

WELDON SPRING PLANT SITE PROFILE FINDINGS MATRIX

TBD Finding No.	Finding	Resolution by NIOSH/SC&A/WG	Status
1	<p>Lack of Personnel Contamination and Egress Monitoring The Weldon Spring (WS) site technical basis documents (TBDs) do not mention the lack of monitoring equipment and procedures to check workers for contamination in the work places and upon leaving the controlled areas. During recent worker interviews, SC&A did not find that the workers recalled any regular egress monitoring, either between the operations areas to the non-operations areas (cafeteria, administration offices, labs, maintenance facilities, sidewalks, storage yards, grounds, etc.), or when leaving the plant site (guard shack, parking lots). Workers were apparently allowed to leave the controlled areas and the WS site without confirmation that they were not contaminated. This could have spread contamination to non-controlled areas at the site, creating chronic exposure (internal and external) to unmonitored workers, as well as leaving contamination on the workers that could lead to chronic beta exposure to the skin (especially in the folds of the skin) and internal exposure through ingestion and resuspension/inhalation.</p>	<p>This issue will be addressed on a case-by-case basis according to DCAS-TIB-0013.</p>	<p><i>After discussion during the May 9, 2011, WS Work Group (WG) meeting, the finding was resolved and it was recommended to close this finding. Finding was closed by the WG, page 229 of transcript.</i></p>

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2	<p>Inadequate Information Concerning Workers Status and Exposures for 1967–1984</p> <p>The WS site TBDs do not explicitly state when U.S. Department of Energy (DOE) employees and/or DOE contractors were no longer at the WS site after it stopped operations in December of 1966. It has not been determined if DOE employees and/or contractors were present or involved during 1967–1969 when the U.S. Army was attempting to decontaminate and renovate buildings located at the WSCP; during the 1970–1984 monitoring and maintenance period; or during 1983–1984 when there were efforts to remediate leaks at the WSRP. If DOE contract personnel were present at the WS site soon after the shutdown in December 1966, they could have been exposed to numerous radionuclides during decommissioning, clean out, and revamping the facility for a completely different use. This could have led to incidences of skin contamination, inhalation, and ingestion of radioactive materials (including uranium and thorium, as well as radionuclides contained in the raffinate concentrates and its scale/soil that had been resuspension) that were not monitored and/or recorded or grossly underestimated.</p> <p>If DOE employees and/or contractors were present at any of DOE’s WS facilities during the period 1967–1984, the TBDs need to be revised to include this period of dose evaluation for the site. Therefore, the issue of legal ownership of the property (and liability) as a function of time needs to be determined through federal/state/local records to determine if the TBDs should be revised to include additional time periods.</p>	<p>This issue will be addressed on a case-by-case basis if cases come up; so far no claims for this period.</p>	<p><i>After discussion during the May 9, 2011, WS WG meeting, the finding was resolved and it was recommended to close this finding. Finding was closed by the WG, page 226 of transcript.</i></p>

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3	<p>Individual Exposures versus Average Exposures</p> <p>The TBDs rely heavily on the fact that mostly natural uranium (>97%) was processed at the WSCP; therefore, the contributions from other forms of uranium (DU, EU, or RU) and other radionuclides (thorium, radium, etc.) are small compared to natural uranium. Whereas the most likely exposures (internal and external) may have been from natural uranium, this does not negate the fact that individuals or certain groups of workers may have been exposed to materials that contained greater concentrations of other forms of uranium and radionuclides, especially in or near plant locations dedicated to the other forms of radioactive material processing and in areas around discharge streams, waste, and raffinate pits.</p> <p>Assuming that natural uranium predominates as the source of a worker's dose could lead to an underestimate of the worker's correct dose if the worker was exposed to radioactive materials other than natural uranium.</p>	<p>The potential exposure to other radionuclides of concern has been addressed in other findings for WS. Therefore, this issue has been addressed.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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4	<p>Recycled Uranium Not Adequately Recognized in the TBDs</p> <p>Recycled uranium (RU) and its associated radionuclides are one of the major concerns of former WS site workers. During onsite worker interviews, in computer-assisted telephone interview (CATI) reports, and in potential Special Exposure Cohort (SEC) issues, the radionuclides from RU (plutonium, neptunium, U-236, and fission products, such as Tc-99) are listed as foremost concerns and among the items that the workers believe the government did not know, or was not fully disclosing the health hazards of. Therefore, RU should be clearly identified in the TBDs and included in the materials handled at the WS site, such as in the bullet points on page 6 of TBD-1 (ORAUT 2005a) and in Section 2.2.2.2 of TBD-2 (ORAUT 2005b, page 10), with equal importance compared to other materials. TBDs 1, 3, and 6 make no mention of RU; TBD-2 contains one paragraph on page 23, and TBD-5 (ORAUT 2005e) has a short section concerning RU on page 15 and mentions it on page 35, along with enriched (1%) uranium for 1963–1967. Of the six TBDs, the environmental dose TBD-4 (ORAUT 2005d) contains the most material concerning RU. On pages 10–12 of TBD-4, the assumption is made that because the amounts of RU handled at the WS site were a small fraction of the total uranium materials handled, then there is no need to consider RU and its associated contaminants to be potentially significant contributors to onsite environmental dose. This may be true on average or for chronic offsite environmental doses, but this assumption does not consider the fact that some workers or certain groups of workers may have received a substantial portion of their inhalation dose from RU and its associated contaminants for a significant amount of time near an RU-handling process. Although TBD-4 (ORAUT 2005d) did mention RU, it did not address the issue of RU for unmonitored workers’ environmental dose in sufficient detail.</p>	<p>The WS TBDs have been revised to include RU and associated radionuclides with the correct dates of usage at WS.</p>	<p><i>SC&A sent email September 20, 2017, to WS WG that this finding has been resolved. SC&A recommends that this finding be closed.</i></p>

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5	<p>Lack of Accident/Incident Documentation Not Sufficiently Addressed</p> <p>The WS site TBDs do not address accidents or incidents at the WS site (or the apparent lack of their documentation being readily available), except for the brief mention of two accidents on page 27 of TBD-2 (ORAUT 2005b). Accidents and incidents that could potentially release material to the operations area and to unmonitored workers onsite are important at the WS site, because the radiological hazards may not have been fully recognized, investigated, or documented at the time of its occurrence. During onsite interviews with former WS site workers, the subject of accidents/incidents was mentioned with the concern that MCW did not identify and document radiological events sufficiently, either through lack of knowledge of the radiological hazards, or as a manner of policy at that time. SC&A’s preliminary investigation of several cases indicates that the accidents described by former workers were not evident or were not recorded sufficiently in the workers’ DOE files. For example, a serious furnace accident occurred in 1960; however, the only mention of it in the worker’s DOE records was a couple of brief sentences describing the <i>medical</i> aspect of the worker’s complaints; no investigation into the radiological aspect of the accident was evident. There was no other documentation of the accident in the worker’s files that SC&A could locate. Another serious accident apparently occurred in 1961; the only reference in the worker’s DOE file was an entry in the “PERSONAL MONITORING SUMMARY RECORD,” which stated that “Data included in Feb. Accident File.” There was no other record of it in the worker’s DOE records. Fortunately, this accident was written up in an MCW report (MCW 1961) and the dose reconstructor evaluated the dose received from the accident during the dose reconstruction process. However, this may not always be the case.</p>	<p>This issue was discussed at the 9/13/2011 WS WG meeting. NIOSH provided information and clarification. SC&A agreed that the issue was resolved (page 136 of transcript).</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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6	<p>Inconsistence in Frequency of X-ray Exams</p> <p>TBD-3 (ORAUT 2005c, page 8) assumes annual x-rays for all periods, and in Section 3.1.2 (page 7), it recommends annually from 1955 through 1966. However, in the same paragraph it states, “A review of pre-1970 files indicates that, approximately 30% of the time, workers received two sets of chest x-rays in a period of 9 months or less (excluding x-rays for termination of employment); the files do not provide reasons for this.” (This would equate to an overall average of 1.25 x-ray exams per worker per year.) In the last paragraph of Section 3.1.2 (page 7), it suggest an x-ray exam was conducted every 2 or 5 years for post-1985 workers. And in the next to the last paragraph on page 13 of the TBD, it recommends annual chest x-rays for 1958–1964.</p>	<p>Resolution to this issue was discussed at the 1/25/2011 WS WG meeting (transcript pages 250–258) and is addressed by recommendations and guidelines in OTIB-0079 and OTIB-0006. Later revision to TBD-3 provides clarification of the issue.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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7	<p>Photofluorography Exams Not Adequately Addressed</p> <p>TBD-3 (ORAUT 2005c) mentions photofluorography (PFG) exams on page 7. However, no recommendations to the dose reconstructor are made concerning this type of exam, other than that there had not been any indications that PFG exams were conducted at the WSCP. ORAUT-OTIB-0006 (ORAUT 2005g, page 21) states, “It is reasonable to presume that at least some of the occupational medical diagnostic chest x-rays with the DOE and its predecessor organizations were accomplished by PFG and, in the absence of data to the contrary, the use of PFG should be assumed to ensure claimant-favorable dose reconstructions.” Table 7-6 of ORAUT-OTIB-0006 (page 24) also indicates that DOE/AEC facilities used PFG equipment from 1953–1968, which would encompass the 1957–1966 operating period at WSCP. If PGF equipment was not located at the WSCP site, workers may have had occupational PFG exams performed at offsite locations, such as Barnes Hospital Labs, which serviced MCW workers in the earlier years. TBD-3 (ORAUT 2005c) does not show evidence of investigating this subject sufficiently (such as checking Missouri state records, etc.) to justify discounting the possibility that some WS site workers received PGF exams.</p>	<p>Resolution to this issue was discussed at the 1/25/2011 WS WG meeting (transcript pages 250–258) and is addressed by recommendations and guidelines in OTIB-0079 and OTIB-0006. Later revision to TBD-3 provides clarification of the issue.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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8	<p>Lumbar Spine Exams Not Addressed</p> <p>TBD-3 (ORAUT 2005c) makes no mention of lumbar spine x-rays and states on page 7 that, “Therefore, the analysis for this TBD assumed annual PA and LAT chest x-ray examinations for all employees, and considered no other view.” This excludes both PFG and lumbar spine exams. Lumbar spine exams were sometimes performed for workers that performed heavy and strenuous work, such as laborers and construction workers, or those with back problems. ORAUT-OTIB-0006 (ORAUT 2005g, page 21) states, “However, the possibility of periodic lumbar spine examinations, including an exit employment physical examination should not be precluded.” Therefore, TBD-3 should address the issue of lumbar spine exams for WS site workers.</p>	<p>Resolution to this issue was discussed at the 1/25/2011 WS WG meeting (transcript pages 250–258) and is addressed by recommendations and guidelines in OTIB-0079 and OTIB-0006. Later revision to TBD-3 provides clarification of the issue.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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9	<p>Use of ICRP-34 Instead of ICRP-74</p> <p>TBD-3 (ORAUT 2005c) utilizes International Commission on Radiological Protection (ICRP) 34 (ICRP 1982) instead of ICRP 74 (ICRP 1996), which was used in NIOSH’s OCAS-IG-001 (NIOSH 2002) to determine absorbed dose from kerma values. Preliminary studies by SC&A indicate that the use of ICRP 34 may tend to underestimate the absorbed dose. ICRP 34 does not have 10 organs that are now in ICRP 74. The use of ICRP 74 is particularly important when the medical examinations included PFG chest x-ray exams, where doses can double or triple based on the differences between ICRP 34 and ICRP 74; for PA and lateral x-rays, the underestimations are not as significant. This issue amplifies the need to ascertain whether WS site workers received PFG exams, as outlined in the previous finding.</p>	<p>Resolution to this issue was discussed at the 1/25/2011 WS WG meeting (transcript pages 250–258) and is addressed by recommendations and guidelines in OTIB-0079 and OTIB-0006. Later revision to TBD-3 provides clarification of the issue.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>
10	<p>Lack of Atmospheric Monitoring Data for Operational Period</p> <p>There is no substantial site-wide atmospheric monitoring data available for the operational period to assure an accurate and integrated onsite environmental dose assessment. The TBD recognizes this lack and relied upon the use of dose estimates for the public derived from its reviews of the Fernald plant data to estimate the onsite environmental dose for the WSCP workers. This is problematic, in that raw emissions data from Fernald is not easily converted to environmental dose for the WS site workers when several emission points of varying geographic locations have to be considered, as well as the lack of knowledge that could place workers at specific locations during exposure events. SC&A believes that the limited environmental data presented in the TBD and the lack of environmental surveys of onsite locations over time does not support the supposition and/or conclusion of negligible dose to onsite personnel.</p>	<p>TBD-4, Rev. 01, of 5/17/2013 added data for assigning environmental intakes with accompanying text for dose reconstruction (DR) (summary of additions on page 2 of Rev. 01). This issue has been resolved.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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11	<p>Insufficient Data for Unmonitored Workers' Internal Environmental Dose</p> <p>The TBD used one series of measurements (decontaminating 5-ton hoppers) and site parameter measurements to determine contributing intakes to non-bioassayed workers during 1957–1967. The hopper dust monitoring experiment consisted of measurements performed on one day under one particular condition, and the parameter measurements contributed very little (<1%) to the final results. This limited (in space, operations, and time) airborne/intake data is not sufficient to construct an adequate intake dose database for unmonitored workers at the WS complex, especially considering that a sizable fraction of the work force was not bioassayed on a routine basis during this period.</p>	<p>TBD-4, Rev, 01, of 5/17/2013 added data for assigning environmental intakes with accompanying text for DR (summary of additions on page 2 of Rev. 01). This issue has been resolved.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>
12	<p>Lack of Validation for Maximum Environmental Dose</p> <p>The TBD fails to validate the adequacy of estimating the maximum environmental dose due to source terms at differing locations at the Weldon Spring Plant. In the current TBD, NIOSH has offered that existing air monitoring data do not distinguish the source of emissions; therefore, to some measure, it only allows evaluation of cumulative emissions and dose. The estimation of dose methodology currently being applied by NIOSH does not reasonably address maximum dose to workers who are not routinely monitored across the site, which could have been 50% of the site workers.</p> <p>SC&A believes that the lack of air monitoring stations in general and the overall lack of stations within a particular geographic location at the WSCP (of known higher releases of uranium and thorium) does not readily enable one to accurately estimate environmental dose using only the very limited existing air monitoring data.</p>	<p>TBD-4, Rev. 01, of 5/17/2013 added data for assigning environmental intakes with accompanying text for DR (summary of additions on page 2 of Rev. 01). This issue has been resolved.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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13	<p>The TBD Lacks Sufficient Effluent Data Prior to 1967</p> <p>The TBD (ORAUT 2005d) has relied, to the extent possible, on data derived from known source terms, yet the validation of that data remains in question. NIOSH/ORAUT should validate this data against any remaining effluent data or reports for the period of 1992 through 2002, when restoration took place and sufficient monitoring data exists.</p>	<p>TBD-4, Rev. 01, of 5/17/2013 added data for assigning environmental intakes with accompanying text for DR (summary of additions on page 2 of Rev 01). This issue has been resolved.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>
14	<p>Stated Uranium/Thorium/Radium/Lead Ratios Should Be Used with Caution</p> <p>TBD-4 assumes that during the operations period, Th-230 was 5% of the U-238 activity, Ra-226 was 1% of the U-238 activity, and Pb-210 was 1% of the U-238 activity (ORAUT 2005d, page 9). These values may have been applicable for some locations and time periods at the WS site; however, this may not have been true for certain locations, as acknowledged in TBD-5 (ORAUT 2005e, page 14).</p>	<p>Revised TBD-4, Rev. 01, of 5/17/2013 added tables and data on pages 19–22 to resolve this issue.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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15	<p>Natural Thorium-232 Not Always Negligible</p> <p>TBD-4 (ORAUT 2005d, page 9) assumes that because the amounts of natural thorium handled/processed at the WS site were a small fraction of the total uranium materials handled and processed, natural thorium is probably not a significant contributor to environmental inhalation doses during the operational period. This may be true on average, but this assumption does not consider the fact that some workers or certain groups of workers may have received a substantial portion of their inhalation dose from thorium and its decay products for a significant amount of time near a thorium handling process, or from operations that concentrated thorium, such as the raffinate pits. A 1983 WS document (Eberline 1983, page 10) shows that the raffinate pits contained significant concentrations of Th-232 as compared to U-238; approximately 20% on average.</p>	<p>Revised TBD-4, Rev. 01, of 5/17/2013, page 10, added information that corrected this issue.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>
16	<p>Use of External Environmental Dose from Protracted Fernald Estimated Data</p> <p>TBD-4 (ORAUT 2005d, page 25) outlines the method used to determine the environmental external dose values at the WS site for the time period of 1957–1967. The external dose of 383 mrem per 2,000 hours (1 work-year) was derived from using the dose information from the Fernald site TBD-4 (ORAUT 2004a) and is listed in Table 4-11 of TBD-4 (ORAUT 2005d, page 27) for the WS site. The data from the Fernald site was not measured directly, but was derived from measurements post-1976 and then projected back to the pre-1976 period by scaling of production levels.</p>	<p>TBD-4, Rev. 1, of 5/17/2013, Section 4.3 uses WS data instead of Fernald data. This issue has been resolved.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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17	<p>Episodic Releases TBD-4 (ORAUT 2005d) details some of the known episodic releases, but fails to give significant estimates of environmental dose for those episodes or provide consideration for unknown incidents.</p> <p>The TBD also notes that there is a paucity of information regarding episodic releases, resulting in potential environmental contamination of workers. NIOSH believes the purpose of the TBD is not to provide estimates of dose, but rather to offer estimates of source terms to be used by dose assessors to estimate the dose to the individual claimant. Effluent data used by dose assessors would often include quantities for both routine and episodic releases; however, NIOSH recognizes that significant current gaps exist in this information.</p>	<p>This issue was discussed at the 9/13/2011 WS WG meeting. NIOSH provided information and clarification. SC&A agreed that this issue along with incidents was resolved (page 136 of transcript).</p>	<p><i>SC&A recommends that this finding be closed.</i></p>
18	<p>Incomplete Assessment of Uranium Decay Products The TBD recommendations for dose estimate from decay products of U-238 are incomplete, and not always claimant favorable. The dose from inhaled Th-234 is not included along with the dose from inhaled U-238 in the dose calculations. What is included is the dose from Th-234 that builds up inside the body after an intake of U-238 takes place. Additionally, the dose contribution due to Pa-234m from the decay of Th-234 in the body also needs to be included in the internal dose calculations. While it is true that the Pa-234m outside the body only contributes to the external dose, the Pa-234m originating inside the body from Th-234 decay must be included in the internal dose calculations.</p>	<p>TBD-5, Rev. 2, of 5/21/2013, Section 5.2.2 provides data to resolve this issue.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

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19	<p>Incomplete Assessment of Radon Exposure The TBD describes the potential radionuclide exposure in the different buildings of the WSCP. Radon is listed as a source of exposure inside buildings 101, 103, 105, 403, and 407. However, the recommended approach used in the TBD to estimate radon doses is based on environmental radon concentrations for the areas within 100 meters of the assumed release point, which is the acid recovery plant stack. Using this approach requires that several assumptions be made, which results in large uncertainties in the dose estimates for workers located in indoor workplaces. For example, documentation shows that indoor radon concentrations averaged four times that of outside radon concentrations.</p> <p>Therefore, the approach recommended in TBD-5 is not always claimant favorable. NIOSH should propose a more reliable and claimant-favorable approach to the assess radon exposure for WSCP workers.</p>	<p>This issues and the proposed radon model was discussed at several of the WS WG meeting. During the 6/7/2012 meeting (transcript page 69), it was stated that the proposed radon model would be brought before the AB at the next meeting.</p>	<p><i>No further action has been received for this item. Therefore, it is still open.</i></p>
20	<p>Different Solubility Classes Listed for the Same Element The TBD provides a list of solubility classes for uranium and thorium compounds in some of the buildings at the WSCP; however, the TBD lists different solubility classes for the same element. Because there were no means of separating isotopes of a given element at the WSCP, the chemical properties were the same for all uranium isotopes, as well as for all thorium isotopes. According to ICRP Publication 78 (ICRP 1997) the biokinetic behavior is the same for U-234, U-235, and U-238. The same applies for thorium Th-232 and Th-228.</p> <p>In view of the operations that took place at the WSCP, the TBD should provide justification/clarification concerning the use of different classes of solubility for the same element at the WS site.</p>	<p>This issue was discussed during the 1/25/2011 WS WG meeting. The most claimant favorable solubility type will be used. Finding closed (transcript page 240). Included in text of TBD-5, Rev. 02, page16.</p>	<p><i>Closed.</i></p>

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21	<p>Missed Dose and Coworker Data Not Adequately Addressed</p> <p>The TBD does not address potentially missed internal doses, which should be part of a TBD for internal dose. The limits of detection (LODs) were generally high in the earlier years, which could result in significant missed doses. For the dose reconstructor to assign missed dose, the TBD needs to provide some information concerning the minimum detectable activity (MDA) for given bioassay techniques for the important radionuclides of concern at the WS site as a function of time. Additionally, the TBD provides some coworker internal dose information, but does not provide sufficient instructions for its use or the details of the data, such as the percent of workers bioassayed or the representativeness of the data (especially important at the WS site, because not all workers were bioassayed and none continuously). Also, most internal dose TBDs provide a summary section in the main text or as an appendix with recommendations and procedural steps for using coworker data.</p>	<p>This issue was discussed and resolved during the 5/9/2011 WS WG and it was closed (transcript page 185).</p>	<p><i>Closed.</i></p>
22	<p>Cost-Center Codes May Not be Reliable for Dose Reconstruction</p> <p>The use of the cost-centers codes listed on pages 19 and 22–27 of TBD-5 (ORAUT 2005e) are not practical, because workers’ DOE files generally do not contain cost-center information; some may contain job titles, or work locations.</p>	<p>It was stated during the 1/25/2011 WS WG meeting that the cost-center code would not be used for DR. This issue was resolved and closed (transcript page 266).</p>	<p><i>Closed.</i></p>

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23	<p>Negative In-vivo Results Do Not Necessarily Indicate Lack of Thorium Uptake</p> <p>TBD-5 (ORAUT 2005e, page 28) indicates that a portable whole-body counter was set up for in-vivo thorium measurements in 1966. On page 29, it states the following:</p> <p><i>The overall results showed workers involved in areas 101, 103, 301, 403, Maintenance, and Health and Safety, which were principal exposure positions, had a more frequent occurrence of ‘trace’ detections. No workers monitored showed a ‘positive’ designation. (Ingle 1991)</i></p> <p>Because the LODs for this bioassay technique were generally very high during that period, the results of these measurements should not be considered as indicative of a lack of internal exposure. Hence, measurements recorded as “negative result” should not be interpreted as the workers not being exposed to thorium. These in-vivo measurements were only performed once in July 1966; the TBD does not address the issue of workers potentially exposed to thorium in early periods and if the thorium and/or decay products would be sufficiently present in the workers’ lungs to be detected by this method.</p>	<p>It was stated during the 1/25/2011 WS WG meeting that these results would not be used for DR. This issue was resolved and closed (transcript page 266).</p>	<p><i>Closed.</i></p>

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24	<p>Enriched Uranium Not Sufficiently Addressed</p> <p>TBD-5 (ORAUT 2005e) discusses enriched uranium (EU) on page 12, where it is stated, “WSCP also processed depleted uranium and slightly enriched (up to 1%) uranium as well as natural thorium.” And on page 13, where it states, “For slightly enriched uranium, it is reasonable to assume that the composition of 1% enriched uranium in the Technical Basis Document for the Fernald Environment Management Project – Occupational Internal Dosimetry (ORAU 2004a, Table 5-3) is applicable to slightly enriched uranium at WSCP.” In addition, it states, “Although uranium with enrichments of less than 1% might have been processed at WSCP, it is claimant-favorable to assume 1% enrichment for all slightly enriched uranium at WSCP.” These statements imply that if the dose reconstructor uses 1% EU with the composition as listed in the Fernald TBD [and reproduced in Table 5-5 of WS site TBD-5 (ORAUT 2005e)], then this is likely an overestimate and, therefore, claimant favorable.</p>	<p>TBD-5, Rev. 03 of 3/14/2017, uses an EU of 1%, which increases the concentration from 0.783 pCi/ug to 0.973 pCi/ug. Therefore, a PER is required.</p>	<p><i>As per NIOSH email of 10/4/2017, a PER will be issued to increase the intake from EU. This finding is open.</i></p>
25	<p>Shallow and Extremity Doses Not Sufficiently Characterized</p> <p>The TBD briefly addresses dosimeter quantities, open window (OW), shielded window (SW), etc., and compares beta dose from NU, EU, and DU for shallow doses; additionally, electron dose is listed as >15 keV. But the TBD does not address geometry factors, total shallow dose, or extremity monitoring during the operational period. A geometry factor is needed for adequate dose assessment, because a film badge does not register the same dose as the worker’s tissue/organ is receiving from the betas and low-energy photons when handling, machining, scooping, etc., uranium containing materials. No WS site documents have been located that sufficiently address the change in film badge response as a function of radionuclide exposure, especially to low-energy photons and changes in beta energies. Additionally, there is no indication that routine extremity monitoring was performed at WS during the operational period.</p>	<p>Revised TBD-6, Rev. 01, of 2/6/2013 added Section 6.3.11, page 30, that discuss geometry factors and references DCAS-0013.</p>	<p><i>SC&A email of 6/13/2017 to WS WG that issue has been resolved and recommended that finding be closed.</i></p>

TBD Finding No.	Finding	Resolution by NIOSH/SC&A/WG	Status
26	<p>Badging Policy Not Consistent</p> <p>The TBD does not provide sufficient and/or consistent information concerning the badging policies at the WS site. This raises the question of what badging criteria were actually used in exposed but not monitored because of being in a pre-defined category. The lack of a consistent and documented badging policy may negatively impact dose reconstruction, because the dose reconstructor could assign an unbadged worker only external environmental dose when the worker should have been assigned coworker external dose. Additionally, badging policies could impact the validity of the coworker dose database.</p>	<p>In NIOSH's 11/9/2011 reply to WS Site Profile/SEC issues this is explained in detail on page 17, followed by revised text in TBD-6, Section 6.3.7, page 28 of Rev. 01 of 2/6/2013. This issue has been resolved.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>
27	<p>Lack of Sufficient Coworker Data Development for External Dose</p> <p>The TBD provides annual average gamma and beta exposures. However, the TBD does not provide any information concerning the details of this information, such as the number of data points for each entry, the percent of workers badged, the range of readings, if background was subtracted, if zeroes or outliers were included, if a threshold dose was used, etc. The data presented is a good start in creating a coworker database; however, in order to determine its validity and representativeness, there needs to be additional work performed on the data, as mentioned above. Plus, for internal coworker data, some guidance for use of the data in a summary form would be appropriate.</p>	<p>TBD-6, Rev. 01 of 2/6/2013 revised Table 6-7 and added Table 6-8 to resolve the issue.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>

TBD Finding No.	Finding	Resolution by NIOSH/SC&A/WG	Status
28	<p>Lack of Documentation and Details for Neutron Doses</p> <p>Table 6-3 of TBD-6 (ORAUT 2005f, page 13) states, “Estimate neutron dose as 10% of the reported gamma dose in facilities containing UF₄ and UF₆.” Table 6-4 on page 14 states that “All MCW Uranium Division personnel who work directly with enriched uranium materials are assigned special neutron dosimeter badges, which are worn in conjunction with the regular film badges.” However, the results of this badging (presumable NTA film) were not discussed and no data is presented, except to mention in Section 6.2.4.2 (page 19) that no neutrons were anticipated or measured with the WSCP film badge. TBD-6 then switches to the use of Fernald’s TBD-6 (ORAU 2004c) neutron-to-photon ratio (n/p) value of 0.1, with the statement that the use of the Fernald analysis is appropriate and will be used in this TBD. The Fernald TBD-6 (ORAU 2004c, pages 18–20) describes the process of deriving the n/p value of 0.10; this consisted of measuring the neutron doses from UF₄ (green salt) canisters in 1995 and then measuring the photon dose from 56 drums of UF₄ in 2001. The n/p geometric mean value was 0.10, with an upper 95th percentile of 0.23, and with a geometric standard deviation of 1.71. There are a number of problems with assuming that the n/p value of 0.1 from the Fernald site can be used at the WS site:</p> <ul style="list-style-type: none"> • There are no indications that the “containers” used in 1995 and the “drums” used in 2001 are the same geometry. • There are no indications that the UF₄ in the containers used in the 1995 measurements and the UF₄ in the drums used in the 2001 measurements are of the same radioisotope composition and concentrations to create similar radiation fields for measurements taken 6 years apart. • There is no indication that the matrix material, which would affect the self-shielding of the emitted radiation, is the same in both the 1995 and the 2001 measurements. • There is no analysis to demonstrate that the radiation fields created by the materials in the containers or drums used at the Fernald site reasonably duplicate the radiation fields at the WS site, to include such variables as radioisotope composition, concentrations, matrix materials, and geometry. <p>The methodology to derive the n/p value of 0.1 at Fernald is questionable, and the application of this n/p value to the WS site is not technically supported in the TBD.</p>	<p>This issue was discussed during the 9/13/2011 WS WG meeting (transcript 95–134) and SC&A evaluated results and sent email to WG 9/20/2011 that the issue had been resolved and could be closed.</p>	<p><i>SC&A recommends that this finding be closed.</i></p>