

**REMAINING HANFORD SEC ISSUES  
FOR SEC PETITION SEC-00057-2 and SEC-00152**

*Prepared by SC&A*

*Updated August 19, 2011*

This is the second update of the Hanford SEC matrix. The first update was in November 2009 (SC&A 2009); it was prepared following the Board's October 22–24, 2009, meeting at which it accepted NIOSH's recommendation that the SEC be extended to June 30, 1972, to cover all eligible Hanford workers, provided they meet the health endangerment requirement of 250 days or more of qualified employment. As a result, issues up to June 30, 1972, were no longer relevant for further SEC review. The matrix revision of October 2009 reflected this fact. SC&A was not asked to review SEC Petition SEC-00152, since that was an "83.14" petition initiated by NIOSH to recommend an addition to the Hanford SEC.

The period covered by SEC Petition SEC-00057-2 extends to December 31, 1990. At the time of the October 2009 meeting, NIOSH had reserved judgment about the feasibility of dose reconstruction for the rest of the SEC-00057-2 period from July 1, 1972, to December 31, 1990. In 2010, NIOSH published a revised Technical Basis Document (TBD) for Hanford in which the dose reconstruction methods for all aspects of dose were set forth, taking into account the NIOSH findings in its SEC Evaluation Reports. The updated TBD also discussed the period in Petition SEC-00057-2 remaining to be addressed by NIOSH. SC&A was asked by the Advisory Board to review the revised TBD in light of the outstanding issues that had not yet been addressed at the time of the matrix update in October 2009. SC&A was also asked to not evaluate any dose reconstruction methods in the TBD that were not in the remaining SEC period from July 1, 1972, to December 31, 1990.

The matrix below updates the November 2009 matrix (SCA 2009) based on the review of the 2010 TBD (ORAUT 2010a through ORAUT 2010f). In the process, SC&A also reviewed the internal dose database, as well as a variety of Hanford documents in the Site Research Database. The main purpose was to examine whether NIOSH had established the feasibility of dose reconstruction for the outstanding matrix issues and, if not, what concerns still remained. SC&A completed its review in July 2011 and the report is in the process of being reviewed by the Department of Energy (DOE). This matrix update is based on the findings of that review.

---

*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.*

## Hanford SEC Issues Matrix – Draft Preliminary SC&A Assessment

Issue number and description	NIOSH ER Position (SC&A Reading)	SC&A Statement	SC&A update July 10, 2011 For the July 1, 1972, to December 31, 1990 period
1. Thorium-232 internal exposure from Sept. 1, 1946, up to December 31, 1959	SEC proposed for Buildings 313, 306, 3722, 3706	Buildings and locations other than the ones listed in the NIOSH ER appear to be involved, for instance, and 303-K, 305 Test Pile, 314, 321, 3307 A and B (change houses with thorium contamination), and Sites 300-33 and 300-26, sites with thorium contaminated soil. The 100 Area was also involved in thorium work; for instance, 105-D and 105-H reactors (there was a slug failure in the latter in 1954). The use of the REDOX facility (202-S) for U-233 separation from irradiated Th-232 slugs was evaluated in 1955. Workers moved within an area without a record being maintained on a day-to-day basis. Many workers were roving workers and/or construction workers.	This issue is resolved.
2. Americium-241 internal exposure, January 1, 1949 to December 31, 1968	SEC proposed for Buildings 231-Z, 242-Z and 234-5Z	Buildings and locations other than the ones listed in the NIOSH ER appear to have been involved. 303-C was used for americium storage. There was Am-241 separation in Building 325. The 216 series cribs and ditches were used for discharge of wastes from the Plutonium Finishing Plant. Workers moved within an area without a record being maintained on a day-to-day basis. Many workers were roving workers and/or construction workers.	This issue is resolved.
3. Thorium-232 internal exposure from January 1, 1960, onward.	The ER assumes that sufficient Th in-vivo data exist, and that dose reconstruction can be done. OTIB-0039 proposes to estimate Th intakes based on uranium intakes. NIOSH investigating further.	The REX database summary in the ER contains no Th data points until 1969, very few scattered data points from 1970 to 1981, and none after that. Data adequacy not established. Validity of using U intakes for Th intake estimation not established.	Data are not adequate from up to at least December 31, 1979. Production and exposure potential may have been intermittent. Validity of uranium bioassay use for Th dose not established by NIOSH.

## Hanford SEC Issues Matrix – Draft Preliminary SC&A Assessment

Issue number and description	NIOSH ER Position (SC&A Reading)	SC&A Statement	SC&A update July 10, 2011 For the July 1, 1972, to December 31, 1990 period
4. HEU – uranium intake estimation	ER does not discuss potential for HEU exposure.	HEU was used at Hanford at various times. Only fluorometric urine data for uranium are available until 1983, preventing an estimation of U isotopic composition. HEU was used in early tritium and U-233 production (1949–1954), for reactor power enhancement (to June 1958), and possibly in the mid-1960s for U-233 production (N reactor). Some R&D uses continued into the 1980s. J and C slugs containing HEU were canned at Hanford. Fluorometric data are generally not adequate to estimate exposure to HEU in a context where most exposure to most workers was to low enriched or natural uranium.	Scattered handling of and experiments with HEU continued past June 30, 1972. NIOSH needs to demonstrate that location data exist to interpret fluorometry data, or that sufficient in-vivo U-235 data exist for dose reconstruction and coworker modeling.
5. Uranium intake estimation prior to 1948	ER considers Hanford U data prior to 1948 unreliable and back-extrapolation of later data to be scientifically inappropriate due to changes in equipment and methods. The ER proposes to use AWE data for this period.	Equivalence of the use of AWE uranium data for the experimental and early production processes has not been demonstrated to be bounding or suitable for Hanford circumstances in an SEC context.	This issue is resolved.
6. Uranium intake estimation to 1990 for unmonitored workers	The ER proposes using coworker data.	Adequacy of coworker model (Table 6-3 in OTIB-0039) remains to be established in the SEC context.	Uranium bioassay data are adequate for dose reconstruction and coworker models. Some revisions are needed to ensure that NIOSH’s approach is claimant favorable.
7. U-233 intakes	The ER proposes using the highest U-233 intake estimate.	Adequacy of U-233 internal monitoring data and data for associated contaminants to determine bounding dose (or a dose estimated with greater accuracy) needs to be examined as a potential SEC issue. The history of U-233 production and separation also needs evaluation in the SEC context.	NIOSH should determine whether any post 1972 thorium pellets were irradiated to make and separate U-233. SC&A has not found evidence for that.

## Hanford SEC Issues Matrix – Draft Preliminary SC&A Assessment

Issue number and description	NIOSH ER Position (SC&A Reading)	SC&A Statement	SC&A update July 10, 2011 For the July 1, 1972, to December 31, 1990 period
8. Recycled uranium intake estimation.	The ER does not discuss intakes of contaminants in RU. The TBD has some data, with the earliest dating from 1988.	Exposure to the trace contaminants in RU may be a potential SEC issue starting in 1952, when RU was recovered at Hanford from the high-level waste tanks. The potential ending time would need further study. Adequacy of the RU contaminant table in ORAUT-TKBS-0006-5 (Vol. 5, Rev. 01, Table 5.32.5-2, p. 24)) needs to be examined in light of 42 CFR 83 requirements, and historical data at Hanford indicating higher contaminant levels. Some data indicate higher levels of trace contaminants in the early period than are shown in the TBD table.	Data from 1970–1972 exist for estimating claimant favorable trace contaminant ratios. NIOSH should use these data instead of late 1980s data.
9. Neptunium-237 intakes, 1958 to 1972	The ER states that, “Plutonium[-238] bioassay was considered sufficient to monitor for neptunium intakes” (p. 41).	The validity of the suggested approach has not been established, especially in the context that Hanford handled separated Np. Only four Np bioassay samples exist for 1972 (REX database summary) and none before that.	Neptunium data are sparse. Neptunium separation was done at least until the end of 1972. Later neptunium processing was discussed, but it is unclear if it took place. This issue needs to be definitively settled. NIOSH should provide a technical basis for the dose assignment using an Np-Pu relationship.
10. Tritium intake estimation from 1949 onwards	The ER states that data are available from 1949 onward and that they are sufficient for coworker dose determination.	The REX database shows no tritium samples until 1982. SC&A awaits the results of NIOSH’s data capture efforts on this issue.	Inadequate technical justification for 1972–1981 coworker intake. Specific worker model needed for July 1, 1972, to June 30, 1973 (production period). OBT and tritide exposure potential not defined and coworker models not provided.
11. Promethium-147	The ER contains a discussion of processes involving promethium, but has no discussion of dose reconstruction methods.	The REX database has promethium bioassay data from 1966 onward. Promethium processing may have started in 1962, and possibly earlier. Feasibility of dose reconstruction remains to be established, at least to 1966. Adequacy of data needs to be investigated from 1966 onwards. The coworker model does not address pre-1966 exposures or roving worker exposures (for workers not based in Buildings 308 or 325).	Contrary to the TBD, Pm-147 occurred during 1972–1975. NIOSH intake assignment is not claimant favorable. Incidents are documented. NIOSH needs to address dose reconstruction for Pm-147 incidents.

## Hanford SEC Issues Matrix – Draft Preliminary SC&A Assessment

Issue number and description	NIOSH ER Position (SC&A Reading)	SC&A Statement	SC&A update July 10, 2011 For the July 1, 1972, to December 31, 1990 period
12. Sr-90, Cs- 137, MFP intake estimation	Prior to 1965, the approach suggested is use of mixed fission product and Cs-137 data. The ER states mixed fission product urinalysis started in 1947; “erratic until 1948” (p. 39)	<ul style="list-style-type: none"> <li>• Dose reconstruction feasibility before 1948 is a potential issue.</li> <li>• The REX database summary shows no fission product data prior to 1974. Use of the REX database for the early years needs to be assessed for possible changes in processes and validity of back extrapolation, and for its use in coworker dose estimation.</li> <li>• Sr-90 bioassay data available from 1965 onwards.</li> <li>• Cs-137 whole-body count data available from 1960 onward (according to the ER), but no data points in REX until 1972.</li> </ul>	<p>Ample data are available, except in certain years. Quality of data needs to be addressed, as MDA was not met in certain years. Audits for 1970s not found. Not clear if they were done.</p> <p>Sr-90 intake assignment is not claimant favorable. Sr-90 and Cs-137 intakes need to be developed in light of Cs and Sr separation and encapsulation programs. Tank farm worker data are sparse to the end of 1977. Comparability of exposure conditions for intake estimation needs to be examined.</p> <p>Coworker model is suitable for reactor areas, but may not be for 200 and 300 Areas.</p>
13. Tank Farm alpha contamination	The ER does not explicitly discuss this issue.	Site expert interviews indicate that tank farm exposures, including alpha-emitting radionuclide intakes (such as those from resuspension), may have been missed.	Tank farm data issues addressed as part of other matrix items, notably item 12.
14. Plutonium intake estimation	The ER has an extensive discussion of data and dose reconstruction approach.	May not be an SEC issue. Frequency of Pu urinalysis fell sharply in the late 1950s. Minimum detection limits were variable (higher in earlier years). Coworker models need to be evaluated from an SEC standpoint (e.g., adequacy of the REX database for coworker models).	<p>Super S intake not addressed. MDA not met in 1981. Audits for 1970s not found. Implications for dose reconstruction and missed dose assignment need review. Unclear if extending 1987 into 1988 and 1989 is appropriate. Method of redacting incident-related samples may result in underestimate of dose.</p>
15. Hot particle ingestion	The ER does not discuss this issue	Ingestion of hot particles could be an issue for 1947 and 1948 T and B plant emissions and for 1952–1955 REDOX plant emissions (TBD Vol. 4 Rev. 2, p. 27).	This issue is resolved.

## Hanford SEC Issues Matrix – Draft Preliminary SC&A Assessment

Issue number and description	NIOSH ER Position (SC&A Reading)	SC&A Statement	SC&A update July 10, 2011 For the July 1, 1972, to December 31, 1990 period
16. Cm-244	The ER states, “However, extraction of curium-244 from high-level waste occurred at the 325 Building sometime in the 1970s. Since the curium and americium procedures were the same, the results would have been reported as curium only, if so requested through the bioassay request system....”	Significant amounts of Cm-244 (65 grams—more than 5,000 curies) appear to have been processed in the 1960s in Building 325 (Gerber, M.S. 1993. <i>Multiple Missions: The 300 Area in Hanford Site History</i> , WHC-MR-0440, Westinghouse Hanford Company, Richland, Washington. September 1993, p. 23). Earliest Cm-244 data in the REX database summary in the ER are from 1968 (6 data points), after which there are 8 more in 1974. NIOSH has not presented a DR method for estimating Cm-244 intakes during the campaign that purified 65 grams in the 1960s.	Exposure potential existed until at least 1978. No data for 1973. Sparse up to 1983. Coworker model may be feasible for 1984–1990. NIOSH has not given adequate justification for using Pu data for Np intake.
17. Neutron doses to December 31, 1971 (after which TLDs were introduced)	ER proposes to use: <ul style="list-style-type: none"> <li>• n/p ratios until 1958.</li> <li>• Adjusted NTA film data, to end of 1971</li> </ul> NIOSH is engaged in an extensive neutron-related data capture effort.	Issues: <ul style="list-style-type: none"> <li>• Validity of n/p ratios for specific time and work location</li> <li>• Adjustment factor accuracy and/or bounding value</li> <li>• Area coverage of neutron monitoring</li> <li>• Construction worker neutron monitoring, since there is a claim in the petition that some construction workers were not monitored for neutrons (OTIB-0052 for construction workers did not address neutron doses)</li> </ul>	This issue is resolved.

## Hanford SEC Issues Matrix – Draft Preliminary SC&A Assessment

Issue number and description	NIOSH ER Position (SC&A Reading)	SC&A Statement	SC&A update July 10, 2011 For the July 1, 1972, to December 31, 1990 period
18. External exposure geometry	The ER does not explicitly discuss this issue.	Site expert evidence indicates significant geometry issues in some circumstances that may prevent film badge or TLD from registering relevant organ dose.	This is a site profile issue.
19. Lack of adequate monitoring: Petitioner issue	The ER discusses this in Section 7.4 and bases dose reconstruction feasibility on coworker models	Coworker model adequacy from the SEC point of view needs to be evaluated in general and specifically in light of petitioner affidavits.	External data are adequate. Internal data addressed in other matrix items.
20. Skin contamination	The ER and TBD describe skin dose and extremity dose monitoring and assignment.	Site expert interviews indicate unusual potential for skin exposure in some maintenance work. This needs to be evaluated against available data. TBD discusses hot particle skin dose. Validity of skin dose coefficients in the Hanford external dose TBD (Rev. 3) needs to be investigated. Hot particle skin doses need to be evaluated for 1947–1948 and 1952–1954.	This issue is joined with item 22 below, since it relates to incidents. Routine exposure is captured by dosimeters.
21. Missing records – routine (Petitioner issue)	The ER refers to the coworker model OTIB-0052 for construction workers and general guidance to fill in doses corresponding to missing records.	SEC-specific analysis for Hanford is needed to verify that the approaches specified are bounding doses (or more accurate than bounding doses) for all members of the proposed class.	Review of box labels of destroyed records indicates vast majority are not relevant or pre-July 1, 1972. Some boxes do not have clear date for contents. Some boxes may have had relevant data. Unclear if duplicates exist.
22. Missing incident records	The ER does not explicitly address this issue.	DOE files of claimants who have affidavits in the Petition need to be examined. Data completeness for incidents needs to be checked. This also links to potential destruction of records and existence of duplicate records. Specific incidents need to be evaluated, including a criticality in the 1950s.	Individual DOE-supplied claimant records examined contain almost all incidents mentioned in CATIs or in REX database. The REX database is not detailed regarding incidents. No pattern of omitting incidents from personnel records was detected.

## Hanford SEC Issues Matrix – Draft Preliminary SC&A Assessment

Issue number and description	NIOSH ER Position (SC&A Reading)	SC&A Statement	SC&A update July 10, 2011 For the July 1, 1972, to December 31, 1990 period
23. REX database adequacy and representativeness for coworker models	The ER acknowledges that the REX database is not complete for early-year data, but that other reports provide the data in question.	Coworker models are based on the REX database. The representativeness of the REX database for estimating coworker doses needs to be examined in the SEC context.	This issue is addressed in the other matrix items.
24. Polonium-210	Bismuth was irradiated at Hanford starting in 1945, but separation and processing did not begin till 1968, from which date bioassay data are available.	Verification of no processing of irradiated bismuth target rods before 1968 is needed.	This issue is resolved.
25. Miscellaneous radionuclides (e.g., Cr-51, Ru-106, Ce-144, Co-60)	The ER relies on the internal dose TBD.	Adequacy of the TBD approach for bounding doses needs to be assessed.	MDA for several radionuclides not met in 1981. Earlier audits not found (not clear if they were done). Later audits do not address these radionuclides. Some radionuclides have adequate data from 1983 or 1984 (e.g., Co-60). Coworker model is needed for MFP and activation products for the 200 Area, including tank farm workers, and in waste handling and processing buildings in the 300 Area.
26. Data completeness	The ER cites individual dose records and other sources of data. Principal reliance is on individual dose records for the most part.	Completeness of individual dose records may need investigation.	This item has been subsumed into the other matrix items.

## Hanford SEC Issues Matrix – Draft Preliminary SC&A Assessment

Issue number and description	NIOSH ER Position (SC&A Reading)	SC&A Statement	SC&A update July 10, 2011 For the July 1, 1972, to December 31, 1990 period
27. Building 324 leaks	N/A	<p>There were leaks of high-level waste in the A-, B- and C-Cells, Building 324. The B-Cell leak resulted in soil contamination, discovered in 2010 during decommissioning. SC&amp;A was asked to investigate the issue but only for the remaining SEC period, July 1, 1972 to December 31, 1990. This item was submitted to the WG by the public during the SEC review process.</p>	<p>There were leaks of high-level waste in B-Cell, Building 324, including a major spill, reportedly in 1986. Decontamination of B cell began in the late 1980s. SC&amp;A conducted interviews. HP coverage was reportedly good. Mixed fission product monitoring data exist for the mid-1980s when the major B-Cell spill occurred. Some specific radionuclides may not have data. There were earlier leaks under A- and C-Cells. The soil under B-Cell was found to be contaminated in 2010. NIOSH should verify whether the workers involved, including those dealing with the A- and C-Cell leaks, were monitored and whether the data that exist can be used with claimant-favorable assumptions to estimate the incident-related doses.</p>

## Hanford SEC Issues Matrix – Draft Preliminary SC&A Assessment

### References

ORAUT 2010a. *Hanford Site – Introduction*, ORAUT-TKBS-0006-1, Rev. 04, Oak Ridge Associated Universities, Cincinnati, Ohio. March 2010.

ORAUT 2010b. *Hanford Site – Site Description*, ORAUT-TKBS-0006-2, Rev. 02, Oak Ridge Associated Universities, Cincinnati, Ohio. February 2010.

ORAUT 2010c. *Hanford Site – Occupational Medical Dose*, ORAUT-TKBS-0006-3, Rev. 02, Oak Ridge Associated Universities, Cincinnati, Ohio. January 2010.

ORAUT 2010d. *Hanford Site – Occupational Environmental Dose*, ORAUT-TKBS-0006-4, Rev. 03, Oak Ridge Associated Universities, Cincinnati, Ohio. January 2010.

ORAUT 2010e. *Hanford Site – Occupational Internal Dose*, ORAUT-TKBS-0006-5, Rev. 3, Oak Ridge Associated Universities, Cincinnati, Ohio. January 2010.

ORAUT 2010f. *Hanford Site – Occupational External Dose*, ORAUT-TKBS-0006-6, Rev. 04, Oak Ridge Associated Universities, Cincinnati, Ohio. January 2010.

SCA 2009. *Remaining Hanford SEC Issues for SEC Petition SEC-00057-2 and Petition SEC-00152: Draft Matrix Issues Update*, S. Cohen & Associates, Vienna, Virginia. November 2, 2009.