990, 1991, 1995, and 1996, but only in 1995 was the reported activity greater than the analysis LLD. In 1995, the analysis LLD was 0.430 pCi and the activity detected result was 0.452 pCi. The concentrations in the effluent at the exhaust stack were below the maximum permitted concentrations (MPCs) of State of California, California Code of Regulations (CCR) Title 17, Section 30253 for exposure of the public. The stack monitoring results for 1992, 1993, 1994, 1996, 1997 and 1998 all reported thorium content as non-detectable. In 1995, all thorium results were below the analysis LLD. Based on NIOSH's review of the document holdings, the results of the effluent monitoring demonstrate americium was not a release concern and americium was not released to the environment by the De Soto facility. The monitoring program included americium and thorium as part of a non-specific suite of radionuclides encompassing concerns from Area IV and De Soto, in response to community concerns. There was only one reported Am-241 result that exceeded what could confidently be called radioactive and none exceeded the release LLD. The isotopic analysis results do not indicate evidence of unencapsulated work with americium or thorium at the De Soto Building 004 facility.

OBSERVATION 1: AM-241 SOURCES

SC&A found examples of Am-241 source material being transferred to different locations at the De Soto site; however, no evidence of the fabrication of new Am-241 sources, as allowed by Radioactive Material License 0015-59, was identified.

NIOSH Response (Observation 1):

No NIOSH response required.

OBSERVATION 2 (TRUMP-S):

Documentation confirms that TRUMP-S material was shipped to the De Soto site. However, SC&A did not find any indication of TRUMP-S operations occurring at the site that could have involved unencapsulated Am-241.

NIOSH Response (Observation 2):

No NIOSH response required.

OBSERVATION 3 (AM-241 IN SMOKE DETECTORS):

Smoke detectors containing Am-241 were in use at De Soto beginning in 1985; however, radiological exposure characterization of routine preventative maintenance of the detectors indicated little to no internal exposure potential. Actual repair of the radioactive smoke detectors, which may involve exposing the Am-241 source material, occurred at SSFL and not De Soto.

NIOSH Response (Observation 3):

No NIOSH response required.

OBSERVATION 4 (URANIUM ISOTOPE INFORMATION):

A 1977 licensing document states that the handling of unencapsulated material at the De Soto facility only involves isotopes of uranium.

NIOSH Response (Observation 4):

NIOSH reviewed process descriptions, radiological surveys, and environmental reports and performed keyword searches to identify any reference to reprocessed fuel, or spent fuel.

NIOSH found no reference to, or evidence of, the handling of U-236 containing material at De Soto. A keyword search of the available documents found reference to U-236 in two documents other than the cited licensing document; a 2012 Final Field Sampling Plan for Soil Sampling Area IV Radiological Study [EPA, 2012] and an internal letter [Tschaeche, 1968] on updated isotopic data for the ATR/ETR Fuel receipt giving the isotopic composition of fuel received between June 1966 and October 1967. This fuel was to be used in the "Powder Room" in Building 101 and generally contained approximately 0.3 Wt. % U-236. This does not constitute a "significant quantity" and does not seem to indicate the fuel was reprocessed. The field sampling plan lists U-236 in a table of radionuclides of interest for soil sample analysis, selected by a National Environmental Laboratory Accreditation Program (NVLAP) certified laboratory rather than a site-specific listing. NIOSH found no indications the fuel material had been irradiated or that americium was a component of the fuel.

OBSERVATION 5 (THORIUM INTAKE ASSIGNMENT):

The NIOSH SEC ER provides calculated intake rates for thorium based on bioassay data related to the 1979 grinding operation. NIOSH notes that such intakes can be assigned to De Soto workers "as appropriate," although it does not indicate what criteria would need to be satisfied for an unmonitored worker to be assigned the derived coworker intake rate. However, it must be noted that establishing policies concerning coworker application are generally considered site profile issues rather than SEC issues.

NIOSH Response (Observation 5):

NIOSH assigns calculated intake rates based on individual claim information and site knowledge. An overarching policy on the criteria for assigning a derived coworker intake rate is not considered feasible given the variations in operations and conditions from site to site. As noted by SC&A, policies concerning coworker application are handled as site profile issues, taking into account available site data and information. Such policy determinations are beyond the scope of SEC evaluation.

OBSERVATION 6: THORIUM

SC&A identified evidence in SRDB documentation indicating spraying, cutting, and laboratory-specific operations involving thorium that were not identified or discussed in the NIOSH SEC ER. However, SC&A did not identify evidence associated with these operations/processes to suggest they would not be bounded by the grinding operation in 1979 for which NIOSH has developed coworker intake rates of thorium. NIOSH should consider these additional operations when assigning unmonitored thorium intakes to workers at the De Soto facility.

NIOSH Response (Observation 6):

NIOSH is aware of transit capsule testing programmatic work using ThO_2 powder containing natural thorium. While authorizations for parts of this campaign have been cited in the evaluation report (Authorization No. 13, Authorization No. 21) as examples, NIOSH does not believe these examples describe the entire campaign. Citation of these authorization documents within the evaluation report was not intended to restrict the scope of this work to June and July of 1970, and NIOSH will continue to pursue and consider any documentation associated with this project that expands the understanding of the scope.

NIOSH reviewed personnel radiation dosimetry files, personnel air sampling data sheets and TAEPs for information on thorium work as part of the evaluation. As stated in the evaluation report, the site frequently relied on the experience of the same individuals to perform work involving thorium. One individual is associated with the work indicated in the SC&A Review document as Th-6, Th-12, and Th-13. This same individual is also identified as working on the 1979 thorium grinding operation. This individual's radiation exposure monitoring data was significant to the development of the conclusion that the other identified thorium operations at De Soto would be bounded by the 1979 grinding operation.

The reference to "ThO_2 machining" in room 11H-28 cited by SC&A (Th-13) is not an activity description that was seen elsewhere in the process documentation. The evaluation report did mention analysis of the thoria-molybdenum cermet fuel simulant was performed by operators for whom NIOSH has dosimetry records. An internal letter [Meyer, 1970] describes the transit capsule post-test analyses. The analysis was to have been performed in 11H-28, the Hot Machine shop in Building 101, and was to have consisted of leak testing, dye-penetrant inspection, and volumetric measurement. The capsule was to be disassembled through machining, and the simulant fuel removed, sealed in packages and ultimately shipped to LASL. The planning did not include machining of the ThO_2 containing fuel simulant discs.

NIOSH has reviewed Table 2. Description of Thorium Related Information Contained in the Site Research Database provided in SC&A's review and performed a targeted assessment of the available data. Additional data capture does not seem indicated at this time. Any future data capture opportunities will include an effort to further support the logbook entries and other documentation.

OBSERVATION 6: FORMER WORKER INTERVIEWS

SC&A identified 13 individuals among over 120 interviews conducted by DOE/EPA related to the SSFL site who may have relevant information regarding De Soto. If available, these individuals may represent suitable interview candidates in the future, as required.

NIOSH Response (Former Worker Interviews):

An attempt was made with help of DOE to contact the former workers who participated in the DOE interviews from 2010. One worker was willing to be interviewed, but scheduling and health issues of the interviewee are ongoing, and it is unclear if the interview will proceed as of this writing.

REFERENCES

Ballif, 1961; Metallurgical Aspects of SRE Fuel Element Damage Episode [SRDB Ref ID 175533]

Boeing, 1999; Draft Docket for the Release of Mass Spectroscopy Laboratory (Building 104) at the Rocketdyne (Boeing North American) De Soto Facility Operated by Former Energy Technology Engineering Center September 1999 [SRDB Ref ID: 170434]

Boeing, 2003; Rocketdyne Propulsion and Power Appendix B: Radiological Operations and Cleanup at the De Soto Facility [SRDB 19145]

Entry 1030, 1965; Log Book De Soto 1964-1965 [SRDB Ref ID 169514]

EPA, 2012; Final Field Sampling Plan for Soil Sampling Area IV Radiological Study Santa Susana Field Laboratory Ventura County, California [SRDB Ref ID 158004]

Surveys, 1997, Collection of survey maps and reports from De Soto Mass Spec Lab, Building 004 in 1997 [SRDB Ref ID 170416]

Handbook V3, 1978; Sodium-NaK Engineering Handbook Volume III 1978 [SRDB Ref ID 175535]

Daniel, 1959; Investigation of Releases from Santa Susana Sodium Reactor Experiment in July, 1959 [SRDB Ref ID: 142171]

Liddy, 1998; De Soto 104 Mass Spectroscopy Laboratory Final Status Survey Report [SRDB Ref ID: 170434]

Meyer, 1970; SSC Fuel Simulant Disc Fabrication Program, June 8-12 [SRDB Ref ID: 170466]

OCAS-IG-002 Rev 00, Aug 2002; Internal Dose Reconstruction Implementation Guideline [SRDB Ref ID: 22402]

NRC, 1981; Decontamination Limits for Americium-241; https://www.nrc.gov/about-nrc/radiation/protects-you/hppos/hppos183.html [SRDB Ref ID 175532]

Rocketdyne, 1988; Rockwell International, 1988. Radiation Survey for Release for Unrestricted Use of De Soto Facility, 1st Floor, Building 104. N001SRR140103 dated Aug 17, 1988 [SRDB Ref ID 170451]

Stelman, 1999; Final Report for Decontamination & Decommissioning of the De Soto 104 Helium Mass Spectrometer Laboratory [SRDB Ref ID: 170434]

Tuttle, 1989; Annual Review of Radiological Controls – 1988 [SRDB Ref ID: 19139]

Tschaeche, 1968; Updated Isotopic Data for ATR/ETR Fuel Receipts [SRDB 171859]