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Advisory Board on Radiation and Worker Health
National Institute for Occupational Safety and Health

A Review of ORAUT-TKBS-0003-5, Revision 04, for Savannah River Site – Occupational Internal Dose Technical Basis Document

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Abbreviations and Acronyms

ABRWH	Advisory Board on Radiation and Worker Health
ANSI	American National Standards Institute
DNC	delayed neutron counting
DOE	U.S. Department of Energy
dpm/L	disintegration per minute per liter
DPSOL	DuPont Savannah River Operating List
DPSOP	DuPont Standard Operating Procedure
DR	dose reconstruction
DU	depleted uranium
EU	enriched uranium
FP	fission products
HP	healthy physics
HPS	Health Physics Society
MDA	minimum detectable activity
NaI(Tl)	sodium iodide (thallium)
NU	natural uranium
NIOSH	National Institute for Occupational Safety and Health
OBT	organically bound tritium
ORAUT	Oak Ridge Associated Universities Team
PAS	personal air sampling
pCi/µg	picocuries per microgram
RWP	radiological work permit
SEC	special exposure cohort
SMT	special metal tritides
SRDB	Site Research Database
SRS	Savannah River Site
SWP	standing work permit
TRM	target residual material
TBD	technical basis document
U	uranium
WBC	whole-body count
WSRC	Westinghouse Savannah River Company

1 Introduction and Background

The Savannah River Site (SRS) occupational internal dose technical basis document (TBD), ORAUT-TKBS-0003-5, revision 04, was issued on March 5, 2024 (ORAUT, 2024a; "TBD-5"). It superseded revision 03 of ORAUT-TKBS-0003, which had been in effect since April 5, 2005 (ORAUT, 2005).

The changes made in this updated TBD-5 are summarized in its publication record (ORAUT, 2024a, pp. 2–3):

> Revised to update entire site profile and to separate it into six technical basis documents. This Part 5 was Section 4.0 of Revision 03. Revised to incorporate comments and guidance associated with issuance of two SEC classes implemented with Petition SEC-0103. Incorporates information from the internal co-exposure study (formerly ORAUT-OTIB-0081 and now ORAUT-TKBS-0003-7). Attributions and Annotations removed. Revised to include a thorough description and delineation of the types of uranium used and processed at SRS. Updated Section 5.6.4.2 to include reference to ORAUT-OTIB-0066 in OBT discussion and to edit unmonitored periods where co-exposure tritium dose is assigned in accordance with Table 7-18. Updated Section 5.6.3 to clarify whether and how to make comparisons between weapons-grade plutonium vs. nonmonotonic "pure" ^{238}Pu for given facilities. Updated Section 5.6.5 to clarify where and how to apply the various uranium mixtures indicated tables other than NU and DU. Added a table in Section 5.6.5 that states which uranium mixture is to be applied for various facility codes by year range. Updated Section 5.6.9 to include wording to assume triple-separated thorium from 10/01/1972 to present. Updated Section 5.6.5.1 to clarify the "intakes to add" values in Table 5-31. Deleted "Uranium co-exposure intakes should be assigned to unmonitored workers while working in D Area from 1954 through 1988. Consult ORAUT-TKBS-0003-2 for rational." from Section 5.6.5.3. Updated Section 5.6.7.1 to change 1988 to 1990 for the following statement: "FP co-exposure intakes should be assigned to unmonitored workers for work in D-Area from 1954 through 1988." Incorporates formal internal and NIOSH review comments. Constitutes a total rewrite of the document.

SC&A was tasked on September 25, 2024, to review all of the updated TBDs for SRS.

2 Comparison with Revision 03 of ORAUT-TKBS-0003

SC&A reviewed the outlined changes reflected in ORAU-TKBS-0003-5, revision 04, as noted in the publication record, and had no findings but had the following comments and observation.

2.1 Incorporates comments and guidance associated with issuance of two SEC classes implemented with Petition SEC-0103

TBD-5 cites the two Special Exposure Cohort (SEC) classes defined for SRS to date:

1. for January 1, 1953, through September 30, 1972, for “All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the Savannah River Site” (ORAUT, 2024a, p. 11)

2. for October 1, 1972, through December 31, 1990, for “All construction trade employees of Department of Energy subcontractors [excluding employees of the following prime contractors who worked at the Savannah River Site in Aiken, South Carolina, during the specified time periods: E. I. du Pont de Nemours and Company, October 1, 1972, through March 31, 1989; and Westinghouse Savannah River Company, April 1, 1989, through December 31, 1990], who worked at the Savannah River Site” (ORAUT, 2024a, p. 11)

SC&A has no comment on these citations.

2.2 Incorporates information from the internal co-exposure study (formerly ORAUT-OTIB-0081 and now ORAUT-TKBS-0003-7)

SC&A’s evaluation of TBD-7 is provided in a separate report by SC&A (2025).

2.3 Revised to include a thorough description and delineation of the types of uranium used and processed at SRS

ORAUT-TKBS-0003 (ORAUT, 2005) provided a history of in vitro bioassay methods for uranium from startup to 2004 (the “present” for that TBD), providing reporting level by uranium mixture, e.g., enriched uranium (EU), depleted uranium (DU), and uranium (U)-235. The glossary section provided activity fractions for these uranium mixtures. Section 4.1.2 noted that the “upper limit at the 99% confidence level for analytical noise and presumably some effect of natural background was set at 0.15 dpm/L” (ORAUT, 2005, p. 69). It also concluded that for “mass uranium analyses, results greater than the reporting level in Table 4.1.1-4 [“Uranium urinalysis”] can be associated with an occupational intake”; for missed dose calculations, these reporting levels can also be applied (ORAUT, 2005, p. 69).

In TBD-5 (ORAUT, 2024a), the National Institute for Occupational Safety and Health (NIOSH) provides a more extensive history of uranium bioassay, with logbooks indicating bioassay samples for uranium being analyzed by both “fluorophotometric analysis and delayed neutron counting (DNC) in 1982 to 1984” (ORAUT, 2024a, p. 15). EU was analyzed by both gross alpha analysis and DNC during the same timeframe. After 1990, alpha spectroscopy for specific uranium isotopes was the method applied (ORAUT, 2024a, table 5-7).

In TBD-5, details concerning these and other methods are provided in table 5-7, “Uranium urinalysis MDAs.” Isotopic parameters and ratios for EU, DU, natural uranium (NU), and target residual material (TRM) are listed in tables 5-8 through 5-11 (ORAUT, 2024a, p. 30). Two key assumptions are established for uranium intakes:

1. “Based on information in ORAUT-OTIB-0060, *Internal Dose Reconstruction*, any result other than a baseline sample that is positive (as defined in ORAUT-OTIB-0060 Section 2.4.2 and further detailed in Section 2.4.3 for occupational intakes of uranium) is assumed to be due to an occupational exposure for the purposes of dose reconstruction [ORAUT 2018]” (ORAUT, 2024a, p. 28).

2. "When the work area is not known and no uranium source term is available, the following assumptions should be made for uranium exposure when only mass-based urinalysis results are available to convert units of mass to units of activity [McCarty 2000]. For 1953 to 1967, assume NU at 0.6928 pCi/µg). For 1968 and later, assume DU at 0.372 pCi/µg" (ORAUT, 2024a, p. 28).

TBD-5 gives U-233 a more extensive treatment by accounting for U-232 as an impurity and thorium-228 as a progeny of U-232, as well as considering fission product impurities in the U-233 product itself. Likewise, U-236 is highlighted as an artificial isotope found in spent nuclear fuel or reprocessed uranium. Table 5-7 provides minimum detectable activity (MDA) values for U-236 at SRS. Table 5-10 provides the activity fraction of U-236 in EU.

For recycled uranium, TBD-5 goes beyond the generalized activity fractions for uranium isotopes provided in the glossary of ORAUT-TKBS-0003, section 4, for depleted, enriched, and recycled uranium (ORAUT, 2005, pp. 132, 133, 136). TBD-5 provides more specific guidance in section 5.6.5 and table 5-26 regarding the ratio of activation and fission product impurities to total uranium (ORAUT, 2024a, p. 59). SRS area codes for depleted, enriched, natural and U-233 uranium location use are identified in tables 5-27 through 5-31, respectively, with the assumption that contamination from past operations exists and is to be addressed for dose reconstruction (DR) purposes.

TBD-5 compares SRS to the Chalk River Reactor as a further basis for assigning EU values to impurities assumed for TRM from the SRS reactors (ORAUT, 2024a, p. 59):

> TRM from the Chalk River Reactor in Canada may be assumed to have similar impurities to SRS reactors and EU values should be applied. Note that the reactor design at SRS was based partially on the Chalk River Reactor . . . .

It is not clear from this statement why the Chalk River Reactor had a similar history of recycled uranium use that would have led to similar TRM impurities and how both reactor types would have generated comparable TRM.

Observation 1: Additional information needed for Chalk River Reactor comparison to support assumed TRM impurities

Overall, SC&A concurs that TBD-5 provides a "thorough description and delineation of the uranium use and processes at SRS" (ORAUT, 2024a, p. 3).

2.4 Updated section 5.6.4.2 to include reference to ORAUT-OTIB-0066 in OBT discussion and to edit unmonitored periods where co-exposure tritium dose is assigned in accordance with table 7-18

(Table 7-18 is from ORAUT-TKBS-0003-7, rev. 00, "Savannah River Site – Internal Dosimetry Co-Exposure Data" (ORAUT, 2024b).)

SC&A has no comment. TBD-5 expands discussion of special tritium compounds, highlighting representative special metal tritide (SMT) absorption types (table 5-23) and health physics (HP) area codes for SMT and organically bound tritium dose assignment (table 5-24). TBD-5 also references ORAUT-RPRT-0072, revision 00, “Locations of Stable Metal Tritide Use at the Savannah River Site” (ORAUT, 2017), as a guide.

2.5 Updated section 5.6.3 to clarify whether and how to make comparisons between weapons-grade plutonium vs. nonmonotonic “pure” Pu-238 for given facilities

SC&A has no comment. TBD-5 provides the stated clarification, citing DCAS-RPT-005, “Alternative Dissolution Models for Insoluble Pu-238” (NIOSH, 2018), and providing in table 5-22 the HP Area codes for insoluble Pu-238 that encompass Building 773-A, Building 235-F, old and new HB-Lines, and subcontractor construction trade workers for the specific time periods provided.

2.6 Updated section 5.6.5 to clarify where and how to apply the various uranium mixtures indicated tables other than NU and DU. Added a table in section 5.6.5 that states which uranium mixture is to be applied for various facility codes by year range

As noted in section 2.3 above, SC&A agrees that TBD-5 comprehensively addresses the various uranium mixtures and isotopes in terms of description and history, location, activity fraction, and urinalysis MDAs. Table 5-25 lists the location codes by areas, the types of uranium handled, and the periods of use. Besides NU and DU, this table includes enriched uranium and two types of uranium related to limited campaigns: U-233, processed in H-Canyon from 1964 through 1969; and TRM, processed in H-Canyon from 2017 through 2020.

2.7 Updated section 5.6.9 to include wording to assume triple-separated thorium from September 1, 1972, to present

SC&A has no comment. Section 5.6.9 directs to “Assume triple-separated thorium for all periods using guidance given in ORAUT-OTIB-0076 [ORAUT [2014]]” (ORAUT, 2024a, p. 66).

2.8 Updated section 5.6.5.1 to clarify the “intakes to add” values in table 5-31

SC&A has no comment. Section 5.6.5.1 clarifies that “For the dose determination, include the additional nuclides based on table 5-32 (this would include the ^{232}U portion),” with the “^{233}U exposure potential . . . monitored using the ‘EU’ bioassay method” (ORAUT, 2024a, p. 63).

2.9 Deleted “Uranium co-exposure intakes should be assigned to unmonitored workers while working in D Area from 1954 through 1988. Consult ORAUT-TKBS-0003-2 for rational.” from section 5.6.5.3

SC&A has no comment. Presumably, this has been superseded by the issuance of ORAUT-TKBS-0003-7, revision 00, “Savannah River Site – Internal Dosimetry Co-Exposure Data” (ORAUT, 2024b).

2.10 Updated section 5.6.7.1 to change 1988 to 1990 for the following statement: “FP co-exposure intakes should be assigned to unmonitored workers for work in D-Area from 1954 through 1988”

SC&A has no comment. Presumably, this is to conform with ORAUT-TKBS-0003-7 (ORAUT, 2024b).

3 TBD-5 Compared to ORAUT-TKBS-0003, Revisions and Additions

3.1 ORAUT-TKBS-0003, sections 4.1 and 4.2

MDA values for in vitro and in vivo counting methods by individual radionuclides are provided, as well as “interferences, uncertainty and use of reporting levels” (ORAUT, 2005, p. 75).

In the 2005 SRS site profile, page 64 lists “radionuclides of concern” for SRS based on chapter 5 of the “Savannah River Site Internal Dosimetry Technical Basis Manual,” WSRC-IM-90139, revision 8, issued December 31, 2001 (WSRC, 2001). From this technical basis manual, minimum MDAs and counting methods are provided for in vitro and in vivo bioassays for individual radionuclides, as well as fission products.

3.2 TBD-5, section 5.3

TBD-5 defines MDAs and decision levels after 1990 as follows:

> Since 1990, SRS has used the concepts and formulas from the draft or published radiobioassay standard American National Standards Institute (ANSI)/Health Physics Society (HPS) N13.30, *Performance Criteria for Radiobioassay* . . . , for determination of decision levels and MDAs . . . .

Section 5.3.1 notes that “SRS implemented bioassay programs to cover 35 facilities that processed actinides, FPs, and thorium” (ORAUT, 2024a, p. 14).

In TBD-5 (ORAUT, 2024a), NIOSH cites the radionuclides of concern from the 2001 Westinghouse Savannah River Company (WSRC) internal dosimetry SRS technical basis manual (WSRC, 2001), provides a description of the SRS routine and special bioassay programs, provides MDAs, and describes analytical methods for individual radionuclides.

3.3 ORAUT-TKBS-0003, section 4.3

Section 4.3 addresses personnel air sampling data and emphasizes that retrieving records for a specific sampling location would be difficult and that “correlation between air sample concentrations in given rooms or work locations and a specific person would be difficult” (ORAUT, 2005, p. 75).

3.4 TBD-5, section 5.5

In addition to such admonitions in ORAUT-TKBS-0003, TBD-5 provides further guidance:

> Dose assigned from PAS [personal air sampling] data might be present in the annual dose summary report. Dose assigned based on PAS data is not directly applicable to the organ of interest when performing a dose reconstruction. If a committed effective dose is recorded and no bioassay data were provided for the dose assignment, the dose reconstructor should make a request for additional data. [ORAUT, 2024a, p. 50]

3.5 TBD-5, section 5.3.1.1, "Routine sampling program"

A major addition to TBD-5 is a historical perspective and basis for the routine and special bioassay programs. However, SC&A had the following observation.

Observation 2: Additional information needed for job-specific bioassays

While job-specific bioassays are cited and explained, no historical perspective is provided as is done elsewhere for internal dosimetry in this section and the TBD as a whole. The dose reconstructor would benefit from a timeline of how and when job-specific bioassays were performed.

The routine bioassay program included job-specific bioassays for workers performing radiological tasks under a facility-specific radiological work permit (RWP), which sometimes involved nonroutine radionuclides or forms. While RWPs were initially required by DuPont in the 1960s with standing work permits (SWPs) extending into the early 1970s, they were replaced with Du Pont Standard Operating Procedure (DPSOP) 40 procedures that directed facility managers to define additional job-specific bioassays for "other nuclides" beyond the mandated DuPont Savannah River Operating List (DPSOL) tables that listed facility radiological exposure sources and required bioassay frequencies (DuPont, 1985, 1987). In DPSOP 40-1, DuPont, the operating contractor, continued to require implementation of RWPs and SWPs, but none were implemented until the succeeding contractor, WSRC, undertook its Radiological Improvement Program in 1991 beginning with the tritium facilities (DOE 1990, p. 4-196). "Radiation and Contamination Control Procedures" established a standardized RWP program requiring job-specific bioassays upon respirator use (WSRC, 1992).

From past NIOSH comments during the SEC review involving data representativeness issues surrounding job-specific bioassays, it is clear that NIOSH does not agree that job-specific bioassays played any role in dose assessment and, therefore, dose reconstruction. However, the lack of RWP implementation, with related job-specific bioassays, until the early 1990s raises questions of data completeness and, therefore, representativeness, in support of co-exposure modeling. Therefore, in SC&A's view, it is relevant to clarify when and how nonroutine source terms and RWP-directed, job-specific bioassays were addressed during the DuPont and WSRC time periods. Without such explanation and timeline, the SEC class recommended by the Board and approved by the Secretary of Health and Human Services has little context in this revised TBD and provides inadequate background for the dose reconstructor when evaluating observed gaps in individual bioassay monitoring.

Observation 3. Additional references to available WSRC source term characterization guidance would be helpful to dose reconstructors where such information is lacking

Related to RWP considerations, another consideration that was raised during the SEC evaluation for this time period (early 1990s) was source term characterization as it pertained to bioassay application. Historically at SRS, the methodology used to determine facility radiological source terms for the bioassay program was based on "facility process knowledge (i.e., safety analysis documentation), procedural guidance, and professional knowledge" (WSRC, 1999). However, this proved inadequate as determined by a number of internal WSRC assessments (as summarized by SC&A (2018)), more so with the rapidly evolving SRS operational missions and facility radionuclide source terms in the 1990s. In 1999, WSRC undertook more systematic facility characterization of radiological sources of concern and provided its methodology in ESH-HPT-99-0051 (WSRC, 1999).

When work was performed in a High Contamination Area or Airborne Radioactivity Area, workers were required to participate in a urinalysis program for the radionuclides of concern (WSRC, 1999). Methods and listings for facility radionuclides of concern are provided in Findlay (1997), WSRC (1998), and WSRC (1999). The TBD should cite these references for the benefit of the dose reconstructor when monitoring data may provide location and date but not specific source term radionuclides.

3.6 TBD-5, section 5.3.2, "Analytical methods for individual radionuclides"

Section 5.3.2 provides analytical methods for prevalent specific radionuclides, including trivalent actinides, plutonium, tritium, and uranium. In vitro bioassay methods are discussed from a historical perspective with narrative timelines for methods in use, and MDAs are established for the operational mixtures, isotopes, or forms, and time periods in question. This section is a considerably expanded and updated version of section 4.1.2, "In Vitro Methods for Individual Radionuclides," of ORAUT-TKBS-0003, revision 03 (ORAUT, 2005). SC&A has no comment.

3.7 TBD-5, section 5.4. "In vivo bioassay minimum detectable activities, counting methods, and reporting practices"

TBD-5 provides updated and more comprehensive tabular data by time period (MDAs by radionuclide), with example whole-body count (WBC) result forms provided by time period. These include radionuclide-specific MDAs for the 4 × 8-inch sodium iodide (thallium) (NaI(Tl)) whole body detector for 1960–1974 and the NaI(Tl) array used for 1974–1979. The reporting format for WBCs beginning in 1979 specified MDAs for each radionuclide for each count. MDAs for more advanced counting systems beginning in the 1990s were generated individually by processing software. For chest counting, which commenced in the late 1960s, updated MDA tables and example results are provided, with the addition of plutonium/uranium lung count guidance for the period 1989 and beyond when that counter was deployed.

Observation 4: Missing WBC MDA guidance

Section 5.4.1 indicates that, "If MDAs are not shown in the worker's records, use Table 5-15 to 5-18" (ORAUT, 2024a, p. 36). Table 5-15 contains whole body counting MDAs from 1960 to October 1974. Table 5-16 contains whole body counting MDAs from November 1974 to December 1979. Table 5-17 contains MDAs for whole body counting from 1988 to present. But Table 5-18 contains MDAs for chest counting from 1988 to 1991. There is no WBC MDA guidance between December 1979 and 1988. Examples of WBC documentation from this time period are provided in figures 5-8 and 5-9, but clear guidance is absent. It is unclear if an additional table was unintentionally omitted.

3.8 TBD-5, section 5.5, "Personal air sampling data"

TBD-5 updates the guidance with the instruction to, "If the site provides information that the dose was based on PAS (no bioassay data is available for the assignment of dose), contact the Principal Scientist for Internal Dosimetry for guidance" (ORAUT, 2024a, p. 50).

Observation 5. Should there be an intermediary step of the dose reconstructor requesting any additional internal dosimetry information (e.g., source term, facility, monitoring frequency, etc.) prior to internal consultation?

3.9 TBD-5, section 5.6, "Assessment of intake"

In support of guidance from ORAUT-OTIB-0060 (ORAUT, 2018), TBD-5 provides specific instructions for assessing intakes for SRS primary radionuclides, including timeframes and locations. These instructions encompass trivalent actinides, plutonium, tritium (including special tritium compounds), uranium (including recycled uranium, U-233 and U-236), polonium-210, fission products, neptunium-237, and thorium. SC&A has no comment.

3.10 TBD-5, section 5.7, "Uncertainty and unmonitored dose"

The major update in this section is the availability of internal co-exposure intake rates from ORAUT-TKBS-0003-7 (ORAUT, 2024b) for dose assignment when monitoring data are lacking. A calculational approach to estimating MDA when an uncertainty value is reported is also provided. SC&A has no comment.

4 Evaluation of Commitments to Modify SRS Guidance

As an extension of the SC&A review of the 2024 revisions of the SRS TBD, SC&A reviewed the records of issues resolution of previously completed DR case reviews for commitments to change the SRS guidance. Throughout the course of DR issues resolution, it is not uncommon for TBD and other guidance document-related issues to be identified. In some instances, as a result of activities by the Subcommittee for Dose Reconstruction Reviews, issues noted in a DR result in commitments by NIOSH to update the guidance when it is revised.

SC&A has reviewed 99 DRs with U.S. Department of Labor-verified employment at SRS. Of those reviews, the Subcommittee for Dose Reconstruction Reviews has completed the evaluation of 84 DRs (called "Tabs") from Sets 1 through 31. SC&A limited this evaluation to claims that were part of Sets 6 through 31, as these cases were most likely to use the previous revisions of the SRS TBD and have completed the issues adjudication. In total, the issues resolution process from 66 DRs was evaluated. SC&A's evaluation identified several commitments to update SRS guidance documents related to the assessment of internal dose at SRS. The observations and findings cited below (as "Tab" observations and findings) were part of that review.

4.1 Recycled uranium

During the issues resolution process of Tab 402,[1] observations 1 and 2, it was identified that the TBD needed guidance on addressing recycled uranium. SC&A evaluated TBD-5 in comparison to the original guidance in the 2005 TBD. SC&A found that section 5.6.5 was added, which addresses uranium at the site. Included in this section is a subsection on recycled uranium and table 5-26, which provides ratios of impurities in EU and DU to total uranium.

[1] The "Tab number" represents an arbitrary sequential number assigned to the individual DR review case and does not represent any personally identifiable information.

4.2 Tritium guidance

During the issues resolution process of Tab 333, observation 1, it was identified that the tritium guidance in the SRS TBD does not correlate with the tritium guidance in ORAUT-OTIB-0001, revision 00 (ORAUT, 2003). Similar problems related to the TBD not containing updated tritium guidance were identified in Tab findings 277.3-F.3, 280.3-F.3, 303.7-F.3, 331.3-F.3 and 334.7-G.2. NIOSH updated the SRS DR guidance document (May 30, 2012) to reflect this and committed to update the TBD to reflect this change. SC&A was unable to locate the May 30, 2012, DR guidance document. The earliest copy available to SC&A is dated August 20, 2014, and has a section titled, "Assignment of Tritium Doses: Maximizing Method." This section addresses annual tritium doses using ORAUT-OTIB-0001. This same guidance was carried through the SRS DR guidance document as recently as August 7, 2023, but was removed in the February 7, 2024, and later versions of the SRS DR guidance document. SC&A located documentation indicating that ORAUT-OTIB-0001, revision 00, was cancelled in July 2020. According to the NIOSH website: "Site-specific hypothetical intakes are no longer assigned. ORAUT-OTIB-0018, "Internal Dose Overestimates for Facilities with Air Sampling Programs", or co-exposure values when available, will be used in its place" (NIOSH Radiation Dose Reconstruction Program, 2024). SC&A consulted ORAUT-OTIB-0018 to verify that tritium guidance was available to replace the cancelled document's tritium guidance; however, the document states, "exposure to tritium, radioiodines, radon/thoron, or ^{14}C has to be accounted for separately from these intake/dose estimations" (ORAUT, 2022, p. 18). SC&A did not find annual maximizing tritium guidance in TBD-5. It is unclear if its omission was intentional. SC&A notes that the MDAs listed in table 5-6 are different than those used in ORAUT-OTIB-0001.

4.3 WBC guidance

During the issues resolution process of Tab finding 276.4, it was identified that clearer guidance for the time frames for the WBC MDAs in TBD tables 4.2.1-1 and 4.2.1-2 was needed. NIOSH committed to update this guidance for clarity in the next TBD revision. SC&A found that the guidance in TBD-5 section 5.4.1 satisfies this commitment. Guidance on the appropriate time periods for WBCs is substantially expanded on, and the section provides example reporting format documentation from several time periods. In some of these examples where there would otherwise be ambiguity, the samples are labeled for added clarity.

4.4 In vitro MDAs

During the issues resolution process of Tab finding 155.4-G.2(a), it was identified that there was ambiguity on whether the in vitro MDA values were intended to replace the guidance in actual bioassay records. NIOSH agreed to add clarification that the values provided in the TBD were intended to be default values for times where no value was available in the records. During issues resolution, sample text was agreed upon to include in the TBD when it was revised. SC&A located a copy of this text in the 8th Set issues matrix updated in April 2011 (note that due to the documentation practices at the time not all subsequent versions of the matrix have the text). SC&A confirmed that the quoted text was added to section 5.3 in TBD-5.

5 References

E. I. DuPont De Nemours and Company, Savannah River Plant (DuPont). (1985). *Bioassay control (temporary)* (DPSOL 193-302T, rev. 0). SRDB Ref. ID 045958, PDF pp. 273–290

E. I. DuPont De Nemours and Company, Savannah River Plant (DuPont). (1987). *Bioassay schedule corrections* (DPSOL 47-186, rev. 1). SRDB Ref. ID 45029

Findley, W. M. (1997). *Understanding urine bioassay sampling* (rev. 3). Westinghouse Savannah River Company. SRDB Ref. ID 167760

McCarty L. E., ed. (2000). *Historical generation and flow of recycled uranium at the Savannah River Site* (ESH-PEQ-2000-00059). Westinghouse Savannah River Company. SRDB Ref. ID 16499

National Institute for Occupational Safety and Health. (2018). Alternative dissolution models for insoluble Pu-238 (DCAS-RPT-005, rev. 01). https://www.cdc.gov/niosh/ocas/pdfs/reports/dc-rprt5-r1-508.pdf

NIOSH Radiation Dose Reconstruction Program. (2024, June 28). Technical information bulletins (TIBs) – numerical listing. https://www.cdc.gov/niosh/ocas/tibsnum.html#tib1

Oak Ridge Associated Universities Team. (2003). *Technical information bulletin: Maximum internal dose estimates for Savannah River Site (SRS) claims* (ORAUT-OTIB-0001, rev. 00). https://www.cdc.gov/niosh/ocas/pdfs/arch/tibs/or-t1-r0.pdf

Oak Ridge Associated Universities Team. (2005). *Savannah River Site* (ORAUT-TKBS-0003, rev. 03). https://www.cdc.gov/niosh/ocas/pdfs/tbd/srs/srs3.pdf

Oak Ridge Associated Universities Team. (2014). *Guiding reconstruction of intakes of thorium resulting from nuclear weapons programs* (ORAUT-OTIB-0076, rev. 00). https://www.cdc.gov/niosh/ocas/pdfs/tibs/or-t76-r0.pdf

Oak Ridge Associated Universities Team. (2017). *Locations of stable metal tritide use at the Savannah River Site*. (ORAUT-RPRT-0072, rev. 00). https://www.cdc.gov/niosh/ocas/pdfs/orau/oraurpts/or-rprt-72-r0.pdf

Oak Ridge Associated Universities Team. (2018). *Internal dose reconstruction* (ORAUT-OTIB-0060, rev. 02). https://www.cdc.gov/niosh/ocas/pdfs/tibs/or-t60-r2-508.pdf

Oak Ridge Associated Universities Team. (2022). *Internal dose overestimates for facilities with air sampling programs* (ORAUT-OTIB-0018, rev. 02). https://www.cdc.gov/niosh/ocas/pdfs/tibs/or-t18-r2-508.pdf

Oak Ridge Associated Universities Team. (2024a). *Savannah River Site – Occupational internal dose* (ORAUT-TKBS-0003-5, rev. 04). https://www.cdc.gov/niosh/ocas/pdfs/tbd/srs/srs5-r4-508.pdf

Oak Ridge Associated Universities Team. (2024b). *Savannah River Site – Internal dosimetry co-exposure data* (ORAUT-TKBS-0003-7, rev. 00). https://www.cdc.gov/niosh/ocas/pdfs/tbd/srs/srs7-r0-508.pdf

SC&A, Inc. (2018, January 11). *Missing or incomplete radiological source terms* [Memorandum to Savannah River Site Work Group]. https://www.cdc.gov/niosh/ocas/pdfs/abrwh/scarpts/sca-incmisradst-011118-508.pdf

SC&A, Inc. (2025). *A review of ORAUT-TKBS-0003-7 for Savannah River Site – Internal dosimetry co-exposure data* (SCA-TR-2025-SEC002, rev. 0). Upload pending.

U.S. Department of Energy. (1990). *Tiger Team assessment of the Savannah River Site* (DOE/EH-0133). SRDB Ref. ID 46767

Westinghouse Savannah River Company. (1992). *Radiation and contamination control procedures* (Manual 5Q1.1, procedure 506, rev. 0). SRDB Ref. ID 152159, PDF p. 55 ff.

Westinghouse Savannah River Company. (1998, August 13). *Specification of bioassay requirements on radiological work permits (U)* [Interoffice memorandum, ESH-HPT-98-0453]. SRDB Ref. ID 167753

Westinghouse Savannah River Company. (1999, March 10). *Specification of urine bioassay requirements on radiological work permits – (U)* [Interoffice memorandum, ESH-HPT-99-0051]. SRDB Ref. ID 167754

Westinghouse Savannah River Company. (2001). *Savannah River Site internal dosimetry technical basis manual* (WSRC-IM-90139, rev. 8). SRDB Ref. ID 722