ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	1	The list of facilities in which thorium-232 was processed, the time periods of thorium processing, and the thorium production data shown in the TBD have significant gaps. Entire periods of processing and plants in which the work was done have been missed. These gaps may affect the feasibility of dose reconstruction for workers for certain time periods and in certain plants.	This is identical to SEC Issue 4.3-5. NIOSH responded as follows: *Additional thorium production documents have been located and interviews have been conducted with people knowledgeable of the thorium processes at FMPC. The knowledge gaps have largely been eliminated in the draft revision of ORAUT-TBKS-0017-5. The current default thorium intake recommendations are applicable to any location and time after 1954 in which thorium exposure is deemed reasonable... Knowledge of the process and locations of processes is now comprehensive, based on interviews, documents, and additional research… See the Thorium Timeline with AA 2-29-07.doc in the following directory O:\Document Review\AB Document Review\Fernald.* All plants for 1955 and 1966 and plant 6 for 1960 were identified by the work group as the buildings and the time periods that will be used to create the database and demonstrate its completeness and reliability for performing dose reconstructions. The work group agreed that it was not necessary to create such a compendium of data and analyses for all buildings and work years, given the magnitude of the effort, and that the selected years should provide the evidence that such a coworker model can, in fact, be developed and implemented. This was resolved for 1954–1967 in primary SEC Issues 6a and 6b. April 2012 – SEC voted based on inadequacy of the activity to mass conversion algorithm from 1968–1978. 1979–1988 – Implementation of a coworker model is an ongoing site profile issue. July 2013 – SEC voted for all workers 1954–1967 based on inability to reconstruct intakes of th-232 with sufficient accuracy from DWE data.	**SC&A suggests closing this finding because the NIOSH coworker model for 1979–1988 does not employ air concentration data.** This finding pertained mainly to the availability of air sampling data pre-1968. The NIOSH coworker model for thorium-232 intakes based on activity measurements of the gamma–emitting progeny Pb-212 and Ac-228 is under discussion by the Fernald WG, last discussed at the July 1, 2013, WG meeting. **This issue is no longer relevant to the post-1978 coworker model, which is based on bioassay data. SC&A's *Completeness and Adequacy of Thorium In-Vivo Records (1979–1989),* November 2012:** ***It is clear from the completeness analysis that there are no significant temporal gaps in the in-vivo data reported in nCi Ac-227 and Pb-212 that might preclude its use in a coworker model.***	Agreed.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

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TBD	2	Air concentration data for thorium in the TBD are sparse and incomplete, though considerably more data are available in the NIOSH Site Research Database. The TBD contains no thorium-232 bioassay or in-vivo data.	This was resolved for 1954–1967 in primary SEC Issues 6a and 6b. July 2013 – SEC voted for all workers 1954–1967 based on inability to reconstruct intakes of Th-232 with sufficient accuracy from DWE data. April 2012 – SEC voted based on inadequacy of the activity to mass conversion algorithm from 1968–1978. 1979–1988 – Implementation of a coworker model is an ongoing site profile issue.	**SC&A suggests closing this finding because the NIOSH coworker model for 1979–1988 does not employ air concentration data.**	Agreed.	
TBD	3	Thorium intakes due to fugitive emissions and resuspension in production areas may have been significant for some locations and periods. The TBD does not address the issue of fugitive emissions in production areas. Furthermore, the TBD does not provide a method to estimate resuspension intakes in the pre-1986 period and for those workers without lapel air sampling in the post-1986 period.	This is identical to SEC Issue 4.3-8. NIOSH responded as follows: *Many thorium air samples, including GA samples from inside the plants, are available. These GA samples from operating areas are sure to bound the concentrations in non- operating areas. A series of contemporary time and motion studies are being considered. These studies characterize intakes for people in clerical areas inside the operating facilities. The Battelle model based on air sample data is also available. Dose reconstruction is possible, the best method is still being considered… An approach to thorium dose reconstruction has been devised using newly available thorium exposure assessments. See the DWE Reports white paper in the following directory: O:\Document Review\AB Document Review\Fernald.* This was resolved for 1954–1967 in primary SEC Issues 6a and 6b. April 2012 – SEC voted based on inadequacy of the activity to mass conversion algorithm from 1968–1978. 1979–1988 – Implementation of a coworker model is an ongoing site profile issue. July 2013 – SEC voted for all workers 1954–1967 based on inability to reconstruct intakes of Th-232 with sufficient accuracy from DWE data.	**SC&A suggests closing this finding because the NIOSH coworker model for 1979–1988 does not employ air concentration data.**	Agreed.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	4	The guidance in the TBD regarding exposures from redrumming thorium is not well founded and is not claimant favorable.	This is identical to SEC finding 4.3-7. NIOSH responded as follows: *See comments in response to Finding 4.3-1 and 4.3-6 above… Guidance will be claimant favorable and in the TBD.* This was resolved for 1954–1967 in primary SEC Issues 6a and 6b. April 2012 – SEC voted based on inadequacy of the activity to mass conversion algorithm from 1968–1978 1979–1988 – Implementation of a coworker model is an ongoing site profile issue. July 2013 – SEC voted for all workers 1954–1967 based on inability to reconstruct intakes of th-232 with sufficient accuracy from DWE data	**SC&A suggests categorizing this finding as "in abeyance." Redrumming was still an issue for the post-1978 period. We discuss redrumming in SC&A's *Completeness and Adequacy of Thorium In-Vivo Records (1979–1989)*. Basically, we don't know who performed redrumming, which is why the coworker model must be applied to all potentially exposed workers at the 95th percentile. NIOSH has agreed to do this, but we have yet to see the formal implementation.**	For the 1979-1994 timeframe, if in vivo results exist, then they will be used to reconstruct thorium dose. For 1979-1989, if there are no in vivo results, then coworker doses will be assigned. A coworker thorium study is in development). For 1990-1994, if there are no in vivo results, thorium doses can be assigned based on an intake of 10% of the derived air concentration (DAC) for the year, as appropriate.	
TBD	5	The TBD has not evaluated exposures due to thorium fires. The TBD has also not evaluated other thorium incidents or failures of industrial hygiene.	(ABRWH 2007, pg. 220) *And it's well documented, and it's also accepted by NIOSH that small fires, spills, explosions were commonplace. And yet it is unlikely that most of the air sampling data that you're compiling will necessarily reflect them, those radiological incidents.* This was resolved for 1954–1967 in primary SEC Issues 6a and 6b. April 2012 – SEC voted based on inadequacy of the activity to mass conversion algorithm from 1968–1978. 1979–1988 – Implementation of a coworker model is an ongoing site profile issue. July 2013 – SEC voted for all workers 1954–1967 based on inability to reconstruct intakes of Th-232 with sufficient accuracy from DWE data.	**SC&A suggests closing this finding because the NIOSH coworker model for 1979–1988 does not employ air concentration data.**	Agreed.	
TBD	6	The approach suggested for estimating thorium intakes does not reflect	This was resolved for 1954–1967 in primary SEC Issues 6a and 6b.	**SC&A suggests closing this finding because the NIOSH coworker model for 1979–1988**	Agreed.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

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		the history of production or the available thorium air concentration data. It is likely to result in significant underestimates of internal dose from thorium.	April 2012 – SEC voted based on inadequacy of the activity to mass conversion algorithm from 1968–1978. 1979–1988 – Implementation of a coworker model is an ongoing site profile issue. .July 2013 – SEC voted for all workers 1954–1967 based on inability to reconstruct intakes of Th-232 with sufficient accuracy from DWE data.	**does not employ air concentration data.**		
TBD	7	The TBD does not specify a method for estimating doses in the raffinate streams, which are uranium-poor, from ore processing in Plant 2/3. These doses may be very difficult to calculate, especially for high-grade ores, notably pitchblende ore from Congo.	**This pertains to SEC finding 4.2-2 and Primary SEC Issue #4:** "Review of radon breath data for adequacy for reconstructing doses due to the inhalation of Ra-226 and Th-230." October 14, 2008 – NIOSH responded: *NIOSH has radon breath analyses for raffinate transfer operations and air sample data in the Plant 2/3 raffinate handling area sufficient to bound possible intakes and allow claimant-favorable dose reconstructions of sufficient accuracy.* The NIOSH approach is contained in ORAUT-RPRT-0052 (ORAUT 2011). Report 52, pp. 24–25: Transfer of drummed K-65 raffinate to Silos 1 and 2 late 1952–June 53; radon breath data available. Q-11 transfer 1954-1957; subsumed in SEC. The concern for the raffinate streams can be bounded by the extensive "radon breath analyses-to-radium deposition" performed during the K-65 raffinate drum disposal operation. In addition, confirmatory air monitoring data in Plant 2/3 specific to the raffinate operations provide assurance that exposures are adequately bounded. The raffinates were wet (minimizing air contamination production) and enclosed in process piping. Other uranium daughters in addition to Ra-226 intake can be adequately bounded by rationing to Ra-226, using the isotopic analyses of the silo contents. A detailed discussion of SEC Issue 4 took place at the April 19, 2011, WG meeting (ABRWH 2011), where SC&A agreed that NIOSH's methods were bounding and sufficiently accurate.	**SEC recommends this issue be changed to "in abeyance" pending revised TBD.**	ORAUT-RPRT-0052, "Feed Materials Production Center Internal Dose Topics" provides a method for estimating raffinate streams, which will be incorporated into ORAUT-TKBS-0017-5, "Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Occupational Internal Dose," and ORAUT-TKBS-0017-4,, "Fernald Environmental Management Project – Occupational Environmental Dose," revisions. ORAUT-OTIB-25, "Estimation of Radium-226 Activity in the Body from Breath Radon-222 Measurements," which is included in ORAUT-RPT-0052, provides a method for reconstructing doses from radon breath analyses results from 1952-1954 and this methodology will be included into the internal TBD revision.	
TBD	8	Workers who may have worked with raffinates may be missed by the protocol specified in Vol.	**See response to Finding #7.**	**See response to Finding #7**.	See NIOSH Response #7.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
		5 of the TBD. The guidelines for determining which workers were exposed to raffinate dusts are too restrictive and place far too great a reliance on completeness of records for job assignments, or in the alternative, place the burden of proof on the claimant. They have not been adequately justified by measurements and are not claimant favorable.				
TBD	9	The data on trace contaminants in RU in the Fernald TBD are incomplete and appear to be incorrect. Different official documents have very different values for various aspects of RU data, including production and contamination. The contradictions have not been sorted out in the TBD.	This finding is the same as SEC finding No. 4.1-6. NIOSH responded as follows: *Some production data are admittedly conflicting. Since dose reconstruction does not depend directly on production data, sufficient data are available to enable a bounding estimate based on the ratio of RU contaminates to the uranium intake determined from the uranium urinalyses. Recommended defaults have been chosen that adequately bound all of the operational data. The shipment(s) from Paducah Gaseous Diffusion Plant were of short duration, the increased hazards were recognized and adequately controlled, and recognized as doubling the total* *inventory of RU contaminants at FMPC, which in turn was factored into the default assumptions.* After many white paper exchanges and deliberations, NIOSH demonstrated that they could place a plausible upper bound on intakes from three principal RU constituents.	**SC&A recommends finding be changed to "in abeyance" pending revised TBD.**	ORAUT-RPRT-0052, "Feed Materials Production Center Internal Dose Topics" provides an upper bound on intakes from RU constituents, which will be incorporated into ORAUT-TKBS-0017-5, "Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Occupational Internal Dose," and ORAUT-TKBS-0017-4,, "Fernald Environmental Management Project – Occupational Environmental Dose," revisions.	
TBD	10	The radionuclide list for RU in the TBD is incomplete. Furthermore, the concentrations of trace	This finding is the same as SEC finding No. 4.1-5 and SEC Primary Issue 3. NIOSH responded as follows: *Adequate material flow information is available to perform bounding analyses – with the recommended defaults being at least an order of magnitude higher than*	**SC&A notes that while NIOSH has provided a method for bounding intakes from Pu, Np-237, and Tc-99, other nuclides such as Am-241 and thorium**	ORAUT-RPRT-0052, "Feed Materials Production Center Internal Dose Topics" provides an upper bound on intakes from RU constituents and has revised ratios for	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
		radionuclides in the raffinates, which are much higher than those in the feed material, are not adequately discussed.	*the average observed contaminant concentration in the processed materials…* *…Any external dose associated with U-232 and decay products would be adequately monitored by the external dosimetry device.* After many white paper exchanges and deliberations, NIOSH demonstrated that they could place a plausible upper bound on intakes from three principal RU constituents. Subsumed into SEC pre-1979. Coworker model applicable 1979–1986 when WMCO took over M&O from NLO and for non-SEC claimants.	**isotopes are not included in the model and were not discussed in WG meetings. SC&A recommends finding remain open and that WG discuss incorporating these other RU constituents into the coworker model.**	recycled uranium constituents that will be incorporated into ORAUT-TKBS-0017-5, "Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Occupational Internal Dose," and ORAUT-TKBS-0017-4,, "Fernald Environmental Management Project – Occupational Environmental Dose," revisions.	
TBD	11	The suggested approach for RU dose estimation in the TBD is claimant favorable for many RU workers, but not claimant favorable for others and for some periods; it is not based on an evaluation of the available data.	This is similar to SEC Primary Issue #3. After many white paper exchanges and deliberations, NIOSH demonstrated that they could place a plausible upper bound on intakes from RU constituents. Subsumed into SEC pre-1979. Coworker model applicable 1979–1986 when WMCO took over M&O from NLO and for non-SEC claimants.	**SC&A recommends finding be changed to "in abeyance" until agreed upon method is incorporated into the TBD.**	ORAUT-RPRT-0052, "Feed Materials Production Center Internal Dose Topics" provides an upper bound on intakes from RU constituents for all workers, which will be incorporated into ORAUT-TKBS-0017-5, "Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Occupational Internal Dose," and ORAUT-TKBS-0017-4,, "Fernald Environmental Management Project – Occupational Environmental Dose," revisions.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	12	The TBD notes that uranium batches with enrichment greater than 2% were processed at Fernald. NIOSH's assumption of 2% enriched uranium is claimant favorable most of the time, but not for periods and batches when uranium of higher enrichments were processed.	This relates to SEC finding 4.1-4. NIOSH responded as follows: *The dose conversion factor for U-234 is applied to all uranium intakes. This results in a bias that is favorable to the claimant. The operational descriptions in the TBD are correct.* 11/11/07 – SC&A to review sample case along with default approaches (1% prior to 1964 and 2% after 1964). NIOSH to provide documentation to support the statement that most of the 'enriched' material was very slightly enriched (slightly greater than 0.71% U-235). 3/18/08 – The following documents were provided to substantiate the assumptions: 8/7/2007 interview [**redact**] and [**redact**] (ORAUT 2007a); 9-11-07 interview with [**redact**] and [**redact**] (ORAUT 2007c); 8-30-07 interview with [**redact**] and [**redact**] (ORAUT 2007b). 10/28/08 (pp. 200–217) – SC&A found documentation indicating enrichments of 3%–10%. NIOSH acknowledges that there were exceptions to normal work. SC&A agrees dose can be reconstructed if the enrichment handled is known, but questions if those workers can be identified. NIOSH proposed assigning everyone 2% unless there is documentation indicating otherwise. After lengthy discussion, the Board accepted the 2% position and closed the finding.	**Closed.**	Agreed.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	13	Female employees were not monitored for long periods at Fernald, even though at least some of them were at some risk of internal intakes of radionuclides.	This is similar to SEC finding 4.5-5. NIOSH responded as follows: *The doses to those female workers who were not monitored during two operating periods can be reconstructed by at least three methods. They are: (1) If the worker in question is doing the same or very similar job during periods when she is monitored, that dose could be used to adjust the missing dose when she wasn't monitored; (2) Workers who were doing the same job and were monitored at the time the female wasn't, could have an equivalent dose assigned to the unmonitored worker, and (3) Assignment of the missed dose as stated in the TBD-Vol 6 of 500 mrem/yr for the missing time periods, which is known to be extremely claimant favorable.* Discussed at 8/8/07 meeting – SC&A raised the concern that women who worked in the laundry were not monitored but in some cases handled highly contaminated laundry. NIOSH stated assigning them a 500 mrem dose exceeds recorded doses by operators which is claimant favorable. SC&A states default dose does not address the following: (1) the shallow dose to the skin, (2) the extremity dose to the forearm/hands, and (3) potential internal exposure from airborne contamination created by handling contaminated items. Suggested linking the internal component to SEC Finding 4.1-3. Discussed at 11/13/07 meeting. Decided this was an issue isolated to a few individuals and should be evaluated on a case-by-case basis in DR. 4/22/09 meeting: Issue closed. Decided three methods suggested are sufficient.	**Closed**	Agreed. ORAUT-OTIB-0073, "External Coworker Dosimetry Data for the Fernald Environmental Management Project," will be incorporated into ORAUT-TKBS-0017-6, Technical Basis Document for the Fernald Environmental Management Project – Occupational External Dose," and will be used for unmonitored workers. Due to changed project approaches towards unmonitored worker dose assignment, missed dose is no longer used to assign unmonitored doses and the 500 mrem upper bound dose methodology will be removed during the TBD revision process since the coworker model will bound unmonitored workers.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	14	The TBD does not address the extremely high uranium dust concentrations, which were present at Fernald under a variety of circumstances, and their effect on dose reconstruction. Particle size and solubility assumptions for workers who experienced chip fires should be examined.	Related to Primary SEC Findings 1, 2a, 2b, which have been closed. This finding was logged at a time when NIOSH had proposed using alpha air concentration data to reconstruct uranium intakes and before a U bioassay coworker model had been developed and the source data examined for completeness and adequacy. This finding is no longer relevant, because the uranium coworker model, which has been accepted by the Board (for prime contractor employees and subcontractors post-1983) is based on bioassay data, not air concentration measurements.	**SC&A recommends that this finding be closed.**	Agreed.	
TBD	15	Ingestion doses are not considered in the TBD.	Thorium ingestion is covered in SEC finding 4.3-9. NIOSH responded as follows: *Use of the intake model based on thorium air concentrations (the Battelle model) addresses this problem. Consequently, it is no longer an SEC issue. ...An approach to thorium dose reconstruction has been devised using newly available thorium exposure assessments. See the DWE Reports white paper in the following directory O:\Document Review\AB Document Review\Fernald.* 3/26/2008 – *Once a reliable estimate is made of the inhalation rate of uranium, Th-232, and the radionuclides associated with raffinates and RU, ingestion intakes and doses would be calculated using OCAS-TIB-009 Rev. 0 (OCAS 2004). Hence, once the inhalation issues are resolved, the matter of ingestion exposures effectively becomes a review of TIB-009.* This issue was partially resolved by the three SEC classes for which it was determined that thorium intakes cannot be reconstructed from 1954–1978 and U doses cannot be reconstructed for subcontractors from 1951–1983. The thorium coworker model post-1978 relies on chest count data, and ingestion modeling is still an issue for discussion.	**SC&A recommends finding be classified "open" as a topic for WG discussion.**	OCAS-TIB-009, "Estimation of Ingestion Intakes," provides an approach towards thorium ingestion doses and will be included in the ORAUT-TKBS-0017-5, "Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Occupational Internal Dose" revision.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	16	Protocols for reconstructing shallow external dose during the operations at FEMP need to be further developed.	This relates to SEC finding 4.5-3, yet is not entirely covered by it. See TBD finding 18. SC&A last tasked to look at several procedures. **From SC&A TBD review, Section 5.6.1, External Dose Reconstruction Protocols (SC&A 2006):** ***As a prefatory remark to external dose findings, SC&A notes that Findings #16 through #20 are largely concerned with skin/shallow dose. The findings are made as technical arguments, but their impacts on potential claims may be modest.*** ***For example, while skin dose to the palm of the hand is likely to be underestimated, there may be few, if any, claims of skin cancer located in that area. However, since the procedure in the TBD is not adequate for estimating such doses, in case there are any claims, SC&A concluded that a technical review of the matter was necessary as part of this TBD review.***	**SC&A recommends finding be classified "open" as a topic for WG discussion**	ORAUT-OTIB-0017, "Interpretation of Dosimetry Data for Assignment of Shallow Dose" is referenced in the ORAUT-TKBS-0017-6, Technical Basis Document for the Fernald Environmental Management Project – Occupational External Dose," revision and provides the protocols for reconstructing shallow external dose. ORAUT-OTIB-0017 was not available when ORAUT-TKBS-0017-6, "Fernald Site – Occupational External Dose," (04/20/2004) was approved.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	17	Extremity doses appear to be underestimated.	This is similar to SEC finding 4.5-2. NIOSH responded as follows: *Extremity doses were measured using "wrist dosimeters and a wrist to extremity ratio." This ratio varied with changes in the dosimeter; it decreased with the introduction of TLDs. However, previous extremity dose records were not adjusted downward to account for the new lower ratio. Consequently, extremity doses are deemed to be sufficiently accurate for dose reconstruction or are biased to produce a result that is favorable to the claimant.* 10/24/07 – SC&A will review data in HIS-20 to consider whether sufficient information is available to estimate extremity doses for individuals who did not have extremity data and who may have had significant extremity exposures. 11/12/07 – Extremity dosimeter not used till 1970. SC&A will review data in HIS-20 to consider whether sufficient information is available to estimate extremity doses for individuals who did not have extremity data and who may have had significant extremity exposures. And then additionally, SC&A will consider whether this should be considered in their review of data completeness. 10/28/08 – SC&A acknowledges that this is not an SEC issue, because extremity cancers are uncommon. Until the 1980s, energy employees (EEs) were not monitored for extremity dose. Extremity monitoring was extremely limited in early years; however, those that were monitored had substantial exposures. SC&A proposes ratio in write-up to apply to chest badge beta readings. NIOSH did not comment on adding this ratio to TBD. This issue was not discussed after this meeting.	**SC&A recommends finding be classified "open" as a topic for WG discussion.**	The ORAUT-TKBS-0017-6, "Fernald Site – Occupational External Dose" revision references DCAS-TIB-13, "Selected Geometric Exposure Scenario Considerations for External Dose Reconstruction at Uranium Facilities," and provides geometry factors for uranium dose and adjustments for wrist to hand, so that extremity doses are not underestimated. DCAS-TIB-13 was not available when ORAUT-TKBS-0017-6, "Fernald Site – Occupational External Dose," (04/20/2004) was approved.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	18	Beta dose to the rest of the body would also be underestimated, based on the TBD guidance.	This is similar to SEC finding 4.5-3. NIOSH responded as follows: *It is true that only contamination in close proximity to the dosimetry device will be recorded, because the dose rate associated with surface contamination is small— probably much less than 1 mrem/hour. In this case, the underlying physics limits the dose rate. The beta dose rate on contact with an unshielded infinitely thick slab of uranium metal is 233 mrem per hour. Knowing this fact, it is feasible to bound the dose from surface contamination. Thus, the finding assertion, "given the complex processes and the many different tasks performed at FMPC, it is inconceivable that credible 'ball-park' and bounding estimates can be derived" can only be viewed as an error or exaggeration.* *Any amount of uranium contamination capable of producing a dose rate in excess of a negligible level is likely to be easily visible and be removed during the frequent showers and clothing changes taken by those workers who may be subject to conditions leading to possible contamination, thereby limiting the dose.* 10/24/07 – NIOSH will examine whether an adjustment is necessary to account for this potential unmonitored dose. 3/18/08 – See the 1958 radiation survey on clothing reported in NLO 1959. These data are interpreted to be mrad per hour for clothing that was in use. Except for exposed skin, clothing is assumed to attenuate dose to skin and will lower the actual dose… All clothing dose rates are in mrad/hr and most measurements of attenuation yield values between 15% and 20% reduction by the clothing. FEMP 1998, pp. 177–204, provides insight to extremity doses and includes a statement that measured workplace values should be reduced by some 14%. 10/28/08 (pp. 356–365) – SC&A will review the procedures NIOSH placed on O Drive (NLO 1952; NLO 1965). Issue was not discussed after this meeting.	**SC&A recommends finding be classified "open" as a topic for WG discussion. Contact beta dose is currently under review in the PRSC.**	The majority of these issues are global issues which are being addressed through the Procedures Review Subcommittee. For known skin contaminations, VARSKIN is used. Unknown skin contaminations cannot be addressed.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	19	The TBD does not analyze the special problems associated with geometry of the source relative to the exposed organ and dosimeter in thorium handling and production.	This topic has not previously been discussed.	**SC&A recommends finding be classified "open" as a topic for WG discussion.** **Dosimeter geometry has been discussed at length in other WGs that may serve to inform this finding.**	The revision to ORAUT-TKBS-0017-6, "Fernald Site – Occupational External Dose" references DCAS-TIB-13, "Selected Geometric Exposure Scenario Considerations for External Dose Reconstruction at Uranium Facilities." Since the factor was determined by an analysis of photon fluence (not dose computation), the recommendations of the TIB would apply to workers exposed to thorium as well.	
TBD	20	Correction factors used during an initial period of use of thermoluminescent dosimeters (TLDs) at Fernald are not scientifically appropriate.	It was discussed specifically during the August 8, 2007, meeting (ABRWH 2007, pp. 321–331). Action Item: NIOSH will follow up on the doses assigned during beginning years with the use of TLD from 1983 to 1985. It was not discussed in meetings afterwards. A note in the October 2008 draft matrix indicates: *A "Status Report - NLO Health Physics Appraisal" dated 7-10-84 (to Thiessen from Adams) has been found indicating that changes to recorded doses may have* (sic) *made. Interviews are continuing to discover if additional corrections were applied.* (SC&A 2008)	**SC&A recommends finding be classified "open" as a topic for WG discussion.**	The appropriate TLD correction factors (based on the Gesell algorithm) were retroactively applied to dosimetry records from the beginning of TLD implementation (i.e. the period 1983-1985) as described in "Feed Materials Production Center, Final Phase-In Report, Volume 4 of 15, Environment, Safety, and Health" (SRDB 3247) and "Status Report - NLO Health Physics Appraisal, July 10, 1984" (SRDB 12405). Both references describe the deficiencies found in the original TLD algorithm developed by Plato, and the studies, comparisons, and field work undertaken to develop a more precise algorithm (the Gesell algorithm). The deficiencies of the Plato algorithm affected the precision of electron dose	Open

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

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					measurements and resulted in overestimates of electron dose.	
TBD	21	The method for estimating external dose to unmonitored female employees is incomplete and its claimant favorability has not been appropriately demonstrated.	This is similar to SEC finding 4.5-5. NIOSH responded as follows: *The doses to those female workers who were not monitored during two operating periods can be reconstructed by at least three methods. They are: (1) If the worker in question is doing the same or very similar job during periods when she is monitored, that dose could be used to adjust the missing dose when she wasn't monitored; (2) Workers who were doing the same job and were monitored at the time the female wasn't, could have an equivalent dose assigned to the unmonitored worker, and (3) Assignment of the missed dose as stated in the TBD-Vol 6 of 500 mrem/yr for the missing time periods, which is known to be extremely claimant favorable.* Discussed at the August 8, 2007, meeting – SC&A raised the concern that women who worked in the laundry were not monitored, but in some cases handled highly contaminated laundry. NIOSH stated assigning them a 500 mrem dose exceeds recorded doses by operators, which is claimant favorable. SC&A states default dose does not address the following: (1) the shallow dose to the skin, (2) the extremity dose to the forearm/hands, and (3) potential internal exposure from airborne contamination created by handling contaminated items. Suggested linking the internal component to SEC Finding 4.1-3. Discussed at the November 13, 2007, meeting. Decided this was an issue isolated to a few individuals and should be evaluated on a case-by-case basis in DR. April 22, 3009, meeting: Issue closed. Decided three methods suggested are sufficient.	**SC&A recommends finding be changed to " in abeyance" until agreed upon method is incorporated into the TBD**	See NIOSH Response #13.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	22	The source term for atmospheric uranium emissions from Fernald is significantly underestimated.	This was discussed briefly in the November 24, 2007, meeting (pg. 247), but was not discussed further.	**SC&A recommends that this finding remain "open" as a topic for WG discussion.**	(from October 24, 2007 meeting), NIOSH believes that stacks were functional and that the majority of source material was released from here, by design, therefore; the emissions are not underestimated. The stack emission data was used in the ORAUT-TKBS-0017-4, "Fernald Environmental Management Project – Occupational Environmental Dose" revision for the operational period.	
TBD	23	The TBD has not adequately considered various aspects of internal environmental dose, including the applicability of the Gaussian model, episodic releases, and particle size.	Episodic releases were discussed at the August 8, 2007, meeting (pg. 38). NIOSH used RAC Report Number CDC-5 (RAC 1995) to establish the source term. The new model incorporates evaluations for episodic releases that occurred. NIOSH indicates that assuming a chronic exposure based on positive bioassays is more claimant favorable than reconstructing individual acute intakes. It does not appear that Gaussian model and particle size have been discussed outside the K-65 radon issue (Primary SEC Issue 5).	**SC&A recommends that this finding remain "open" as a topic for WG discussion.**	ORAUT-TKBS-0017-4, "Fernald Environmental Management Project – Occupational Environmental Dose" revision uses a standard annualized Gaussian model including assumption regarding atmospheric stability that are claimant favorable. Short-term episodic releases are modeled using the "Puff" model instead of the continuous release model. A factor to account for respirable fraction of particles is included.	
TBD	24	Diffuse emissions of uranium and thorium may have produced significant internal exposures for some personnel.	This topic has not previously been discussed.	**SC&A recommends that this finding remain "open" as a topic for WG discussion.**	See NIOSH response to #22. In addition to stack effluent for the operational period, NIOSH has identified releases of thorium and uranium that emerged from building exhaust, waste pits, UF6 release from storage containers and six specifically identified off-normal events. NIOSH is unaware of any additional	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

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					significant sources.	
TBD	25	NIOSH's modeling of radon dose is not claimant favorable and does not take actual working conditions into account.	This topic has not previously been discussed.	**SC&A suggests this finding be subsumed into SEC Primary Issue #5 (moved to TBD issues April 2011).**	ORAUT-TKBS-0017-4, "Fernald Environmental Management Project – Occupational Environmental Dose" revision incorporates radon intake modeling which has been included in Gaussian dispersion calculations. 100% of radon and progeny are assumed to respirable. An assumption regarding the equilibrium between radon and progeny has been made that is favorable to the claimant and likely to exist only indoors under stagnant air flow conditions.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

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TBD	26	NIOSH has not considered a major source of radon dose—the storage source of pitchblende ore onsite near Plant 1.	This was discussed at the August 8, 2007, meeting. Pitchblende ore storage from the Q-11 silos was identified in the Pinney Report (Pinney et al. 2008). They were added to the radon source term. It appears that the bins were located on the south side of Plant 1. 10/24/07 – Research compiled by Susan Pinney of U of C took into consideration, in addition to the K-65 silos, other potential source terms of radon. And those included some of those specific bins outside of the refinery, in which the Q-11 ore was contained. 10/28/08 (pg. 258) – Discussion again on how the Pinney Report included Q-11 silos as a contributor to radon exposures. 4/22/09 – Discussions on Q-11 became blended with discussions on SEC Issue 4.2-1. NIOSH indicated that they are already updating the TBD to include the Pinney report, which includes the Q-11. It was debated changing 4.2-1 to a TBD issue, but no decision was reached. 1/29/10 – The Q-11 source term is separate from the K-65 source term in the Pinney report and should be discussed separately when modeling dose. Q-11 appears to be the dominate source term in the beginning years. SC&A will look at the report NIOSH prepared. 11/09/10 – More discussions on the pulmonary and skin implications in a DR of Q-11. SC&A to produce white paper on disagreements in source term and if SC&A can buy off on the NIOSH suggested approach. 2/8/11 – Anigstein states our opinion is that NIOSH has not demonstrated that the ranges can be bounded, though SC&A thinks they can be. But to do that they have to have a model that is validated and scientifically robust. Board decides this should be considered a TBD issue and was no longer discussed.	**SC&A suggests this finding be subsumed into SEC Primary Issue #5 (moved to TBD issues April 2011).**	The ORAUT-TKBS-0017-4, "Fernald Environmental Management Project – Occupational Environmental Dose" revision includes effluent from Q11 silos.	
TBD	27	The TBD does not consider outdoor diffuse emissions in production areas as a source of external environmental dose.	This topic has not previously been discussed.	**SC&A recommends finding be classified "open" as a topic for WG discussion.**	The "Exposure Areas" concept is also applied to external dose consistent with the NIOSH position on Item 22 for the ORAUT-TKBS-0017-4, "Fernald Environmental Management Project – Occupational Environmental Dose" revision.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
TBD	28	External environmental dose for workers near the K-65 silos needs to be better evaluated.	This relates to SEC Primary Finding #5 which is still unresolved as a site profile issue. 2/9/2011 – NIOSH to consider rescinding its technical guidance regarding the K-65 silos based on what SC&A believes is a flawed source term and atmospheric dispersion model and its conclusions regarding the validity of their model based on the Pinney report. NIOSH to identify which cases might be impacted by SC&A's findings regarding the applicability of the atmospheric dispersion model and the veracity of the source term.	**SC&A suggests this finding be subsumed into SEC Primary Issue #5 (moved to TBD issues April 2011).**	The external environmental dose for workers near the K-65 silos is addressed in the ORAUT-TKBS-0017-4, "Fernald Environmental Management Project – Occupational Environmental Dose" revision.	
TBD	29	Occupational internal exposure to radon is estimated based on just two radon data points from 1953. This is an inadequate basis to reconstruct occupational radon dose.	This issue is not related to radon emanating from the silos, but to the radon and radon progeny inhaled during drum unloading when Silos 1 and 2 were being filled. It is not clear whether this issue was discussed and/or resolved in the WG. Need more research.	**SC&A recommends finding be classified "open" as a topic for WG discussion.**	Radon from the material stored in drum at Plant 1 is now a source term for 1951, 1952 and 1953 before the material was moved into the K65 silo in the ORAUT-TKBS-0017-4, "Fernald Environmental Management Project – Occupational Environmental Dose" revision. NIOSH has recommended that 1953 radon exposure be added to the SEC.	
TBD	30	The possible use of photofluorography (PFG) at Fernald in the early years was ruled out in the TBD without adequate documentation. This is contrary to NIOSH general guidance and is not claimant favorable.	This topic has not previously been discussed. However, the same issue has been discussed in other WG meetings which may inform the resolution of this finding.	**SC&A recommends finding be classified "open" as a topic for WG discussion.**	No evidence of PFG has yet turned up for Fernald. This includes no evidence in claim files, no historical documentation of PFG equipment, & no evidence in several reviews of actual film folders of Fernald workers that have been performed over the years.	
TBD	31	The assumption that there was a 15% retake rate for x-rays is not adequately documented or analyzed.	This topic has not previously been discussed.	**SC&A recommends finding be classified "open" as a topic for WG discussion.**	The reference for this piece of information was not found in the historical information, and so it was removed from the revision of ORAUT-TKBS-0017-3, Fernald Environmental Management Project – Occupational Medical Dose.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

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TBD	32	The assumption that there was collimation is not technically justifiable based on the evidence provided in the TBD and is not claimant favorable.	This topic has not previously been discussed. However, the same issue has been discussed in other WG meetings which may inform the resolution of this finding.	**SC&A recommends finding be classified "open" as a topic for WG discussion.**	The current version of the ORAUT-TKBS-0017-3, Fernald Environmental Management Project – Occupational Medical Dose assumes poor collimation prior to 1970.	
TBD	33	NIOSH has prematurely concluded that lumbar spine x-rays for laborers and construction workers were not conditions of employment. Based on the evidence provided, this assumption is not sufficiently documented and is not claimant favorable.	This topic has not previously been discussed. However, the same issue has been discussed in other WG meetings which may inform the resolution of this finding.	**SC&A recommends finding be classified "open" as a topic for WG discussion.**	It is very clear that the few lumbar spine x-rays in claim file records (9727, 16972, 27894, 31741) are indicated as having been performed for "dispensary" and not "annual," "pre," or "term"; very strongly suggesting that lumbar spine x-rays were performed for back pain (a common ailment), or for workplace injuries, not for screening. 31 claims out of 1790 work periods/claims were reviewed and there were 0 non-dispensary lumbar spines in this random sample.	
SEC P	3	Default concentrations (on U mass basis) of Pu-239, Np-237, and other isotopes associated with RU at Fernald may not be bounding for some classes of worker activities, buildings, and time periods.	After many white paper exchanges and deliberations, NIOSH demonstrated that they could place a plausible upper bound on intakes from the three principal RU constituents.	**SC&A recommends issue be placed "in abeyance" until implemented in Site Profile.**	ORAUT-RPRT-0052, "Feed Materials Production Center Internal Dose Topics" provides an upper bound on intakes from RU constituents for all workers, which will be incorporated into ORAUT-TKBS-0017-5, "Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Occupational Internal Dose," and ORAUT-TKBS-0017-4, "Fernald Environmental Management Project – Occupational Environmental Dose," revisions.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

Doc	No	Finding Text	History	SC&A	NIOSH Response	Status
SEC P	4	Use of radon breath data for reconstructing doses from inhalation of Ra-226 and Th-230.	SC&A agrees – radon breath analysis is a scientifically valid method for reconstructing the intake of Ra-226 and Th-230 when the intake ratios of the two radionuclides are known and the impacted worker population can be identified. April 15, 2011: NIOSH posted a response [in ORAUT- RPRT-0052 (ORAUT 2011)] to SC&A's white paper, *Review of the NIOSH "White Paper on Fernald Th-230 and Other Associated Radionuclides – Rev. 7,"* (SC&A 2010) that summarizes their position.	**SC&A recommends issue be placed "in abeyance" until implemented in Site Profile.**	ORAUT-RPRT-0052, "Feed Materials Production Center Internal Dose Topics" provides a method for use of radon breath data for reconstructing doses from inhalation of Ra-226 and Th-230 which will be incorporated into ORAUT-TKBS-0017-5, "Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Occupational Internal Dose." For ORAUT-TKBS-0017-4, "Fernald Environmental Management Project – Occupational Environmental Dose" revisions, intake rates for Ra-226 and Th-230 have been modeled based on a source term associated with the uranium stack effluent from Plant 2/3. This material may have included Ra-226 and Th-230 impurities that were not removed in the ore milling process that occurred at different vendor facilities. Otherwise radon breath analysis is not pertinent to environmental intake rates.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

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SEC P	5	Radon release rate from the K-65 silos as estimated by NIOSH substantially underestimated. Method to derive the atmospheric dispersion factors, given the source term, is scientifically flawed, but results in an overestimate of the atmospheric dispersion factors at receptor locations (still does not compensate for underestimated source term).	Numerous white papers have been exchanged; Both sides 'agree to disagree.' NIOSH to consider rescinding its technical guidance regarding the K-65 silos based on what SC&A believes is a flawed source term and atmospheric dispersion model and its conclusions regarding the validity of their model based on the Pinney reports. April 19, 2011 – Board agrees to remove from SEC issues to TBD Issues.	**Open site profile issue.**	ORAUT-RPRP-0052, "Feed Materials Production Center Internal Dose Topics" presents what NIOSH believes is the best available analysis of annual radon effluent from the K-65 silos. The result of that analysis is 70.4 Ci/year. In the interest of being claimant favorable, ORAUT-RPRP-0052 recommends that the radon effluent values stated in ORAUT-TKBS-0017-5 "Technical Basis Document for the Fernald Environmental Management Project (FEMP) – Occupational Internal Dose" be used. This value of 5,000 to 6,000 Ci/y is similar to the value of 6,700 Ci recommended in the RAC report.	
SEC P	6b	Use of chest counts to reconstruct Th-232 exposures (1968–1988).	1968–1978 – Reported in milligrams thorium. SEC voted April 2012 based on inadequacy of the activity to mass conversion algorithm (now SEC class). 1979–1988 – Reported in activity (nCi) Pb-212 and Ac-228.	**Implementation of a coworker model is an ongoing site profile issue for 1979–1988.**	A thorium coworker model is in development.	

ISSUES RESOLUTION MATRIX FOR FERNALD SITE PROFILE AND SEC PETITON

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SEC	4.5-1	Absence of Performance Standards/Quality Assurance for Personnel Dosimeters. This issue goes toward the availability of approved standardized procedures for performing external dosimetry and adequacy of the training and qualifications of personnel performing external dosimetry.	NIOSH responded: *The Oak Ridge film dosimeter, which was the dosimeter used at FMPC, was included in external dosimeter intercomparison studies and did compare with other AEC sites' dosimeters very well. Discussions held with former FMPC employees involved with the early dosimetry program from startup through 1985 have revealed that written instructions did exist, but to date none could be identified. ...* *NIOSH will attempt to recover QA intercomparison studies or internal studies (Herb Parker report and other reports). NIOSH will also attempt to identify procedures and/or QA reports from the early time period (53–85).* 11/13/2007 – The Parker report (Parker 1945) showed that the three dosimeters performed very well in the measurement of exposures to uranium. The OR dosimeter was used at FEMP for several years and modifications were made to it. 3/26/08 – SC&A raises concerns about qualifications of badge technicians. 10/28/08 – NIOSH will attempt to make more information available on O drive from data capture. **It is not evident that this issue was closed by the WG.**	**This issue is apparently open for WG deliberation.**	SRDB Reference ID # 2921, "Health Protection Program Review," from November 1962, concurs with the proposal to issue a FMPC Nuclear Safety Guide. This Guide and the Industrial Hygiene and the Radiation Department Procedures Manual should provide sufficient criteria to permit operating groups to accept health and safety responsibility without excessive audit. Several other references exist in the SRDB that support the adequacy of the external dosimetry program at Fernald, some of which include: 4330, 4618, 4204, 439, 8599.	