Interim Review of Pinellas SEC-00256 Petition Evaluation Report

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SC&A ER review appendices

SC&A included three appendices with additional information:

- **Appendix A, "DOE Tiger Team Report":** reviews the 1990 report, highlighting items that appear relevant to the SEC
- **Appendix B, "Radiological Incidents":** summarizes all the incident and health physics investigation reports that involved a potential or actual radiological release, contamination, and/or personnel exposure
- **Appendix C, "Former Worker Interview Notes":** summarizes all worker interview records

Background: SC&A SEC-00256 ER review

- SC&A issued SCA-TR-2023-SEC001, “Interim SC&A Review of the SEC Petition Evaluation Report for Petition SEC-00256: Pinellas Plant,” on June 16, 2023
- SC&A had no findings and 13 observations
- The report:
  - Summarizes the plant history and site information
  - Discusses radiation sources and types
  - Examines radiation monitoring procedures and compliance pre- and post-1990 U.S. Department of Energy (DOE) Tiger Team report
  - Evaluates whether the ER adequately recognizes and addresses all petitioner concerns, incorporates worker interview information, and accounts for all relevant reported radiological incidents

Pinellas Plant background

- Located on ~100-acre site in Clearwater, FL
- Constructed in 1956 and operated though 1994 by General Electric to manufacture neutron generators
- After 10 years, expanded to include other specialized electronic equipment for the nuclear weapons program
- At peak operations, the plant employed ~2,000 people
- Decontamination and decommissioning activities from 1994 through 1997
- Remediation activities in 1999, 2008, and 2009

Pinellas SEC background

- **12/16/2019:** Initial Pinellas SEC-00256 submitted to NIOSH
- **5/20/2020, 8/17/2020:** Petitioners revised class definition twice
- **10/20/2020:** NIOSH qualified the 8/17/20 petition and modified the class definition
- **10/13/2021:** NIOSH completed the SEC petition evaluation report:
- **12/8/2021:** NIOSH presented the ER at the ABRWH meeting, and the ABRWH requested SC&A review
- **12/8/2022:** SC&A presented status of ER review at the ABRWH meeting
- **6/16/2023:** SC&A issued its interim review, recognizing that several new issues have recently been raised by the petitioners that may have SEC implications and that documents found in recent data captures have not yet been reviewed.

SEC development

- The revised SEC petition of 8/17/2020 proposed a period from January 1957 through December 1997
- NIOSH determined that the petition qualified for evaluation under the F.4 basis – scientific or technical report issued by a government agency or peer reviewed journal that identifies dosimetry information is unavailable – based on two statements from the 1990 DOE Tiger Team report:
  - "GEND [General Electric Neutron Devices] estimated that 20 percent of the personnel that terminated in 1988 did not provide a termination bioassay."
  - "Seventy percent of the required monthly samples and 35 percent of the required weekly samples were not submitted."

NIOSH evaluated class definition

- Since the 1990 Tiger Team report assessed conditions in 1988 and 1989, NIOSH determined that the Tiger Team's findings were not directly applicable to the period that followed because the plant had adequately and promptly addressed the bioassay compliance issues raised in the report by the end of 1990
- Consequently, NIOSH terminated the SEC class definition period on 12/31/1990 rather than on 12/31/1997 as proposed in the petition
- NIOSH's SEC class: "All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Pinellas Plant in Clearwater, Florida for the period from January 1, 1957 through December 31, 1990"

SEC petition evaluation report conclusion

The ER asserts that NIOSH can reconstruct doses during the proposed SEC period:

- NIOSH concludes that it has access to sufficient information to estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed
- Therefore, NIOSH does not recommend adding the NIOSH-evaluated class to the SEC

SC&A's ER assessment conclusions

- SC&A believes that it may be possible to bound doses to workers covered by the SEC petition
- However, SC&A notes that it has yet to be demonstrated that a suitable co-exposure model can be developed for other soluble tritium compounds.

Pinellas site profile

- The ER and SC&A's review rely, in part, on the technical basis documents (TBDs)
- NIOSH produced the original set of TBDs in 2005 and 2006
- SC&A submitted its assessment of the TBDs in 2006 and identified 11 primary and 8 secondary issues
- NIOSH revised the TBDs beginning in 2011
- As of the 8/9/16 ABRWH meeting, the primary and secondary issues had been adequately resolved except Primary Issue 2 concerning stable metal tritides (SMTs), which is in abeyance until NIOSH revises the internal dose TBD
- The bases for many of the assertions and methods in the ER have already been reviewed favorably by both SC&A and the ABRWH

Source characterization

- Radioactive materials (sealed or unsealed) vs. radiation generators
  - Neutron generators (NGs) containing tritium targets
  - Radioisotope-powered thermoelectric generators (RTGs) containing plutonium dioxide
  - Borosilicate glass structures containing uranium
  - Leak-testing systems containing krypton-85
  - Tritium storage systems, which may also contain uranium beds
  - Check sources and analytical standards for lab analyses
- Potentially dispersible radioisotopes: tritium, carbon-14, nickel-63, krypton-85, plutonium-238 and -239, uranium-234, -235, and -238,

Potential external exposures

- Photon
  - NG production area
  - RTG production area
  - Chemistry lab
- Beta (electron)
  - Tritium (primary source)
  - Kr-85 (leak detection)
  - C-14 (tracer in solvents)
- Neutron
  - NGs (intermittent)
  - RTGs (continuous)

The ER claims: "While radioactive material and radiation-generating devices were necessary to the product manufacturing, the majority of the work performed at the Pinellas Plant did not involve exposures to external sources of radiation. This lack of external exposure potential is why the Pinellas Plant did not monitor many workers for external exposures."

Potential internal exposure radionuclides

- Tritium
- Uranium
- Plutonium
- Carbon-14
- Krypton-85
- Strontium-90
- Cobalt-60
- Thallium-204

Tritium internal exposure potential

- ER asserts tritium is the only source of internal exposure risk
- ER references internal dosimetry TBD for guidance on reconstructing doses from soluble tritium—gas, oxide, organically bound tritium (OBT)—from bioassays, which:
  - Calculates exposures to both 100% tritium gas and 100% OBT and selects the most claimant favorable
  - Assumes workers exposed to insoluble tritium compounds (metal tritides) were also exposed to soluble tritium, which was monitored
- Claimant-favorable approach: Although workers probably had limited exposures to insoluble tritium compounds, NIOSH assesses all workers monitored for soluble tritium as though they were exposed to insoluble tritium at the same time

Tritium exposure review

- Potential tritium exposure and how to determine dose has been a subject of concern and scrutiny since SC&A's earliest TBD review, which resulted in 2 primary and 1 secondary issues
- Subsequent discussions, papers, and reviews closed all issues except for Primary Issue 2 (potential doses from insoluble metal tritides not sufficiently addressed), which was put in abeyance pending NIOSH revising the internal dosimetry TBD
- SC&A and the Pinellas Work Group (WG) accepted NIOSH's tritium dose reconstruction (DR) methods, except for issue 2

Stable metal tritide issue

- ORAUT-OTIB-0066, "Calculation of Dose from Intakes of Special Tritium Compounds" (rev. 01, 2020), provides background on the issue associated with determining doses from SMT exposures:

  > Stable metal tritides (SMTs) are a class of tritium compounds that cannot be detected by urine bioassay as easily as tritium oxide. "Stable" is used to indicate that the tritium is not easily separated from the metal matrix in which it is bound. This material is more strongly retained in the lung, resulting in much smaller fractions of the intake excreted in urine. Therefore, a relatively small amount of tritium in a urine sample can indicate a large intake of an SMT.

- All issues closed by the Subcommittee for Procedure Reviews (SPR) 11/3/2021 meeting.

OTIB-0066, rev. 01, and internal dose TBD

- OTIB-0066, rev. 01, was reviewed by SC&A, all issues closed, and methodology accepted by the SPR at its 11/3/2021 meeting
- The revised OTIB-0066 removed the recommendation to use ORAUT-OTIB-011 for assessing OBT exposures and added a discussion on interpreting urinalysis results following assumed intake of SMTs
- The current internal dose TBD (rev. 03) was issued in 2016, before OTIB-ORAUT-0066 (rev. 01)

Uranium internal exposure potential

- Depleted uranium (DU) was used in tritium storage beds.
- Secondary issue 8 from the original SC&A TBD review concerns the potential for missed DU intakes from inhalation of loose DU from cutting and machining of the beds.
  - A NIOSH investigation and SC&A review established that such activities were conducted off site at a GE plant in Milwaukee, not at Pinellas.
- Pinellas used borosilicate glass containing 1.5% by weight of naturally occurring uranium oxide (U_3O_8).
  - As part of plant operations, this glass was cut and chemically etched.
  - Site health physicists evaluated the exposure risk and determined that minimal external and no internal hazards were present.

Plutonium internal exposure potential

- The Pu issue has been discussed since SC&A's initial review of the site profile in 2006. As of 2016, the issue was resolved as follows:
  - Pinellas received triply encapsulated RTGs and did not open them, so the only chance of exposure was from surface contamination.
  - Surface contamination levels of the capsules were quite low.
  - At its October 2011 meeting, the WG considered the issue resolved and that no further consideration is necessary unless new information becomes available.
- For this SEC ER review, SC&A revisited the potential for Pu exposure, beginning with a more detailed look at the form, handling, and plant operations involving Pu, and concluded that the potential for Pu intakes has been adequately addressed and resolved.

Carbon-14 internal exposure potential

- According to the State of Florida Dept. of Health and Rehabilitative Services, approximately 0.00034 Ci of C-14 were released from plant stacks 1979–1983.
- The potential for C-14 internal exposure was identified by SC&A in its site profile review and discussed at the June 2009 Pinellas WG meeting.
  - The quantity of material released was determined to be negligible and contributed less than 1 mrem/year dose.
  - At the meeting, the Pinellas WG considered this issue resolved.
- Unless new information is identified, SC&A believes the potential for C-14 intakes has been resolved. C-14 does not contribute significantly to the internal dose hazard on site.

Krypton-85 internal exposure potential

- According to the State of Florida Dept. of Health and Rehabilitative Services, approximately 846 Ci of Kr-85 were released from plant stacks 1963–1992.
- As a noble gas, Kr-85 does not react chemically within the body and, when it is breathed in, it is soon breathed out. Since it has a 10.8-year half-life, little decay would occur in the lungs.
- The ER asserts that Kr-85 is not a significant internal exposure hazard.
- SC&A reviewed the ER's assumption and concurs.

Strontium-90, cobalt-60, and thallium-204

- The petition requests that Pinellas be added to the SEC partly based on the claim of incomplete radiological characterization of Sr-90, Co-60, TI-204, and beryllium (beryllium is an element, not a radionuclide).
- SC&A did not find that the presence of the three radionuclides in the Pinellas inventory represents a sufficient internal exposure risk that should have been monitored for by Pinellas.
  - All Co-60 and TI-204 sources were sealed (not loose), so there was no potential for direct exposure unless there was leakage. (A Co-60 leakage in 1961 was found by a routine survey and corrected immediately.)
  - Sr-90 was present in both sealed and unsealed forms. However, the unsealed sources were small.
  - While these radionuclides can be used in RTGs, no evidence has been found so far that such was the case at Pinellas.

Radiation monitoring

SC&A reviewed the radiation monitoring data available for two time periods: before and after the 1990 Tiger Team review.

- SEC period: 1957–1990
- Post-SEC period: 1991–1997

Rad monitoring: SEC period 1957–1990 (ER)

The ER states for the SEC period:

- Both external and internal dosimetry results are available, and the available data extend beyond 1981.
- Claimant records provided by DOE generally include both internal and external dosimetry results for potentially exposed workers.
- Pinellas did monitor potentially exposed personnel and did not find indications of lack of monitoring for the class under evaluation.
- NIOSH concludes that it has sufficient data to perform dose reconstructions.

Rad monitoring: SEC period 1957–1990

- During its review, SC&A did not have access to the searchable NOCTS database to analyze claimant data. As a workaround, SC&A manually reviewed the list of ~2,500 documents made available by NIOSH.
- SC&A reviewed those documents that, based on their titles, could potentially contain bioassay or external dose data.
  - The data contain tritium and some plutonium bioassay results as well as external monitoring records for photons, betas, and neutrons as applicable.
  - SC&A cannot make a definitive judgment on the adequacy of the internal dosimetry data during the SEC period at the time of this review.

Rad monitoring: post-SEC period 1991–1997

- NIOSH ended the petitioner-requested SEC period at 12/31/1990 because Pinellas significantly improved its monitoring performance post-Tiger Team.
- Bioassay compliance tracking results 1990–1995: The annual ALARA reports showed improvements in compliance.
  - For example, the 1990 report states that the bioassay program average participation was 78%.

Rad monitoring: SC&A observations

After examining the available bioassay data, SC&A had two observations:

- **Observation 4:** Lack of bioassay records for 1988–1990. Few records (3–10 claimants per year) available for approx. 1,750 employees.
- **Observation 5:** Bioassay schedule noncompliance. Appropriate bioassay compliance levels is a subjective judgment to be made by the Board. NIOSH should demonstrate that an appropriate co-exposure model can be constructed to address incompleteness in the tritium bioassay program.

Rad monitoring: post-SEC period – Tiger Team

The 1990 Tiger Team report made several relevant comments that SC&A captured in observations 6–11:

- **Observation 6:** Praise for the overall radiological protection program at Pinellas for providing adequate radiological protection for all employees
- **Observation 7:** Bioassay sampling frequency requirements not followed
- **Observation 8:** Contamination controls generally good
- **Observation 9:** Bioassay sampling program implementation inadequacies
- **Observation 10:** Deficiencies root causes: mindset of production and no unusual risks
- **Observation 11:** Transition year of 1990 after assessment led to overall reduced exposures

Computer-assisted telephone interviews (CATIs)

- SC&A reviewed 490 available CATI reports for indications of internal and external monitoring and incidents and their followups
- SC&A did not have access to individual claimant monitoring files to compare CATI statements to relevant dosimetry records
- 16% of the CATIs indicated that the EE was involved in a radiological incident
- 38% of the CATIs stated that the EE received urinalysis after the incident
- Of the CATIs that were completed with the EE themselves:
  - 46% recalled being internally monitored and 45% externally monitored
  - 27% did not recall if they were involved in an incident
- Therefore, the number of EEs involved in incidents might be underestimated if using CATI information alone

Dose reconstruction cases

- As part of its work with the Subcommittee for Dose Reconstruction Reviews, SC&A had reviewed a few Pinellas cases.
- SC&A summarized the monitoring history of each individual and compared it with the CATI reports and internal monitoring NOCTS history.
- Due to the limited available data, this comparison cannot be used to tell if the records are complete, but it can be used more broadly to identify the presence or absence of records in the EE's files.
- The comparison shows that, for this limited sample, internal monitoring records match the claimant recollections reported in the CATI.
- The external monitoring results are less conclusive: Several claimants reported being externally monitored, while the external data were not available at the time of the DR. SC&A did not have access to NOCTS to check if these records have since been located.

Recordkeeping procedures

- SC&A reviewed the procedure used for obtaining claimant records and found that occasionally all the claimants' records and other information are not contained in the files that DOE sends to NIOSH following a record request from NIOSH.
- NIOSH has placed, and is still placing, these documents in the SRDB system.
- Upon receipt of new information for a noncompensated, completed DR, NIOSH reworks the case to ascertain any impacts.

Documented communications with former workers

- SC&A evaluated available interview summaries to determine if they contain information pertinent to the SEC evaluation.
- Appendix C to SC&A's review report summarizes these interviews.
- The interviews reflect the total period Pinellas operated and encompass a broad range of professions.
- Observation 12: SC&A believes that the recollections reported in the interviews, in general, are consistent with those in the ER.

Petitioner concerns

- The ER identifies and addresses 9 different concerns extracted from the SEC petition. SC&A also examined the petition and categorized the same set of concerns into 12 different issues.
- SC&A determined that each of the 12 issues was addressed by NIOSH to various extents in the ER, although not always explicitly point-by-point.
- The issues related to DR were not explicitly addressed in the ER, but the common practice employed by NIOSH is to assign job titles, work locations, and work processes for any given year or dosimetry exchange period based on the information provided by the claimant or in the employment records. When in doubt, NIOSH assigns parameters that yield the highest doses.

Additional petitioner concerns

- The petitioners or their representatives also made several additional submittals after the petition was received up to (and beyond) the time SC&A was preparing this review.
- SC&A preliminarily looked at submittals made after the December 2022 Board meeting (which had a session on the Pinellas petition, the ER, and SC&A's progress in evaluating the ER), up to the beginning of March 2023.
- These new concerns and submittals through March 2023 involved subjects such as: "leaking" Pu, multiple myeloma study, history of radiologic incidents report, metal tritides, the occupational internal dose TBD, the "Pinellas Plant Environmental Baseline Report," a request to investigate a report on cancer incidence in Pinellas County, and some nontechnical or not relevant communications.

SC&A review: Observations overview

- SC&A has no findings but 13 observations.
- SC&A is especially concerned about compliance with bioassay program requirements before the Tiger Team assessment in 1990
  - Summarized in observations 2, 4, 5, 7, and 9

Observation summary (1–2)

- **Observation 1: Neutron generator production was fairly steady.** SC&A reviewed NG production from 1974 through 1993 and found it fairly steady.

- **Observation 2: Potential for tritium contamination is adequately addressed.** Key aspect 4 of the NIOSH SMT model indicates that SMT exposures would only be applied if the worker were also monitored via urinalysis. However, given the uncertainties noted by the Tiger Team in the performance of the bioassay program as late as 1990, relying on bioassay completeness to establish exposure potential is likely inappropriate.

Observation summary (3–4)

- **Observation 3: The ER does not reference recent special tritium compound document.** Neither the ER nor the internal dosimetry TBD incorporate guidance for dose reconstruction for intakes of SMTs from revision 1 of ORAUT-OTIB-0066. NIOSH should evaluate whether it has any consequential effects on the ER.
- **Observation 4: Lack of bioassay records for 1988–1990.** Despite between 129 and 201 employees reportedly bioassayed from 1988 to 1990, NIOSH only has monitoring records for 3-10 claimants per year. According to the Tiger Team report, approximately 1,750 people were employed at Pinellas in 1989.

Observation summary (5–6)

- **Observation 5: Bioassay schedule noncompliance by the plant.** This was one of the principal Tiger Team findings. In addition, the level of compliance with the bioassay program is unknown for prior years. SC&A believes that NIOSH should demonstrate that an appropriate co-exposure model can be constructed to address apparent incompleteness.

- **Observation 6: Radiological protection program commended by Tiger Team.** The Tiger Team report stated that its overall assessment was that all levels of the organization are receiving adequate radiological protection.

Observation summary (7–9)

- **Observation 7: Bioassay sampling frequency requirements not followed as noted by the Tiger Team.** The Tiger Team compliments the plant for maintaining low overall internal dose exposures but also makes a finding on noncompliance issues. This is one of the bases of the SEC petition.
- **Observation 8: Contamination controls found generally good by Tiger Team.**
- **Observation 9: Bioassay sampling program implementation inadequacies noted by the Tiger Team.** 20% of personnel terminated in 1988 did not provide a sample. In 1989, 70% of the required monthly samples and 35% of the required weekly samples were not submitted. This is one of the bases of the SEC petition.

Observation summary (10–11)

- **Observation 10: Tiger Team assessment of deficiency root causes: emphasis on production and mindset that Pinellas poses no unusual radiological risks.** The Tiger Team report states that:
  - Emphasis on production has traditionally overshadowed interest in fully complying with environment, safety, and health requirements.
  - There is a wideset mindset that the Pinellas Plant poses no unusual or unique risks.

- **Observation 11: Transition year of 1990 after Tiger Team assessment led to overall reduced exposures.** Data indicate a significant decrease in external doses from 1990 to 1991, but an increase in internal doses from tritium from 1990 to 1991 (due to an incident), then a gradually decreasing trend from 1992 to 1995. SC&A has not found indications that there are issues with exposure records that would prevent DR feasibility for the SEC period 1957–1990, nor for 1991–1997.

Observation summary (12–13)

- **Observation 12: ER is consistent with interview records.** SC&A reviewed all available documented communications records that reflect the total period operated and encompass a broad range of jobs. In general, the workers in physics, engineering, chemistry, and lab-related professions had experience with the site's internal and external monitoring program. The recollections from these interviews are consistent with the ER.

- **Observation 13: Pinellas plant diligent in following up on contamination-related incidents and personnel exposures.** SC&A concurs with the conclusion in the ER. However, given the lack of bioassay records for 1988–1990 described in observation 4 and the issues surrounding bioassay noncompliance described in observations 5, 7, and 9, it is possible that the program might not have captured all the internal exposures related to contamination incidents.

Potential path forward (if tasked by WG)

Evaluate all new data from data collection activities made available after this report was produced

Respond to any new reports, presentations, etc.

Revise ER review incorporating all new information

Questions?