



To: Savannah River Site Work Group
From: SC&A, Inc.
Date: March 11, 2022
Subject: March 2022 Update of Issues Matrix for the SRS SEC Petition and Petition Evaluation Report

On behalf of the Savannah River Site (SRS) work group, SC&A maintained and updated a Special Exposure Cohort (SEC) issues matrix, starting in September 2009, that compiled all identified exposure potential issues at SRS based on the work group's review of Petition SEC-00103. The original 2009 matrix (SC&A, 2009a) was based on issues that were unresolved from the SC&A review of the SRS site profile and SC&A's preliminary review of NIOSH's evaluation report (ER) (NIOSH, 2008). The initial 2009 matrix listed 25 issues of SEC relevance; an additional issue was added later, for 26.

SC&A issued an updated 2014 SEC issues matrix (SC&A, 2014) in February 2014 following the designation of an SEC class for all SRS employees for 1953–1972. This designation rendered moot some SEC issues, while others needed additional research to address questions related to latter time periods, including those for construction trade workers (CTWs), nuclide-specific issues (e.g., neptunium, special tritium compounds, and thorium), and co-exposure modeling. For this current review, SC&A reviewed the 2014 matrix (the latest generated) to confirm any outstanding issues for which documented resolution is not apparent.

Of the 26 SEC-relevant issues listed in the 2014 matrix, three issues lacked a documented resolution: issue 3 for “Recycled Uranium,” issue 22 for “Badges not capturing dose,” and issue 26 for “additional worker and worker representative issues.”

The original recycled uranium (RU) issue, which was identified in SC&A's 2005 site profile review (SC&A, 2005), found that a timeline for RU operations had not been issued and it was not clear when and how RU (with trace radiological contaminants) may have been handled at SRS. NIOSH issued trace contaminant data for RU in 2010 (NIOSH, 2010b), and SC&A responded with a memorandum about remaining RU issues in 2014 (SC&A, 2014b). While there is no confirmation of an outstanding SEC issue, no final resolution was apparent in the work group records on this matter.

For issue 22 (and subsumed issue 23), SC&A had found that worker interviews indicated that some workers kept their badges out of higher radiation areas in order to not exceed dose limits (SC&A, 2011c) and that badge dose readings may have been under-recorded or not recorded. NIOSH was to review SC&A's report of these worker interviews and provide a response.

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For issue 26, SC&A had compiled and categorized a number of worker and petitioner comments about specific workplace issues for which a specific NIOSH response has not been received to date. However, as noted in SC&A's updated matrix in this memo, a number of the comments are addressed in existing SEC issues reviewed by the work group and NIOSH.

A number of other SEC-relevant issues from the 2014 matrix have either been closed, resolved, subsumed under other issues, or superseded by the 2011 Board action to recommend an SEC for 1953–1972 (issues 1, 8, 12, 15, 16, 17, 18, 19, 21, 23, 24, and 25). Still others are being addressed by the development of co-exposure models under ORAUT-OTIB-0081, “Internal Dosimetry Co-Exposure Data for the Savannah River Site”: issue 2 for thorium via ORAUT-RPRT-0070 (NIOSH, 2017a) and ORAUT-RPRT-0081 (NIOSH, 2017d); issue 4 for trivalent actinides and thorium; issues 6 and 7 for fission and activation products; issue 9 for tritium; and issue 13 for comparing intakes for CTWs versus non-construction workers. Issue 5 for neptunium (Np)-237 has been addressed by NIOSH in ORAUT-RPRT-0065 (NIOSH, 2016a), ORAUT-RPRT-0077 (NIOSH, 2016b), and ORAUT-RPRT-0080 (NIOSH, 2017c) and is being handled by the work group as an ongoing issue. Issue 10 for special tritium compounds, which are being addressed as “Metal Hydrides” in ORAUT-RPRT-0072 (NIOSH, 2017b), is also ongoing. Issue 11 (exotic radionuclides), issue 14 (special exposure conditions), and issue 20 (tank farm geometry) have reached the resolution stage and are ready for work group review for closure.

Other than the three specific outstanding items—issues 3, 22, and 26, none of which have been judged SEC-significant to date—SC&A has determined that the relevant SEC issues have flowed down to and have been included in subsequent priority action lists presented by NIOSH to the work group. Their status is summarized in SC&A's informal internal update of SEC-00103 issues status in October 2021 (SC&A, 2021).

Given how long ago this 2014 issues matrix was last updated and the challenge faced by SC&A in reconstructing several status items, SC&A recommends to the work group that the 2022 updated matrix¹ included in this memo be reviewed and corroborated by NIOSH and the work group.

¹ Please note that the structure of the 2014 matrix has been updated and the text proofread and reformatted to comply with current NIOSH requirements for Section 508 compliance.

Table 1. March 2022 update of issues matrix for the SRS SEC petition and petition ER

Matrix issue no.	Issue brief	ER section no.	Issue description	NIOSH issue status	SC&A review status/update	Current status (March 2022)
1	Thorium up to 1965	7.1.1.8	Thorium work was carried out in a number of areas and dose reconstruction methods need to be specified. NIOSH had reserved the issue for further research up to 1960 in the ER (NIOSH, 2008), but extended the date to 1965 when it published an addendum to the ER in May 2010 (NIOSH, 2010a).	NIOSH published Addendum 2 to its ER in August 2011 (NIOSH, 2011a) recommending that workers with certain area and dosimetry codes who worked between Jan. 1, 1953, and Sept 30, 1972, be added to the SEC because of the infeasibility of thorium dose reconstruction in certain buildings in this period.	SC&A did an analysis of the completeness of area and dosimetry codes in the records of 10 claimants (not a random sample) (SC&A, 2011e). Update – February 21, 2014: This issue is resolved.	Resolved. Board recommended addition of all workers from Jan. 1, 1953, to Sept. 30, 1972, to the SEC. Includes CTWs and non-construction workers (NCWs).
2	Thorium, 1965 onwards	7.1.1.8	Thorium 1965 and after. No coworker model or specific approach to bounding dose was provided in the ER.	Refer to issue 1 up to September 30, 1972. NIOSH is researching the thorium issue after that date.	SC&A has provided draft reports to the Board indicating some thorium work after Sept. 30, 1972. Update – February 21, 2014: NIOSH has published Addendum 3 to its ER (NIOSH, 2012a). NIOSH has also published its internal coworker dosimetry data in NIOSH 2013a and a revision of that document (NIOSH, 2013b). SC&A has reviewed NIOSH 2012a and the data relating to thorium that NIOSH proposes to use (SC&A, 2013a). NIOSH has responded to SC&A's review (NIOSH, 2014a). SC&A is reviewing the new information in NIOSH 2013b and NIOSH 2014a and provided its comments during the Work Group meeting held on February 5, 2014, and will provide further comments during the conference call scheduled for February 26, 2014. SC&A's review of NIOSH SRS coworker models is connected with its review of NIOSH's proposal to aggregate internal monitoring data according to a "One Person-One Sample" (OPOS) method, as described in NIOSH 2012b. SC&A's review of the OPOS method, in	Resolved up to Sept. 30, 1972. Open after that.

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					<p>general, has been issued to the SEC work group. SC&A's review of OPOS includes some SRS-specific matters. SC&A's SRS-specific finding is that SRS NCW data cannot be used for the estimation of unmonitored CTW internal doses for a variety of reasons. NIOSH disagrees and contends that it can.</p> <p>Update – March 2022: NIOSH issued ORAUT-RPRT-0070, "Evaluation of Method for Assessment of Thorium-232 Exposures at the Savannah River Site from 1972 to 1989" (NIOSH, 2017a). This document discusses a new method for bounding potential internal doses from thorium using known inventories and routine air monitoring data. Following issuance of Addendum 3, NIOSH learned that the method used to analyze urine samples for trivalent radionuclides was changed in 1990 to alpha spectroscopy, which rendered the proposed use of trivalent radionuclide bioassay coworker data impracticable. SC&A provided comments in an October 2018 response (SC&A, 2018), with one finding re alternate sampling methods as applied to decontamination and decommissioning and off-normal sources. NIOSH responded in December 2018 and agreed with SC&A's finding and clarified that "the intake rate associated with these data should only be used for normal conditions," with a 50th percentile co-worker intake applied for off-normal circumstances (NIOSH, 2018, p. 5). This issue appears to be resolved, although work group closure is needed.</p>	

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3	Recycled uranium (RU)	7.1.1.2	This issue is in part a carry-over from the SC&A technical basis document (TBD) review (SC&A, 2005, p. 71). A timeline for the RU operations has not been published.	Some revised trace contaminant data were provided in July 2010 (NIOSH, 2010b) using U.S. Department of Energy (DOE) RU publications and a 1984 SRS document as references. A start date of 1955 for RU was provided.	<p>SC&A started a review of the NIOSH ratios and associated reference material. Report preparation was stopped pending resolution of issues related to ER addenda.</p> <p>Update – February 21, 2014: SC&A is preparing a review of the RU ratios; the review is scheduled to be completed by June 2014.</p> <p>Update – March 2022: SC&A issued its review in a memorandum of June 6, 2014, that requested clarification of NIOSH's ratios and associated supporting material. SC&A's major concern was that there were "two different tables provided by NIOSH, and it is not obvious how the values in the tables were derived; therefore, it is difficult to evaluate them" (SC&A, 2014b, p. 2). SC&A recommended to the SRS work group that NIOSH (1) restate and justify their recommended RU components and their appropriate values and (2) provide a description of how the recommended values were derived, so that they can be independently verified. This would include the location in the documents where the values were obtained, any assumptions, conversion factors, and other information necessary to trace the values NIOSH recommends. While no NIOSH response was found, this issue may have been overtaken by other, broader reviews of RU. SC&A believes this to be a matter of clarification, not of SEC significance.</p>	Relevant only after Sept. 30, 1972.

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4	Trivalent actinides americium (Am), curium (Cm), and californium (Cf)	7.1.1.5, 7.1.1.6, 7.1.1.7	Trivalent actinides: Am, Cm, and Cf. There are no data for Cm-244 until 1963 (ER figure 7-1). Data analysis and coworker models have not been provided for any period. Relevance of later data to earlier periods has not been established. Relationship between NCW and CTW intakes for trivalent radionuclides in the period before monitoring began and after monitoring began has not been established. Where NIOSH proposes to use gross alpha data (e.g., for Cf-252, method for selecting workers for assigning dose and selecting the radionuclide) have not been scientifically established. The resulting dose estimates would need to be examined for validity and reasonableness. Cf-252 assignment would also need to be reviewed in relation to spontaneous fission-related organ doses (including neutrons from spontaneous fission after intake).	NIOSH proposes to use measured data or coworker models for estimating dose with sufficient accuracy (ER sections 7.1.1.5 to 7.1.1.7). Since data were collected for all three trivalent radionuclides rather than each separately, NIOSH proposes to assign the result to Cf-252 as appropriate (ER, p. 51). NIOSH has not yet published its coworker model. NIOSH has specified an International Commission on Radiological Protection (ICRP) model for Cf-252 spontaneous fission.	<p>SC&A awaits the coworker model and will review it when it is available. SC&A agrees with NIOSH regarding the ICRP model for Cf-252.</p> <p>Update – February 21, 2014: NIOSH has published a coworker model for trivalent actinides (NIOSH, 2012d). Many of the findings for thorium in SC&A 2013a apply to NIOSH’s proposed methods for coworker trivalent actinide dose estimation because NIOSH proposes to use trivalent actinide monitoring data for thorium dose reconstruction. Therefore, SC&A has not reviewed NIOSH 2012d as such, pending resolution of the findings in SC&A 2013a that also apply to NIOSH 2012d. SC&A notes that SC&A 2013a does not address adequacy or completeness of SRS trivalent actinide data for coworker modeling of those three radionuclides (Am, Cm, Cf).</p> <p>Update – March 2022: SC&A reviewed rev. 03 (NIOSH, 2016c; SC&A, 2017) and rev. 04 (NIOSH, 2019; SC&A, 2020) of ORAUT-OTIB-0081, “Internal Coworker Dosimetry Data for the Savannah River Site,” with findings and observations discussed by the work group. Additional reviews were conducted regarding multiple imputation methods and trivalent bioassay variability. Remaining issues are before the work group for discussion and are summarized in the October 25, 2021, internal memorandum, “Updated Status of SEC-00103-Related Issues” (SC&A, 2021).</p>	SC&A has not checked the ending date for these radionuclides. Now only relevant after Sept 30, 1972.

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5	Np-237	7.1.1.4	Data analysis and coworker model not provided. Adequacy of data for coworker model not established. Applicability of back-extrapolation of data from 1960s and after to pre-1960 period not established.	NIOSH proposes to use data for the workers who were monitored to reconstruct their dose and a coworker model for the rest. Data available from 1960 onward in claimant database. NIOSH has not yet published its coworker model.	<p>SC&A awaits the coworker model and will review it when it is available.</p> <p>Update – February 21, 2014: NIOSH has published a coworker model for Np-237 (NIOSH, 2012c), which SC&A has reviewed (SC&A, 2013b). NIOSH has responded to SC&A's review (NIOSH, 2014b). SC&A provided its comments regarding NIOSH 2014b at the meeting held on February 5, 2014, and will provide further comments during the during the work group conference call scheduled for February 26, 2014. SC&A's review of NIOSH SRS coworker models is connected to its review of NIOSH's proposal to aggregate internal monitoring data according to an OPOS method (NIOSH, 2012b). SC&A's review of the OPOS method, in general, has been issued to the SEC work group. SC&A's review of OPOS includes some SRS-specific matters. SC&A's SRS-specific finding is that SRS NCW data cannot be used for the estimation of unmonitored CTW internal doses for a variety of reasons. NIOSH disagrees and contends that it can.</p> <p>Update – March 2022: NIOSH issued RPRT-0065 (2016a, neptunium operations), RPRT-0077 (2016b, codes), and RPRT-0080 (2017c, Plutonium Fuel Form Facility), with SC&A and NIOSH exchanging responses for all three reports. The outstanding issues await work group discussion and resolution and are summarized in SC&A's October 25, 2021, memorandum, "Updated Status of SEC-00103-Related Issues" (SC&A, 2021).</p>	Now relevant only after Sept. 30, 1972.

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6	Fission and activation products	7.1.1.9	Validity of back-extrapolation of strontium (Sr)-90 data has not been established. Adequacy of fission product monitoring data for coworker model has not been established. ER states that strontium radioisotope monitoring began in the "late 1950s." The proposed coworker model has not been published.	NIOSH has not yet published its coworker model.	<p>SC&A awaits the coworker model and will review it when it is available.</p> <p>Update – February 21, 2014: NIOSH has published a coworker model for mixed fission and activation products (NIOSH, 2012e). Some of the findings for thorium and neptunium in SC&A 2013a and SC&A 2013b apply to NIOSH's proposed methods for mixed fission and activation products. SC&A has not reviewed NIOSH 2012e as such, pending resolution of the findings in SC&A 2013a and SC&A 2013b that also apply to NIOSH 2012e. SC&A notes that SC&A 2013a and SC&A 2013b do not address adequacy or completeness of SRS mixed fission and activation product data for coworker modeling of those radionuclides.</p> <p>Update – March 2022: SC&A reviewed rev. 03 (NIOSH, 2016c; SC&A, 2017) and rev. 04 (NIOSH, 2019; SC&A, 2020) of ORAUT-OTIB-0081, with findings and observations discussed by the work group. Remaining issues are before the work group for discussion and are summarized in SC&A's informal, internal October 25, 2021, memorandum, "Updated Status of SEC-00103-Related Issues" (SC&A, 2021).</p>	Now relevant only after Sept. 30, 1972.

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7	Co-60	7.1.1.10	Validity of use of fission product data prior to 1960 has not been established. Coworker model has not been published. ER does not address the issue of incidents. Individual bioassay data or coworker model based on claimant data will be used. Targets were encapsulated (comment in TBD matrix). The potential similarity of the irradiation of encapsulated sources is noted in the July 7, 2007, work group meeting notes.	NIOSH has not yet published its coworker model.	<p>SC&A awaits the coworker model and will review it when it is available.</p> <p>Update – February 21, 2014: NIOSH covered cobalt (Co)-60 in its report on “exotic radionuclides” (NIOSH, 2012f). NIOSH states that whole body counting data are available. There is no indication of production after October 1, 1972, in NIOSH 2012f. SC&A has not reviewed NIOSH 2012f.</p> <p>Update – March 2022: SC&A reviewed rev. 03 (NIOSH, 2016c; SC&A, 2017) and rev. 04 (NIOSH, 2019; SC&A, 2020) of ORAUT-OTIB-0081, with findings and observations discussed by the work group. Remaining issues are before the work group for discussion and are summarized in SC&A’s informal, internal October 25, 2021, memorandum, “Updated Status of SEC-00103-Related Issues” (SC&A, 2021).</p>	Now relevant only after Sept. 30, 1972.
8.	Po-210	7.1.1.11	The coworker model has not been published. Incidents are not addressed. Relationship of CTW to NCW intakes has not been established.	NIOSH published a paper on polonium (Po)-210 in January 2011 (NIOSH, 2011b). The Po-210 program at SRS ended in 1970.	<p>No review needed.</p> <p>Update – February 21, 2014: NIOSH’s report on exotic radionuclides (NIOSH, 2012f) includes further information on Po-210 and does not provide any indication of production of Po-210 after October 1, 1972. SC&A has not further checked the ending date for Po-210 production at SRS. SC&A recommends that this issue be tentatively closed.</p> <p>Update – March 2022: Awaits work group action.</p>	Resolved by the Board SEC vote. Ending date may need to be checked.

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9	Tritium	7.1.1.1	NIOSH has not demonstrated that the TBD approach of applying environmental doses to unmonitored workers (no badge, no bioassay) and reporting level to workers with external monitoring only is suitable for unmonitored CTWs. NIOSH has not demonstrated that it has a bounding dose approach for tritium for CTW.	NIOSH published a report on use of tritium data for CTW exposure estimation in November 2010 (NIOSH, 2010c). NIOSH is preparing a second part of this report that specifically addresses CTW vs. NCW exposure.	<p>SC&A published a report that included tritium, comparing CTW and NCW data, in January 2010 (SC&A, 2010b) and another in November (SC&A, 2010c) using a larger tritium bioassay database provided by NIOSH. Both indicate that CTWs had higher bioassays than NCWs in some areas, some periods, and some job types. SC&A will produce a single review of NIOSH's tritium report when the second part is published.</p> <p>Update – February 21, 2014: NIOSH published Part 2 of its tritium report in November 2011 (NIOSH, 2011c). SC&A has not resumed its review of tritium-specific issues pending resolution of findings relating to issues 2, 4, 5, and 6, as well as general issues relating to the methods by which CTW and NCW monitoring data can be compared and/or combined (matrix issue 13).</p> <p>Update – March 2022: SC&A reviewed rev. 03 (NIOSH, 2016c; SC&A, 2017) and rev. 04 (NIOSH, 2019; SC&A, 2020) of ORAUT-OTIB-0081, with findings and observations discussed by the work group. Remaining issues are before the work group for discussion and are summarized in the October 25, 2021, memorandum, "Updated Status of SEC-00103-Related Issues" (SC&A, 2021).</p>	Only the data from Oct. 1, 1972, onward will be evaluated. There have been tritium/tritides-related data capture visits and interviews (NIOSH and SC&A). SC&A tritium interview summary has been merged with a prior summary of other issues. Combined summary is being sent to DOE for classification review.

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10	Special tritium compounds for CTWs	NA	ER refers to ORAUT-OTIB-0066 (NIOSH, 2007b) for special tritium compound exposure. Relationship of CTW to NCW exposure to special tritium compounds or some other means of bounding CTW exposure to them needs to be established. OTIB-0066, which discusses a method to calculate doses due to exposure to special tritium compounds, is not specific to SRS and does not discuss dose reconstruction issues for such compounds specific to CTWs.	The solubility of one—lanthanum-nickel hydride—is under investigation at SRS. NIOSH is completing a draft of its interview notes.	SC&A awaits the NIOSH approach to estimating tritide doses. Update – February 21, 2014: NIOSH has not published any data regarding tritides since the last matrix update in 2011. Update – March 2022: NIOSH issued ORAUT-RPRT-0072, “Locations of Stable Metal Tritide Use at the Savannah River Site,” in 2017 (NIOSH, 2017b). SC&A reviewed and provided comments in 2018 with a NIOSH response in 2019. No findings to date. Needs work group discussion and resolution.	Refer to issue 9 for interview status.
11	Exotic radionuclides	7.1.1.9 in part	About 150 radionuclides were produced at SRS, and targets were fabricated there (NIOSH, 2006, p. 25). No analysis of the production processes is provided, nor are there any descriptions of incidents. The incident database is incomplete, which was one of SC&A’s findings in its TBD review. The lack of analysis may be parallel to the situation at Y-12, where a large number of isotopes were produced, with the difference that at Y-12, they were produced in accelerators, and at SRS, they were produced in reactors. No documentation of the encapsulation processes is provided. The exceptions to the coverage of radionuclides by whole-body counting are not discussed. There is no discussion of whether any of the target materials were themselves radioactive.	NIOSH will respond to the SC&A report on exotic radionuclides. NIOSH will also sort out what other radionuclides were produced that are not in the SC&A report. NIOSH will specify dose reconstruction methods with due attention to the criteria for exotic radionuclides presented by Jim Neton to the Board during the November 2010 Santa Fe Board meeting.	SC&A provided the work group with a report on exotic radionuclides in December 2010 (SC&A, 2010d). Update – February 21, 2014: NIOSH published a report on exotic radionuclides in 2012 (NIOSH, 2012f). SC&A 2010d raised a question whether an exotics production program that was proposed in 1969 was ever pursued. NIOSH did not find any evidence that it was (NIOSH, 2012f, p. 12). SC&A has not reviewed this finding. Most of NIOSH 2012f covers the pre-1972 period. SC&A has not further reviewed the periods of exotic radionuclide production beyond that in SC&A 2010d. Update – March 2022: No further discussion of this issue is evident. No apparent SEC issues have been found. Awaits work group disposition.	Only relevant after Sept. 30, 1972.

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12	Internal dose due to incidents	5.2.3, 7.3.6	The Special Hazards Investigations list is incomplete. In its Tank Farm Fault Tree Databank, the site acknowledged that many early Tank Farm area incidents were not recorded (until 1965). The ER states that there are incident records, including the Special Hazards Investigation files, and that NIOSH has data relating to incidents (ER, p. 29). No evidence of cover up of incidents was found, and NIOSH can bound dose in any case (ER p. 71).	NIOSH will respond to the SC&A report. NIOSH may follow up with workers interviewed by SC&A.	<p>SC&A prepared a report on extent of and potential gaps in incident documentation in worker records to elaborate on its TBD review finding (SC&A, 2011b).</p> <p>Update – February 21, 2014: NIOSH has not responded to SC&A 2011b. The issue remains open.</p> <p>Update – March 2022: Work group closed this issue at February 26, 2014, meeting.</p>	Interviews also indicate that there were unrecorded incidents. Only relevant after Sept. 30, 1972.
13	Overall CTW to NCW internal dose relation	7.1	ER states that ORAUT-OTIB-0052 (NIOSH, 2007a) found NCW intakes “were generally higher than construction trades workers” (ER, p. 39). OTIB-0052 suggests a 1:1 ratio for CTW to NCW intakes. SC&A analysis indicates that the assumption that NCW intakes (as indicated by bioassay data) would be generally higher than for CTW is not generally valid. The adequacy of bioassay data for constructing coworker models needs to be examined for different periods, areas, radionuclides, and types of CTWs.	NIOSH has produced an analysis of tritium data comparing CTWs to all workers (including CTWs) (NIOSH, 2010c). NIOSH is preparing a second part comparing CTWs to NCWs. NIOSH is also revising OTIB-0052. NIOSH included both CTWs and NCWs in its thorium SEC recommendation in the ER Addendum 2 (NIOSH, 2011a).	<p>Besides the two reviews of CTWs vs. NCWs (SC&A 2010b and SC&A 2010c), SC&A also produced a report evaluating the plutonium database used in OTIB-0052 (SC&A, 2010e). SC&A also published a master interview summary as part of SC&A 2011b; this summary contains some discussion of CTW vs. NCW matters. SC&A was to review NIOSH’s revision of OTIB-0052 when it is published. SC&A will await instructions on this issue, given the December 8, 2011, Board vote on the SRS SEC to include CTWs and NCWs.</p> <p>Update – February 21, 2014: This issue is being covered under the review of coworker models for specific radionuclides as well as in SC&A’s review of the NIOSH’s “One-Person-One-Sample” aggregation of monitoring data. A number of findings relating to CTW dose reconstruction, comparison on NCW and CTW distributions of measurements, and NIOSH’s coworker models remain open.</p> <p>Update – March 2022: This issue is subsumed under the work group’s review of OTIB-0081 and the extensive</p>	CTW vs. NCW resolved up to Sept. 30, 1972, by Board vote of 8 Dec. 1972 since both CTW and NCW were included in the SEC recommendation. Also, issues 19 (tentatively) and 21 are closed. A considerable amount of work has been done by NIOSH and SC&A as indicated in the reports cited here. The work group had directed tritium data as the current focus of this issue to be followed by uranium. This is still an outstanding issue for the period after Sept. 30, 1972. Issue may need re-assessment in light of the inclusion of both CTWs and NCWs in the SEC up to Sept. 30, 1972.

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					work group deliberations in 2017–2021 that led to an SEC class being designated for SRS subcontractors for 1972–1990.	
14	Special exposure conditions	7.4.2	There are several areas of concern that can be described as “special exposure conditions,” including off-normal or unauthorized work practices, burning of spent tributyl phosphate in open pans in the early years (to 1971), and high exposure potential during certain authorized work practices, such as opening tank risers or cleanup of high-level waste leaks.	NIOSH has stated that it has air concentration data in the burning ground area, and that it will provide a dose reconstruction approach.	Refer to comment column. Update – February 21, 2014: This issue has been subsumed under matrix issue 12 for the period October 1, 1972, through 2007.	SC&A worker interviews done as part of the SEC investigation also indicate off-normal practices and high exposure potential during certain types of work, including in the Tank Farms. A master summary of SC&A’s interviews (excluding tritides) is in SC&A 2011b. The burning ground issue is no longer relevant, since open pan burning ended in February 1972 (WSRC, 2000, PDF p. 1068).
15	Construction worker job types		Worker intakes and coworker models may have to be built by CTW job type in order to ensure that the models are bounding doses (or more accurate than bounding doses).	NA	Update – February 21, 2014: Refer to update for matrix issue 13.	This issue is merged into issue 13.
16	OTIB-0075 validity for SEC use – internal dose	7.1, 7.3.4, 7.4.2	The use of ORAUT-OTIB-0075 (NIOSH, 2009b), which asserts representativeness of claimant data for the whole worker population, for SRS CTW SEC is questionable.	NIOSH also produced a report on data with a significant fraction of “less-than” results that is general, but also applies to the SRS SEC (NIOSH, 2009a).	SC&A reviewed OTIB-0075 (SC&A, 2010b). SC&A also reviewed NIOSH 2009a (SC&A, 2010f). Update – February 21, 2014: Refer to update for matrix issue 13	This issue is merged into issue 13.

Matrix issue no.	Issue brief	ER section no.	Issue description	NIOSH issue status	SC&A review status/update	Current status (March 2022)
17	Early neutron dose to 1961	7.2.2.2	Fig. 7-3 of the ER (p. 65) shows no neutron monitoring data for the 200-F Area until about 1958, and generally less than 20 badges per cycle until 1962 (except for part of 1959). This was "one of the highest neutron-exposure areas at SRS," according to the ER (p. 64). The entire early period will have to depend almost exclusively on area neutron and photon monitoring data. The relationship of the neutron-to-photon (n/p) ratio data to workers and their personnel neutron exposure experience will need to be established with essentially no reference to actual monitoring data. It is unclear whether there are any early neutron monitoring data for CTWs.	NIOSH will use an approach based on n/p ratios. On Feb. 3, 2011, NIOSH reported no progress on this item, which has been pushed down the list of priorities due to many other action items. NIOSH will provide a date when this will be done. NIOSH stated it has the data to do dose reconstruction.	Update – February 21, 2014: This issue has been resolved.	This issue is resolved by the Dec. 8, 2011, Board vote.

Matrix issue no.	Issue brief	ER section no.	Issue description	NIOSH issue status	SC&A review status/update	Current status (March 2022)
18	Neutron dose 1962–1971	6.2 and 7.2.2	ER acknowledges unmonitored dose at SRS due to neutrons, since monitoring was required only when area neutron dose rates were in excess of 1 mrem per hour. Neutron data are very sparse in general up to the mid-1960s, and sparse even after that. Representativeness of area monitoring for worker exposure and representativeness of available n/p data for all workers in the class needs to be assessed. Additionally, back-extrapolation of post-1972 data was proposed in the TBD. It is unclear whether there will be back-extrapolation to demonstrate bounding dose; if there is, the validity of such back-extrapolation may need to be examined. Validity of assumption of low neutron doses in the reactor areas needs to be examined. Validity of implicit assumption that CTW neutron doses were lower than NCWs needs to be examined in view of the higher bioassay results for some periods and radionuclides, including plutonium in some periods.	NIOSH had stated that it has paired neutron and photon data and may issue a report in March 2011.	Update – February 21, 2014: This issue has been resolved.	This issue is resolved by the Board vote of Dec. 8, 2011.
19	Test reactor neutron dose	NA	Neither the ER nor the TBD analyzes the neutron dose at the Heavy Water Components Test Reactor. Issue of an incident was raised in a worker interview done by SC&A.	NIOSH is addressing neutron doses as part of issues 17 and 18.	SC&A research did not result in any specific information about this accident (such as date and accident description). Update – February 21, 2014: No information that would warrant a reopening of this issue has come to light since the last matrix update.	One SC&A interviewee indicated an incident took place at this reactor (crack in the core). No further information was available from the interviewee, and no information on such an incident was found in document research done by SC&A. As a result, this issue has been tentatively closed.

Matrix issue no.	Issue brief	ER section no.	Issue description	NIOSH issue status	SC&A review status/update	Current status (March 2022)
20	Tank Farm exposure geometry	NA	NIOSH to estimate the geometry of exposure in special work situations, such as those described in the F and H Area Tank Farm Fault Tree Databank, and the frequency with which these corrections may need to be applied to external dose. While correction factors can, in principle, be calculated, it is not clear that a scientifically valid set of scenarios, including time worked and radiological conditions, can be constructed. NIOSH has not addressed this issue in the ER.	NIOSH is preparing a model for developing adjustment factors due to geometry of exposure in the Tank Farm.	SC&A will review the NIOSH report when it is published. Update – February 21, 2014: NIOSH has stated that it is using MCNP modeling to address this issue. The final model has not been published. This issue was put into a low priority since external dose geometry issues have been satisfactorily resolved in the past and have not been SEC issues (ABRWH, 2013, pp. 57–64).	A more general issue of geometry, and specifically hand exposure, has been raised in worker interviews. NIOSH is preparing a Tank Farm geometry report. Work group needs to address whether work beyond that is needed for SEC review. Open pan burning issue is not relevant since it ended in Feb. 1972.
21	External exposure co-worker data adequacy for CTWs	7.2.1.3	ORAUT-OTIB-0052 (NIOSH, 2007a) is claimant favorable for a large majority of CTWs. However, it is not claimant favorable for some categories. A bounding dose (or better) demonstration needs to be made for all CTW job types.	A suitable adjustment has been made for all CTWs. No further work is needed.	SC&A agrees that existing databases can be used for CTW coworker external dose estimation with appropriate adjustment. This does not include issues 22 and 23, which do not concern coworker data adequacy. Refer to SC&A's review of OTIB-0052 (SC&A, 2007). Update – February 21, 2014: This issue has been resolved.	No issue at this time.
22	Badges not capturing dose		SC&A worker interviews suggest that workers kept their badges out of higher radiation areas in order not to exceed dose limits, or sometimes CTWs would be in radiological situations without knowing it (one incident is described when workers were working with radioactive tools thought initially to be clean).	NIOSH will review the SC&A report.	SC&A prepared a report compiling worker issues relating to radiation dose as it was experienced compared to dose that was recorded. This includes matrix issue 23 (SC&A, 2011c). Update – February 21, 2014: NIOSH has not responded to SC&A 2011c. Update – March 2022: SC&A did not find a response or disposition on this but acknowledges that this is not likely an SEC issue.	No issue at this time.

Matrix issue no.	Issue brief	ER section no.	Issue description	NIOSH issue status	SC&A review status/update	Current status (March 2022)
23	External dose recording accuracy and completeness	7.3	Petitioners raised the issue of working conditions with high dose rates when badge dose may have been under-recorded or not recorded (such as weekend work) and/or pencil dosimeters were off-scale, or when there are zero doses in the record. An issue connected to this would be whether the HPAREH database reflects actual work experience. Petitioners also state that in some cases, workers thought they were working in clean areas that were then determined to be contaminated.	NIOSH will respond to the SC&A report.	SC&A 2011c covers both matrix issues 22 and 23. Update – February 21, 2014: Refer to update on matrix issue 22.	This issue has been merged with issue 22. SC&A prepared a single report on matrix issues 22 and 23.
24	Early monitoring data	Various	The ER has addressed lack of early monitoring data for many workers and radionuclides by a number of devices, including building coworker models, using reporting levels, using air monitoring data, and estimating n/p ratios. While each of these needs to be assessed in its own right (as described in the issues listed in this matrix), an overall assessment of early recordkeeping practices, adherence to procedures, and adequacy of data appears to be warranted.		Update – February 21, 2014: This matrix issue has been resolved.	This issue had been merged with other issues but is no longer an SEC issue in view of the Board vote on Dec. 8, 2011.

Matrix issue no.	Issue brief	ER section no.	Issue description	NIOSH issue status	SC&A review status/update	Current status (March 2022)
25	Environmental dose	None	Using dispersion modeling of stack source terms as described in the TBD and referred to in the ER (p. 72) is not appropriate for onsite SRS workers. For instance, thousands of gallons of solvents contaminated with fission products and plutonium were burned in the burning ground. Use of a Gaussian plume model is not appropriate here, especially for particles greater than half a micron. Furthermore, the resuspension factor does not appear to be claimant favorable and is not entirely appropriate for this class of problem. It may not be claimant favorable by three or four orders of magnitude. Even for stack releases, one potentially significant issue is the non-conservatism of the standard Gaussian model used in the TBD, where it pertains to "non-standardized" short-term releases occurring during stable atmospheric conditions.	Refer to issue 14.	Update – February 21, 2014: Merged with issue 14. This matrix issue has been resolved for open pan burning.	This issue has been merged with issue 14. Now resolved since open-pan burning stopped in Feb. 1972. Refer to comment for issue 14.

Matrix issue no.	Issue brief	ER section no.	Issue description	NIOSH issue status	SC&A review status/update	Current status (March 2022)
26	Additional worker and worker representative issues	NA	Worker and petitioner representatives raised various issues during work group meetings and comment periods.	NIOSH will respond to SC&A report.	<p>SC&A compiled a report detailing the issues raised and categorized them, with an indication of where the issue was already covered by an existing matrix issue (SC&A, 2011d).</p> <p>Update – February 21, 2014: NIOSH has not provided a specific response to SC&A 2011d. The issues raised in SC&A 2011d are broadly similar to matrix issues 12 and 22/23 in most cases, but workers provided specific additional examples, such as lack of Health Physics coverage in some cases.</p> <p>Update – March 2022: While a number of these comments are addressed in other SEC issues reviewed by the work group and NIOSH, a full response is not evident. SC&A acknowledges that none of the issues to date are of apparent SEC significance.</p>	No issue at this time.

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