

 Memorandum

To: Subcommittee for Procedure Reviews
From: SC&A, Inc.
Date: September 4, 2026
Subject: SC&A's Focused Review of ORAUT-RPRT-0109 for Battelle-TIB-5000
Observations 5 and 6

Introduction

During SC&A's review (SC&A, 2022) of the Battelle Team Dose Reconstruction Project for the National Institute for Occupational Safety and Health (NIOSH), (Battelle) technical information bulletin (TIB), Battelle-TIB-5000, revision 00 (Battelle, 2007), SC&A identified 13 observations and no findings. All observations have been closed except for the following two:

Observation 5: Battelle-TIB-5000 lacks a sound basis for asserting that the NCRP [National Council on Radiation Protection and Measurements] assessment of the reliability of the ICRP [International Commission on Radiological Protection] Publication 30 [ICRP, 1979] models can be applied to the currently used ICRP Publication 66 [ICRP, 1994] respiratory tract and biokinetic models. [SC&A, 2022, p. 16]

Observation 6: A GSD [geometric standard deviation] of 10, derived from redundant data across seven uranium refining plants, is excessive for a sitewide assessment of an individual worker.

SC&A makes this an observation rather than a finding, since NIOSH is using a GSD of 5 as the default value in DRs [dose reconstructions] when no other uncertainty data is available. [SC&A, 2022, p. 17]

During the Subcommittee for Procedure Reviews (SPR) meeting June 5, 2026, the subcommittee tasked SC&A to perform a focused review to determine whether NIOSH adequately addressed observations 5 and 6 in the Oak Ridge Associated Universities Team (ORAUT) report, ORAUT-RPRT-0109 (ORAUT, 2024; "RPRT-0109"), per NIOSH's response for observations 5 and 6 in the Board Review System (BRS).

Background

The following documents are relevant to this review:

- ICRP Publication 30 (ICRP, 1979)

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- ICRP Publication 66 (ICRP, 1994)
- NCRP Commentary No. 15. (NCRP, 1998)
- Battelle-TIB-5000 (Battelle, 2007)
- NCRP Report No. 164. (NCRP, 2009)
- SC&A review of Battelle-TIB-5000 (SC&A, 2022)
- RPRT-0109 (ORAUT, 2024)

According to section 3.4 of Battelle-TIB-5000 (Battelle, 2007), the NCRP Commentary No. 15 used an expert group of internal dosimetrists to create a subjective quantification of the reliability of ICRP Publication 30 (ICRP, 1979) biokinetic and dosimetric models.

SC&A's observation 5 (SC&A, 2022) highlighted that the Integrated Modules for Bioassay Analysis (IMBA) program, which is used for DR, incorporates the more recent ICRP Publication 66 (ICRP, 1994) respiratory tract model along with updated biokinetic models. In light of this, SC&A requested that NIOSH explain the rationale for extending the assessment of reliability from the ICRP Publication 30 (ICRP, 1979) biokinetic and dosimetric models to the newer ICRP Publication 66 (ICRP, 1994). Specifically, the request focused on the applicability of using a GSD of 3.0 for fitted dose from bioassay data. The GSD serves as Parameter 2 for lognormal dose distributions of fitted dose values in the DR Interactive RadioEpidemiological Program (IREP) input tables.

In response to the SC&A request, NIOSH referenced RPRT-0109 (ORAUT, 2024) in their BRS response. As tasked by the SPR, SC&A performed a focused review of RPRT-0109 to evaluate the appropriateness of applying a GSD of 3.0 for fitted internal dose.

SC&A's Focused Review of ORAUT-RPRT-0109

Since this focused review specifically assessed the appropriateness of using a GSD of 3.0 for fitted dose estimates derived from bioassay data, SC&A did not perform a comprehensive examination of all background information and statistical analyses provided in RPRT-0109. Rather, SC&A concentrated its evaluation on the methodology, equations, tables, results, and recommendations in RPRT-0109 directly relevant to the application of a GSD of 3.0.

To support SC&A's evaluation, this memorandum briefly summarizes RPRT-0109. Section 2.0 of RPRT-0109 addresses the uncertainties in dose conversion factors (DCFs), section 3.0 analyzes the uncertainties in fitted intakes, and section 4.0 analyzes the total uncertainties in fitted organ doses.

Section 2.0 – Uncertainties in DCFs

- Table 2-1 of RPRT-0109 summarizes data from Pawel et al. (2007) concerning uncertainties in GSD (cancer risk plus DCF) and the range of GSD values for DCFs as a function of five categories of potential uncertainties. Table 2-2 of RPRT-0109 provides the percent ratios of the cancer risk and DCF uncertainties.

- Note, footnote c of table 2-2 refers to column 3, but the table has no column 3 and the footnote should refer to column 2.
- Pawel et al. (2007) expresses uncertainties as the ratio of the 95th and 5th percentiles (Q95 and Q5, respectively).
- Section 2.1 of RPRT-0109 develops the GSD for lognormal distributions.
 - Note that the report states, “uncertainty in the DCFs and ‘log’ refers to the natural logarithm” (ORAUT, 2024, p. 8). However, it should read, “uncertainty in the DCFs and ‘log’ refers to the common logarithm.” The term “log” generally refers to a logarithm using the base 10, whereas the term “ln” generally refers to the natural logarithm using the Euler’s number, 2.718 If RPRT-0109 is using the natural logarithm to the base 2.718 . . . , it should read, “uncertainty in the DCFs and ‘ln’ refers to the natural logarithm.”
- Section 2.2 of RPRT-0109 uses a conservative ratio of the 99th and 1st percentiles (Q99 and Q1, respectively) for 12 different bioassay data sets, with known solubility types, from NCRP Report No. 164 (NCRP, 2009) to derive DCF GSD values for various target organs. All DCF GSD values for these 12 bioassay data sets listed in table 2-4 are less than 3.0.
 - Note that the 12 different bioassay data sets are postulated situations (models) with calculated results, not actual bioassay results.

Section 3.0 – Uncertainties in fitted intakes

Dose reconstructors use IMBA to fit observed bioassay data to predicted radionuclide intakes. This process aims to minimize the difference between measured bioassay data and the projected intakes. Section 3.1 of RPRT-0109 details the analysis of 10 discrete acute intakes involving nine radionuclides, applying the weighted least squares regression method. Figures 3-1 through 3-20 illustrate the results and include a lognormal probability plot (intake versus standard normal quantile ranging from -2 to 2) and a scatter plot (activity versus intake retention function) for each acute intake. Each plot displays the calculated geometric mean value and the GSD value for the intake, with all GSD values below 2.1.

Section 4.0 – Uncertainties in fitted dose

The total uncertainty in the fitted dose used in the IREP table for a DR consists of the GSD values due to both the DCF and the intake. These two GSD values are propagated using equation 4-1 of RPRT-0109.

$$\text{GSD}_H = \exp[(\log \text{GSD}_i)^2 + (\log \text{GSD}_{\text{DCF}})^2]^{1/2} \quad (\text{equation 4-1})$$

Where:

GSD_H is the GSD of the dose

GSD_i is the GSD of the intake

GSD_{DCF} is the GSD of the DCF

Table 4-1 of RPRT-0109 summarizes the results of this analysis for the 10 different acute intakes described in section 3.1. This table presents the GSD values for each intake (column 5), the DCF (column 6), and the dose (column 7). The dose GSD values, which would appear as Parameter 2 in the IREP table for a lognormal distribution of a fitted internal organ dose, are all less than 3.0 for these 10 examples.

Conclusions

SC&A review

Based on the review of RPRT-0109, SC&A determined that assigning a dose GSD of 3.0 to fitted doses calculated from bioassay data is justified. This conclusion is supported by the observation that all cases examined in RPRT-0109 resulted in a dose GSD below 3.0.

Therefore, SC&A recommends closing observation 5, which raised concerns regarding Battelle-TIB-5000's lack of a robust basis for claiming that the NCRP evaluation of the reliability of the ICRP Publication 30 models could be applied to the currently used ICRP Publication 66 respiratory tract and biokinetic models.

Additionally, SC&A recommends closing observation 6 concerning Battelle-TIB-5000. This recommendation is based on the fact that a GSD value of 10 is no longer in use, as confirmed by NIOSH's response to observation 6 in the BRS.

SC&A's focused review of RPRT-0109 brought to light several notable points; however, this memorandum does not formally document these as observations. Recognizing the importance of a comprehensive evaluation, SC&A suggests that a more effective course of action would be for the SPR to task SC&A to conduct a full review of RPRT-0109. This approach would ensure that all pertinent issues are systematically assessed and appropriately documented and addressed.

References

Battelle Team Dose Reconstruction Project for NIOSH. (2007). *Default assumptions and methods for Atomic Weapons Employer dose reconstructions* (Battelle-TIB-5000, PNWD-3741, rev. 00). <https://www.cdc.gov/niosh/ocas/pdfs/tibs/b-t5000-r0.pdf>

International Commission on Radiological Protection (ICRP). (1979). *Limits for intakes of radionuclides by workers* (ICRP Publication 30, Part 1). *Ann. ICRP* 2(3-4).

International Commission on Radiological Protection (ICRP). (1994). *Human respiratory tract model for radiological protection* (ICRP Publication 66). *Ann. ICRP* 24(1-3).

National Council on Radiation Protection and Measurements. (1998). *Evaluating the reliability of biokinetic and dosimetric models and parameters used to assess individual doses for risk assessment* (NCRP Commentary No. 15).

National Council on Radiation Protection and Measurements. (2009). *Uncertainties in internal radiation dose assessment*. (NCRP Report No. 164).

Oak Ridge Associated Universities Team. (2024). *Uncertainty in fitted dose in internal dose assessments* (ORAUT-RPRT-0109, rev. 00).

<https://www.cdc.gov/niosh/ocas/pdfs/orau/oraurpts/or-rprt-109-r0-508.pdf>

Pawel, D. J., Leggett, R. W., Eckerman, K. F., & Nelson, C. B. (2007). *Uncertainties in cancer risk coefficients for environmental exposure to radionuclides: An uncertainty analysis for risk coefficients reported in Federal Guidance Report No. 13* (Oak Ridge National Laboratory ORNL/TM-2006/583). <https://info.ornl.gov/sites/publications/files/Pub3735.pdf>

SC&A, Inc. (2022). *Review of Battelle-TIB-5000, "Default assumptions and methods for Atomic Weapons Employer dose reconstructions"* (SCA-TR-2022-PR001, rev. 0).

<https://www.cdc.gov/niosh/ocas/pdfs/abrwh/scarpts/sca-tib5000-r0-508.pdf>