



Summary of Four Document Reviews Approved by the Subcommittee for Procedure Reviews

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Advisory Board on Radiation and Worker Health

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SPR-approved documents

- ◆ DCAS-PER-042, rev. 0, “Linde Ceramics Plant TBD Revision”
- ◆ DCAS-PER-055, rev. 0, “TBD-6000 Revision”
- ◆ ORAUT-RPRT-0078, rev. 00, “Technical Basis for Sampling Plan”
- ◆ ORAUT-OTIB-0054, rev. 01, “Fission and Activation Product Assignment for Internal Dose-Related Gross Beta and Gross Gamma Analyses”

DCAS-PER-042, rev. 0

- ◆ Title: “Linde Ceramics Plant TBD Revision”
- ◆ Issued November 16, 2012
- ◆ Determines the effect between the issuance of rev. 03 and all previous versions of the Linde Ceramics Plant technical basis document (TBD) (ORAUT-TKBS-0025)
- ◆ Revisions resulted in both decrease and increase in dose:
 - Doses decreased due to establishment of three SECs based on inability to reconstruct internal doses
 - Doses increased due to:
 - Changes in exposure scenarios in utility tunnels
 - Distribution of internal dose applied to construction trade workers

Linde Ceramics Plant Operations

- ◆ Included three different uranium production activities
 - Production of U_3O_8 from June 1943 through July 1946
 - Production of UO_2 from April 1943 through March 1944
 - Production of UF_4 from July 1943 through June 1946
- ◆ Received UO_2 from Mallinckrodt Chemical Works from 1947 to 1949
- ◆ Produced nickel material for K-25 diffusion barrier
- ◆ Operation period October 1, 1942–October 31, 1953
- ◆ Residual period January 1, 1954–July 2006

SC&A's review of PER-042, rev. 0

- ◆ Review issued [August 19, 2014](#)
- ◆ SC&A's Subtasks 1–3 review identified two findings
- ◆ SC&A presented this review to the SPR at its August 28, 2014, meeting

PER-042 finding 1

Finding date	Finding description	NIOSH response	Finding resolution
8/19/2014	SC&A questions restrictive methodology behind failing to assign internal exposure for uranium and radon for 1954–1969 (part of SEC period) due to the availability of air sampling data representing the operational and residual period, which satisfy OTIB-0070 criteria.	2/18/2015. Based on SEC regulations, NIOSH cannot develop a model using any data during the designated SEC period. Since a portion of the residual period falls within the SEC timeframe, doses cannot be estimated using OTIB-0070 guidance. NIOSH will, however, use any internal or external monitoring data that may become available.	2/18/2015. SPR found this explanation acceptable and closed the finding.

PER-042 finding 2

Finding date	Finding description	NIOSH response	Finding resolution
8/19/2014	Radon exposure rates in tables 6-11 and 6-12 of ORAUT-TKBS-0025 rev. 03 are correctly based on occupancy factors of 50% and 5% for trade workers and all other, respectively, not by the occupancy factors described in the text. 2/19/2016. SC&A reviewed TBD rev. 04 and confirmed wording has been appropriately changed.	11/25/2014. NIOSH agrees and indicated that the language will be changed appropriately in the next TBD revision. 12/17/2015. NIOSH reports that TBD was revised 5/8/2015.	11/25/2014. SPR agreed and changed status to in abeyance. 5/16/2016. Since SC&A confirmed revised TBD wording is correct, SPR closed the finding.

SC&A's Subtask 4 review of PER-042, rev. 0

- ◆ Two cases of the 71 cases evaluated were selected for review of reworked external and internal doses
- ◆ Subtask 4 report issued [December 8, 2014](#)
- ◆ SC&A's Subtask 4 review identified one finding
- ◆ Review presented to SPR at its February 18, 2015, meeting

PER-042 finding 3 (Subtask 4)

Finding date	Finding description	NIOSH response	Finding resolution
12/8/2014	NIOSH used an incorrect skin dose conversion factor (DCF) of 0.892 from IG-001 rather than the OTIB-0017 value of 1.0 for plant photon dose. It was noted that the outcome would not be impacted.	2/18/2015. No response was provided or required.	2/18/2015. SPR concluded that incorrect DCF would not affect the outcome and closed the finding.



Discussion of PER-042

DCAS-PER-055, rev. 0

- ◆ Title: “TBD-6000 Revision”
- ◆ Issued September 12, 2014
- ◆ Determines the effect of Battelle-TBD-6000, rev. 1, on previously adjudicated cases
- ◆ Revisions resulted in both decrease and increase in dose:
 - Revision to conversion factors from uranium surface contamination
 - Slight decrease in photon values
 - Beta dose rate values increased due to introducing conversion factors
 - Revision to surface contamination settling time (30 days):
 - External dose decreased for nonoperational areas (365 day in rev. 0)
 - External dose increased for metal-working processes (7 days in rev. 0)
 - Beta dose rates added resulting in an increase in dose for both operational and nonoperational areas

SC&A's review of PER-055, rev. 0

- ◆ Subtasks 1–3 review issued [July 24, 2015](#)
- ◆ SC&A presented review to the SPR at May 16, 2016, meeting
- ◆ Under Subtask 2, SC&A noted that TBD-6000, rev. 0, was reviewed under the TBD-6000 Work Group (WG) and SC&A identified 10 findings
 - 9 findings were resolved by WG
- ◆ One remaining finding was carried over to PER-055 review

Issue resolution for PER-055 finding 1

Finding date	Finding description	NIOSH response	Finding resolution
7/21/2015	For a short period of time (months) after the melting and molding of uranium, Th-234 migrates to the surface during the cooling process, known as the Putzier effect. This could result in a 10–15-fold increase in the beta field and a significant skin dose during the handling of uranium metal. Is this potential effect being included in the calculation of external dose to the skin?	10/31/2018. Issue was discussed extensively at many TBD-6000 WG meetings. NIOSH explained that external doses are entered in IREP as a lognormal distribution with GSD of 5, which makes the 95th percentile almost 15 times the geometric mean.	10/31/2018. Issue resolved to the satisfaction of the Subcommittee and the finding was closed.

SC&A's Subtask 4 review of PER-055, rev. 0

- ◆ Two cases of the 30 cases evaluated were selected for review of external and internal doses
- ◆ Subtask 4 report issued December 7, 2016
- ◆ Review presented to SPR at its January 10, 2017, meeting

PER-055 Case A: POC changed to >50%

- ◆ SC&A compared original DR to the reworked DR
- ◆ No formal revised DR found in file
- ◆ PER database contained 2 files indicating NIOSH calculated doses using TBD-specific job category and environmental doses
- ◆ Although internal and external doses decreased for both calculational methods, the original POC of 28% increased to >50%
- ◆ POC increased in reworked DRs due to internal doses being entered in IREP as lognormal distributions with geometric standard deviation (GSD) of 5 rather than a constant
- ◆ SC&A confirmed doses calculated correctly and was able to calculate POC values of >50% for both exposure scenarios
- ◆ SC&A had no findings or observations

PER-055 Case B: Doses decrease using OTIB-0070

- ◆ SC&A compared original DR to the reworked DR
- ◆ No formal revised DR prepared since compensation decision did not change
- ◆ External doses decreased slightly; internal doses did not change
- ◆ POC decreased slightly from 20% to 19%
- ◆ SC&A confirmed doses calculated correctly and was able to calculate a similar POC value
- ◆ SC&A had no findings or observations

SPR discussion of PER-055 Subtask 4

- ◆ **1/10/2017 SPR meeting –**
SPR questioned:
 - why the original DR for Case A entered dose values in IREP as constants rather than lognormal
 - is this issue confined to only this case or are other cases impacted
- ◆ Due to significant impact of entering doses as lognormal with GSD of 5, SPR requested NIOSH confirm no other cases were affected
- ◆ **10/31/2018 SPR meeting:**
 - NIOSH evaluated whether the error re entering doses in IREP as constants was a systemic error
 - 10 out of several 100 cases were randomly reviewed; it was determined that in all cases doses were correctly entered as lognormal distributions with a GSD of 5
- ◆ Based on this information, SPR closed this concern



Discussion of PER-055

ORAUT-RPRT-0078, rev. 00

- ◆ Title: “Technical Basis for Sampling Plan”
- ◆ Rev. 00 issue June 2016
- ◆ RPRT describes the technical basis for sampling co-exposure datasets to determine transcription error (typo) rates
- ◆ SC&A reviewed the RPRT in [October 2017](#)
 - 0 findings identified
- ◆ SC&A’s review presented to the SPR November 2017

Overview of ORAUT-RPRT-0078

- ◆ Datasets used for co-exposure modeling are often created by manually transcribing data from original records into an electronic database.
- ◆ NIOSH has specified:
 - The data acceptance criteria for the coded datasets should be such that the error rate in the analytic results should be less than 1% with the overall error rate (all data fields combined) should be less than 5%*

Methods to determine acceptance criteria of ORAUT-RPRT-0078

- ◆ Report uses statistical methods to develop a sampling plan
- ◆ Uses an application of hypothesis testing to determine whether the percentage of defects (entries with one or more typos) is within acceptable levels
- ◆ Provides insight as to how and why the plan works by using:
 - Binomial approximation for large populations
 - Confidence intervals for number of defectives
 - Operating characteristic curves
 - Examples
- ◆ Various parameters are considered for dose reconstruction purposes, which apply to both critical fields (i.e., field containing an analytical result) and all fields

Fixed parameters in ORAUT-RPRT-0078

- ◆ Total population
- ◆ Total number of typos in population

Variable parameters in ORAUT-RPRT-0078

- ◆ Producer's risk (rejecting data with acceptable typo rate) is 2.5%
- ◆ Consumer's risk (accepting data with excessively high typo rate) is 2.5%
- ◆ Acceptable error rate for critical fields is 0.5%
- ◆ Acceptable error rate for all fields is 2.5%
- ◆ Unacceptable error rate for critical fields is 1%
- ◆ Unacceptable error rate for all fields is 5%

Derived or observed values in RPRT-0078

- ◆ The value of the number of fields to be sampled under a given set of fixed and variable parameters
- ◆ The value of the accept number (i.e., number of typos in a sample of n fields) that balances the producer's and consumer's risk
- ◆ The number of typos observed in a sample of n fields
- ◆ The operating curve
- ◆ The confidence interval

SPR discussion on ORAUT-RPRT-0078

SPR question	NIOSH response	SPR action
<p>11/20/2017. The selection of acceptance criteria seems somewhat arbitrary. Is there guidance or a benchmark on how other groups determine their acceptance criteria?</p>	<p>10/31/2018. NIOSH searched the literature and could not identify any relevant guidance. An outside expert was consulted who stated no benchmarks has been established. The selection of 1% for critical values and 5% for all other values was simply an intuitive, reasonable judgement.</p>	<p>10/31/2018. Even though there appears to be no standard approach to determining acceptance criteria, the SPR considers these values reasonable and recommends NIOSH proceed with the values.</p>



Discussion of RPRT-0078

SC&A's review of ORAUT-OTIB-0054

- ◆ SC&A reviewed the following revisions of OTIB-0054 (note: current revision is rev. 04, August 2015):
 - Rev. 00 PC-1 – March 2008
 - Rev. 01 – [November 2013](#)
 - Rev. 02 – [April 2014](#); review performed as part of evaluating NIOSH's responses to SC&A's comments on OTIB-0054, rev. 01
- ◆ SC&A identified 26 findings in review of rev. 00 PC-1
 - 11 classified as observations in the BRS
- ◆ SC&A identified 10 additional findings in review of rev. 01. BRS labeled them findings 27–36

Reactor modeling in OTIB-0054: Initial 7

Representative Reactor	Category
Hanford N Reactor	Plutonium production reactors
Hanford single-pass reactors	Plutonium production reactors
Fast Flux Test Facility (FFTF)	Sodium-cooled fast reactors
Advanced Test Reactor (ATR)	High-flux reactors
Training, Research, Isotopes, General Atomics (TRIGA) Reactor (Al-clad fuel)	Research reactors
TRIGA Reactor (SS-clad fuel)	Research reactors
Pressurized-water Reactor (PWR)	Generic reactor

Reactor modeling in OTIB-0054: Final 4

- ◆ NIOSH ran 11 ORIGEN2 (radioactive buildup and decay code) cases to calculate fission and activation product inventories in fuel discharged from the initial 7 reactors considered
- ◆ The results of the 11 runs were compared based on activities relative to Cs-137 after 10 days of decay, and 4 representative reactors were selected:
 - **ATR:** high-enriched uranium, high-burnup reactors
 - **FFTF:** mixed oxide fast reactors
 - **N Reactor:** low-burnup Pu reactors (PWR cross-section library)
 - **TRIGA:** research reactors (stainless steel-clad fuel, PWR library)

Issue resolution for OTIB-0054 finding 1

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Observation on Reactor Modeling: OTIB does not specify what version of ORIGEN2 NIOSH used in performing the calculations, nor does the OTIB justify its use. 7/18/2013. SC&A reviewed and found section 5.1 identifies that NIOSH used ORIGEN2, Version 2.1.	10/4/2010. Information on the code version used (v2.1) will be added. ORIGEN2 is an industry standard tool for predicting the content of irradiated nuclear fuels. 6/13/2013. NIOSH issued rev. 01 of OTIB-0054.	10/13/2010. Status changed to in abeyance awaiting revision to OTIB. 7/18/2013. Since SC&A's review of the revised OTIB addressed the concern, the SPR closed the finding.

Findings closed by SPR as informational observations

The SPR closed 5 findings without NIOSH response because they were informational only (would be classified as observations today):

◆ Observations on Reactor Modeling:

- **Finding 2:** OTIB's advice to select decay times most appropriate to the claimants and accompanying guidance are helpful.
- **Finding 3:** The OTIB correctly notes the overestimation of activity ratios for short-lived radionuclides.
- **Finding 10:** SC&A finds the OTIB's rationale in selecting the four representative reactor cases and the seven decay times to be reasonable.

◆ Observation on ATR:

- **Finding 4:** Methodologies, assumptions, and data sources are reasonable.

◆ Observation on N Reactor:

- **Finding 6:** OTIB appears to have taken all its data for the N Reactor from authoritative sources, and reasonably simulated the actual isotopic composition after irradiation by considering two different data sets.

Issue resolution for OTIB-0054 finding 5

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	<p>FFTF: Methodologies and data sources are reasonable. SC&A questions the chosen burnup value.</p> <p>10/13/2010. At 80,000 MWd/MTHM it is likely that the Sr-90 and Cs-137 inventories have reached equilibrium and further burnup would not change their activities.</p>	<p>10/4/2010. 80,000 MWd/MTHM burnup value selected since Sr-90:Cs-137 ratio at discharge for the maximum burnup case (152,230 MWd/MTHM) was identical to that for the nominal burnup (80,000 MWd/MTHM) case (ratio equals 0.365 in both cases).</p>	<p>10/13/2010. Based on SC&A's acceptance of NIOSH's response, the SPR closed the finding.</p>

Issue resolution for OTIB-0054 finding 7

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	<p>Single Pass Reactors: The fuel dimensions, compositions, and burnup values apply to Manhattan Project era. Since the reactors continued to operate well after that period, OTIB should provide some justification for the assumption that these data did not change significantly.</p>	<p>10/4/2010. The intention was to capture the Manhattan era fuel in modeling for the single-pass reactors and the later fuel with the N Reactor model. The evolution of the solid core fuel slugs, which were used until the mid-1950s, would not affect the fission/activation product results.</p>	<p>10/13/2010. SPR tasked SC&A with reviewing NIOSH's response. Finding status changed to in progress.</p> <p>4/28/2015. SPR noted that all findings have been closed.</p>

Issue resolution for OTIB-0054 finding 8

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Observation on Single Pass Reactors: SC&A questions the OTIB referencing Robert Burns, Jr. (CHP, Sr. Health Physicist, Shonka Research Assoc.) rather than citing original source material directly and including a discussion of assumptions in the text.	10/4/2010. The discussion of bases for the data used for W slugs will be expanded to include appropriate reference citations in a future revision to OTIB-0054.	10/13/2010. SPR changed status to in abeyance awaiting OTIB-0054 revision.

OTIB-0054 finding 8 followup

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Observation on Single Pass Reactors. 7/16/2013. SC&A reviewed rev. 01 and found that OTIB section 5.2.4 of rev. 00 PC-1 (which treated the Hanford Single-Pass Reactors) has been eliminated in rev. 01. Hence, SC&A's comment no longer applies.	7/15/2013. The ORIGEN calculations for Single Pass Reactors were revised to reflect a different set of dimensions for the Manhattan-era fuel slugs. Original source documents have been cited for all data used. That discussion has been removed from OTIB-0054 and will be included in a separate document.	7/18/2013. SPR closed finding and tasked SC&A with a full review of rev. 01.

Issue resolution for OTIB-0054 finding 9

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	TRIGAs ranged in power from 20 kW to 16 MW and in U-235 enrichment from about 20% to 70%. OTIB chooses 20% enrichment but did not justify its choice. It is also not clear what reactor power level is selected.	10/4/2010. Intent was to represent TRIGA reactors used within the DOE complex that operated with moderate enrichments and burnup. The uranium content of fuel was based on assays of fuel elements from TRIGA reactor operated in Hanford Neutron Radiography Facility (NRF). A power level of 3 kW was used, which was average power level for NRF assembly.	10/13/2010. SC&A was tasked to review response. SPR changed status to in progress. 4/28/2015. Closed by SPR after SC&A reviewed and concurred with the latest version of the NIOSH workbook.

Findings about rev. 00 PC-1 closed because NIOSH removed or replaced the item at issue in rev. 01

SC&A finding	Rev. 01 resolution
Finding 11 – Reactor Source Term: SC&A notes that more than 200 nuclides are included for each of the ATR, FFTF, N Reactor, and TRIGA. There are 277 different nuclides, but a listing of the remaining 738 radionuclides for which dose conversion factors (DCFs) were obtained should be included in OTIB.	Removed DCF tables.
Finding 17 – Urinalysis: SC&A believes NIOSH did not present sufficient data to justify the derivation of the values given for the beta yield and counting adjustment factors in table F-1. NIOSH should demonstrate, using measurement data, that those factors are acceptable and best ones to be used.	Removed beta adjustment factors.
Finding 19 – Urinalysis: SC&A agrees with the way the percentage of each radionuclide’s contribution to beta and or gamma urine counts should be calculated. SC&A does not agree that results should be averaged for four reactors to determine a bounding value.	Replaced averaging over the 4 with a “limiting reactor” approach.

Issue resolution for OTIB-0054 finding 12

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Observation on Reactor Source Term: SC&A agrees with the list of radionuclides presented in table D-1, although NIOSH does not provide an explanation for the derivation of the relative exposure activity fractions listed in the table.	<p>10/4/2010. NIOSH will elaborate on the method used to calculate the values in table D-1 in the revised OTIB.</p> <p>7/15/2013. Table D-1 values are relative intake fractions that contributed at least 1% of dose to any organ or to effective dose for at least one of the three solubility categories that were deemed the dosimetrically significant nuclides. A better description of this process has been provided in the revised text.</p>	<p>10/13/2010. SPR changed status of finding to in abeyance.</p> <p>7/18/2013. Since SC&A (7/16/2013) confirmed that the OTIB revision addressed the concern, the SPR closed the finding.</p>

Issue resolution for OTIB-0054 finding 13

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Reactor Source Term: The list of 17 radionuclides in table E-1, "Simplified reactor source terms for intake calculations," should include 4 additional radionuclides (Pr-143, Co-60, Te-132, and Nd-147), using a quantitative criterion (effective doses >1% sum of effective doses for all radionuclides).	10/4/2010. NIOSH agrees and will make this change in the revised OTIB.	10/13/2010. SPR changed status of finding to in abeyance.

OTIB-0054 finding 13 followup

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Reactor Source Term: 7/16/2013. Table E-1 was revised to include each radionuclide where contribution equals 1% of effective dose for any reactor case, decay interval, and solubility category. Co-60 and Pr-143 are now on the table, but not Te-132 and Nd-147. SC&A will check calculations under review of rev. 01.	7/15/2013. The method used to establish the simplified set of dosimetrically important radionuclides was modified as recommended in OTIB rev. 01 table E-1.	7/18/2013. Based on SC&A's review of the revised OTIB-0054, the SPR closed the finding.

Issue resolution for OTIB-0054 finding 14

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Reactor Source Term: SC&A questions averaging the source terms over the four reactor types to produce the “default source terms” in table E-2, since, in most cases, the dose reconstructor would know which type of reactor or reactor fuel produced the claimant’s exposure.	10/4/2010. NIOSH does not agree that dose reconstructors will know what reactor to select in most cases. The purpose for averaging across the four representative reactors was to create a single, hypothetical, representative reactor appropriate for all sites.	10/13/2010. SPR asked SC&A to evaluate this further.

OTIB-0054 finding 14 followup in 2011

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Reactor Source Term: 8/5/2011. SC&A agrees that dose reconstructors may not know what reactor to select. However, using an average across four reactor types would not produce a bounding exposure. Source terms for the reactor type that yield the maximum exposure should be used for consistency with stated purpose of the OTIB.	8/5/2011. NIOSH asks SC&A to review OTIB-0054, section 6.3, "Verification that Default Source Terms Do Not Underestimate Dose," for justification that dose is not underestimated.	8/5/2011. SPR agreed and changed the status to in progress.

OTIB-0054 finding 14 followup in 2014

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Reactor Source Term: 4/4/2014. OTIB rev. 01 replaces the methodology of rev. 00 PC-1 with a new methodology, so finding 14 is no longer applicable and is resolved. SC&A's findings on OTIB rev. 01 cover all reactor modeling issues and supersede finding 14.	7/15/2013. The approach of averaging over 4 representative reactor cases has been replaced with one where the assigned dose is the maximum determined for 9 individual reactor cases. The 9 cases reflect a range of irradiation parameters for 4 representative reactors considered in OTIB-0054.	4/16/2014. SPR concurs with NIOSH and SC&A and closed finding.

Issue resolution for OTIB-0054 finding 15

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Reactor Source Term: Some radionuclides were not released in significant quantities from all four reactor types. The average source term for those radionuclides, as listed in table E-2 (Default Source Terms), underestimates the values given in table E-1 (Simplified Source Terms).	10/4/2010. All discussions and comments in finding 14 are the same for finding 15.	10/13/2010. SPR agrees and closed the finding.

Issue resolution for OTIB-0054 finding 16

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Source Term Verification: As the OTIB does not provide the quantitative effect of the uncertainties cited in section 6.3, SC&A cannot agree with the conclusion that the default source term produces an upper bound to doses from a nonspecific radioanalysis.	10/4/2010. NIOSH is in the process of establishing appropriate methods to assess the sources of uncertainty identified in section 6.3. Response to this comment is forthcoming.	10/13/2010. SPR changed status to in progress awaiting NIOSH's response.

OTIB-0054 finding 16 followup

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Source Term Verification: 4/4/2014. Assigning the maximum dose obtained from 9 individual reactor cases adequately addresses SC&A's concerns under this finding. Hence, the finding is resolved.	7/15/2013. OTIB-0054 rev. 01 now states to assign the maximum dose obtained from 9 individual reactor cases. The 9 cases were selected to reflect the expected range of irradiation parameters for the representative reactors so any uncertainties associated with those parameters would be encompassed with respect to assigned doses.	4/16/2014. Since the revised OTIB addresses SC&A's concern, the SPR closed finding.

Issue resolution for OTIB-0054 finding 18

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Observation on Urinalysis: SC&A verified the intake retention fraction (IRF) values of table F-1 with a different software package than IMBA. The only nuclide with a difference is iodine, for which the IRF is 23% higher than the one derived by SC&A.	10/4/2010. The 23% iodine difference has no effect on the indicator nuclide activity fractions, as iodines were not considered in those calculations. This is favorable to the claimant since including the iodines would decrease the activity fractions for the indicator nuclides for the shorter decay times.	10/13/2010. Based on NIOSH's response, the SPR closed the observation.

Issue resolution for OTIB-0054 finding 20

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	<p>Urinalysis: SC&A could not reproduce all the percentages listed in tables G-1 to G-4 (radionuclide contributions to urinalysis counts) following the procedure described by NIOSH, with the values listed for Sr-90 presenting the greatest difference.</p> <p>7/16/2013. Two sets of data not comparable.</p>	<p>10/4/2010. NIOSH noted the issue with attachment G data and a revision is in progress to correct it.</p> <p>7/15/2013. Attachment G tables revised to present somewhat different information than the previous versions, as only the 2-year chronic intake period is considered. The inputs to these calculations are documented in attachments D and F.</p>	<p>4/16/2014. SPR changed the status of the finding to in abeyance awaiting an OTIB revision.</p> <p>7/18/2013. SPR closed the finding since SC&A will review rev. 01.</p>

Issue resolution for OTIB-0054 finding 21

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Observation on Urinalysis: Radionuclides listed in tables G-1 to G-4 are the ones taken from table D-1, and the simplifications introduced in tables E-1 and E-2 were not used. 1/5/2011. SC&A agrees with NIOSH's response.	10/4/2010. That is correct. The simplified source terms given in attachment E are the basis for tables 7-3 and 7-4. Attachment G and tables 7-1 and 7-2 are based on the nuclide mix given in table D-1.	4/16/2014. SPR changed the status of the finding to in progress awaiting SC&A response. 1/5/2011. SC&A agreed with NIOSH's response and the SPR closed the observation.

Issue resolution for OTIB-0054 finding 22

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Urinalysis: Looking at tables G-1 to G-4, SC&A does not agree that trends are similar for all solubility categories. SC&A does not agree with averaging the results for each solubility category. The most claimant-favorable would be to use the percentages for insoluble radionuclides.	<p>10/4/2010. OTIB-0054 will be revised to use just the most insoluble forms, as recommended.</p> <p>7/15/2013. As recommended, the revised OTIB made use of only the most insoluble form of each radionuclide, thus maximizing the urine activity fractions for the indicator radionuclides.</p>	<p>4/16/2014. SPR changed the status of the finding to in abeyance awaiting an OTIB revision.</p> <p>7/18/2013. Since the revised OTIB addresses SC&A's concern, the SPR closed the finding.</p>

Issue resolution for OTIB-0054 finding 23

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Urinalysis: SC&A notes that the oversimplification of results creates reference numbers that do not relate to the real exposure of the workers. 1/5/2011. Further discussion is required to clarify what the OTIB should and should not be used for.	10/4/2010. OTIB-0054 was intended to provide a favorable overestimate. The document states doses determined via OTIB-0054 should be assigned as upper bounds.	10/4/2010. SPR changed the status of the finding to in progress. 1/5/2011. SPR determined the finding should remain in progress.

OTIB-0054 finding 23 followup

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Urinalysis: 4/4/2014. SC&A's review of rev. 01 produced 2013 finding 10 (BRS finding 36) which raises similar but broader issues and supersedes finding 23.	7/15/2013. Interpretation of doses assigned via OTIB-0054 rev. 01 is discussed in section 8.1, which states the assigned doses are likely upper bounds and should be treated as such.	7/16/2014. Subcommittee concurs with SC&A that finding 36 provides similar but broader issues; as such, finding 23 was closed.

Issue resolution for OTIB-0054 finding 24

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Air/Surface Contamination: SC&A notes that the same oversimplifications, as discussed in finding 23, are creating reference numbers in table 7-4 (activity ratios for air and workplace samples) that do not relate to the real exposure of the workers.	10/4/2010. All discussions and comments for finding 23 are the same for finding 24.	4/16/2014. Since this finding will be further addressed in finding 36, the SPR closed finding 24.

Issue resolution for OTIB-0054 finding 25

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Summary: SC&A finds: (1) urine activity fraction used for indicator radionuclide is somewhat arbitrary, (2) overestimation of doses due to simplification does not relate to real intakes and excretion rates, and (3) reactor averaging, solubility averaging, and other assumptions underestimate urine activity fractions.	7/15/2013. Rev. 01 of OTIB-0054 addressed all these issues.	4/16/2014. Since the revised OTIB addressed all SC&A's concerns, the SPR closed the finding.

Issue resolution for OTIB-0054 finding 26

Finding date	Finding description	NIOSH response	Finding resolution
3/17/2008	Summary: SC&A finds methods described in the OTIB will provide intakes and doses not correlated with the real ones. The differences are unknown and depend heavily on the scenario (periods of fuel irradiation and decay), reactor type, and detection methods.	7/15/2013. Input from the Subcommittee has been used to implement a substantial revision of the methods used to derive the intake and activity fractions presented in OTIB-0054 for assigning radionuclide intakes from gross beta or gross gamma assays.	4/16/2014. Since SC&A has been tasked to review the revised OTIB, the SPR closed the finding.

Issue resolution for OTIB-0054 finding 27 (rev. 01 finding 1)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	<p>SC&A not able to evaluate the appropriateness of the input parameters used for the ORIGEN2 runs since they are not specified, or references cited in the OTIB.</p> <p>2/6/2015. SC&A reviewed RPRT-0067 and is satisfied that the report adequately specifies and references ORIGEN2 input parameters and assumptions.</p>	<p>2/4/2014. A separate report is planned that will document the reactor modeling process in detail.</p> <p>8/26/2014. NIOSH issued ORAUT-RPRT-0067, "Supporting Calculations for OTIB-0054 and RPRT-0047," rev. 00.</p>	<p>4/16/2014. SPR changed status of finding to in progress and tasked SC&A to review NIOSH report when published.</p> <p>2/18/2015. Since SC&A confirmed that the revised OTIB addresses their concerns, the SPR closed the finding.</p>

Issue resolution for OTIB-0054 finding 28 (rev. 01 finding 2)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	The OTIB does not provide sufficient information to allow evaluation of its downselect from the initial seven to final four representative reactors chosen.	2/4/2014. A separate report is planned that will document the reactor modeling process in detail. 8/26/2014. NIOSH issued ORAUT-RPRT-0067, "Supporting Calculations for OTIB-0054 and RPRT-0047," rev. 00.	4/16/2014. SPR changed status of finding to in progress and tasked SC&A to review NIOSH report when published.

OTIB-0054 finding 28 (rev. 01 finding 2) followup

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	2/6/2015. SC&A reviewed RPRT-0067 and concluded it does not provide sufficient detail, such as comparative data; i.e., whether they capture the full range of isotopic mixtures encountered by workers, and whether they represent the most commonly encountered types of reactors.	4/21/2015. NIOSH note: “Response to SC&A Finding Number 2 on OTIB-0054 Revision 1.” This document provides the requested background information on representative reactor selection and fission and activation product inventory comparison tables.	4/28/2015. Based on NIOSH’s response, the SPR closed the finding.

Issue resolution for OTIB-0054 finding 29 (rev. 01 finding 3)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	<p>For each of the nine representative reactor cases, ORIGEN-S parameters include specific power, irradiation time, and burnup, and the OTIB includes a basis, but does not say how the values were selected or cite any reference.</p> <p>2/6/2015. SC&A is satisfied RPRT-0067 adequately references ORIGEN2 parameters.</p>	<p>2/4/2014. A separate report is planned that will document the reactor modeling process in detail.</p> <p>8/26/2014. NIOSH issued ORAUT-RPRT-0067, "Supporting Calculations for OTIB-0054 and RPRT-0047," rev. 00.</p>	<p>4/16/2014. SPR changed status of finding to in progress and tasked SC&A to review NIOSH report when published.</p> <p>2/18/2015. Since SC&A confirmed that RPRT-0067 addresses their concerns, the SPR closed the finding.</p>

Issue resolution for OTIB-0054 finding 30 (rev. 01 finding 4)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	<p>OTIB lists both aluminum and stainless steel-clad TRIGA reactors among initial seven reactors. However, the four reference reactors do not indicate which cladding was assumed for the TRIGA reactor.</p> <p>2/6/2015. RPRT-0067 contains the information on the TRIGA reactor cladding.</p>	<p>2/4/2014. A separate report is planned that will document the reactor modeling process in detail.</p> <p>8/26/2014. NIOSH issued ORAUT-RPRT-0067, “Supporting Calculations for OTIB-0054 and RPRT-0047,” rev. 00.</p>	<p>4/16/2014. SPR changed status of finding to in progress and tasked SC&A to review NIOSH report when published.</p> <p>2/18/2015. Since SC&A confirmed that RPRT-0067 addresses their concerns, the SPR closed the finding.</p>

Issue resolution for OTIB-0054 finding 31 (rev. 01 finding 5)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	In selecting release fractions for exposures to airborne radionuclides associated with reactor operations, the OTIB starts with the fuel inventory rather than mix of radionuclides in the gas gap or primary coolant. For workers involved in handling waste streams, using isotopic mix in fuel as the starting point might not be appropriate.	2/4/2014. Limiting the radionuclides to just those in the gap or coolant would not be appropriate for fuel separations or other work activities and would likely reduce assigned doses. Also true for filtration media: Limiting the source term to just the volatile and semi-volatile species would likely reduce assigned doses.	4/16/2014. SPR changed status of finding to in progress and tasked SC&A to review NIOSH response.

OTIB-0054 finding 31 (rev. 01 finding 5) followup

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	4/10/2014. (1) SC&A agrees with response preferring reactor fuel radionuclide inventory rather than gas gap inventory as a starting point. (2) Not knowing organ of concern, SC&A questions whether the NIFs used to derive radionuclide intakes based on gross beta analysis of urine are claimant favorable.	4/21/2015. NIOSH prepared white paper that concluded although release fractions adopted in OTIB-0054 can result in lower doses under certain conditions (use of whole-body count data), they are considered more appropriate for use during normal operating conditions.	4/16/2015. Based on NIOSH's response, the SPR closed the finding.

Issue resolution for OTIB-0054 finding 32 (rev. 01 finding 6)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	The use of effective DCFs is appropriate for screening purposes if the objective of the OTIB was to reconstruct whole-body doses, but not necessarily claimant-favorable for organ doses. Some radionuclides not present in the reduced NIF table E-1 may be a significant contribution to intakes and organ doses.	2/4/2014. The list of nuclides in table D-1 was not created using effective dose conversion factors. The list was created using committed organ doses. The list created in table D-1 was later reduced using effective dose, as shown in table E-1, as recommended by SC&A.	4/16/2014. SC&A agreed with NIOSH's response and the SPR closed the finding.

Issue resolution for OTIB-0054 finding 33 (rev. 01 finding 7)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	Intakes and organ doses should be calculated using the same set of radionuclides as used to derive the contributions to the total beta excretion rate results.	2/4/2014. It is desirable to limit the number of associated radionuclides considered in the organ dose calculations to reduce the computational burden on the dose reconstructors.	4/16/2014. SC&A agreed with NIOSH's response and the SPR closed the finding.

Issue resolution for OTIB-0054 finding 34 (rev. 01 finding 8)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	SC&A questions whether the OTIB methods would miss certain radionuclides, such as radioiodines, especially if a large fraction of the activity is lost during the analysis of urine samples.	2/4/2014. NIOSH made the claimant-favorable assumption that iodines were not present in the urine. Chemical recoveries for separations procedure are immaterial unless they differ significantly for different radioelements. For gross beta counting, the chemistry used is mostly irrelevant since most of the activity is from radiostrontium (for any reactor or decay time).	4/16/2014. SC&A agreed with NIOSH's response and the SPR closed the finding.

Issue resolution for OTIB-0054 finding 35 (rev. 01 finding 9)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	The current OTIB workbook (Workbook 1.01) needs to be revised to match the current version of OTIB-0054 (rev. 01), and then be reevaluated.	2/4/2014. A revised tool was released for use in dose reconstructions on November 22, 2013.	4/16/2014. The SPR changed the status to in progress, and SC&A was tasked to review the revised tool.

OTIB-0054 finding 35 (rev. 01 finding 9) followup

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	10/02/2014. Teleconference held between SC&A, NIOSH, and ORAUT; concerns related to the OTIB-0054 workbook's lack of workplace monitoring were clarified. The current version of the tool functions as designed but does not include the adjustments depicted in table 7-4 and needs Pm-147 values added.	2/17/2015. A new tool, version 1.5.10, has been published with workplace monitoring, table 7-4 adjustments, and Pm-147 values.	4/28/2015. Based on SC&A's review of the new tool, the SPR closed the finding.

Issue resolution for OTIB-0054 finding 36 (rev. 01 finding 10)

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	SC&A accepts that the basic approach used in the OTIB is claimant favorable, with due consideration of the question raised under finding 31, but believes that more discussion of the overall claimant-favorability of the strategy employed in the OTIB is warranted.	2/4/2014. OTIB goal was to develop a process that had little chance of underestimating a worker's dose. It was never intended to be precise. Additional discussion of that point can be added, as requested.	4/16/2014. SPR changed status to in progress to allow SC&A further evaluation of NIOSH's response.

OTIB-0054 finding 36 (rev. 01 finding 10) followup

Finding date	Finding description	NIOSH response	Finding resolution
11/5/2013	513/2014. SC&A-NIOSH-ORAUT held technical call. Concerns related to radionuclide release fractions will be addressed in finding 31 (rev. 01 finding 5). SC&A withdraws the remainder of its concerns with finding 36 (rev. 01 finding 10).	2/4/2014. OTIB goal was to develop a process that had little chance of underestimating a worker's dose. It was never intended to be precise. Additional discussion of that point can be added, as requested.	4/16/2014. SPR agrees with results of technical call and closed the finding.

Conclusions on OTIB-0054

- ◆ Findings
 - 26 findings on rev. 00 PC-1
 - 10 findings on rev. 01, which also apply to rev. 02
- ◆ All findings have been discussed and closed by the SPR
- ◆ NIOSH has made appropriate revisions to the OTIB based on the papers and discussions



Discussion of OTIB-0054