Memorandum

To: Subcommittee for Procedure Reviews
From: SC&A, Inc.
Date: October 11, 2023
Subject: DCAS-PER-049 Subtask 4 – Internal Dose Issue

Introduction

SC&A reviewed external doses for a case reevaluated by the National Institute for Occupational Safety and Health (NIOSH) under DCAS-PER-049, revision 0 (NIOSH, 2016; "PER-049"). Evaluation of internal dose was outside of the scope of this evaluation. However, when reviewing SC&A's report (SC&A, 2018), the Designated Federal Official (DFO) had a question concerning the total internal dose assigned using the hypothetical intake model versus using bioassay data. In the 2005 dose reconstruction (DR), NIOSH assigned a total internal dose of 18.330 rem using the hypothetical model to derive intakes, but in a 2016 DR, NIOSH assigned a total internal dose of 33.244 rem using bioassay data and overestimating methods to derive intakes. This raised concerns that the hypothetical model may not provide adequate overestimate of intakes and resulting doses and may impact other cases. This issue was addressed by NIOSH in 2023 by reworking the claim using bioassay data and more reasonable but claimant-favorable DR methods. NIOSH's 2023 DR resulted in a lower total internal dose and probability of causation (POC) than the two previous DRs. The following is a summary of the correspondence and DRs concerning this issue.

History of the Internal Dose Issue

The following is a brief outline of the documents and correspondence leading to the concerns about NIOSH's internal dose assignments for a case SC&A reviewed under DCAS-PER-049, subtask 4.

2012: NIOSH revised sections 3, 4, and 6 of the Paducah Gaseous Diffusion Plant (PGDP) site profile.

August 5, 2016: NIOSH issued DCAS-PER-049 (NIOSH, 2016) to address changes in the PGDP site profile that could affect DR.

March 2, 2018: SC&A submitted its review of one case under subtask 4 (SC&A, 2018).

March 6, 2018: After reviewing SC&A's PER-049 subtask 4 report, the DFO sent an email to SC&A inquiring why, when using the hypothetical intakes, the estimated internal doses were only about half of the internal doses estimated using the energy employee's bioassay records.

The DFO realized the assessment of internal dose assignments was not tasked under PER-049 but requested that SC&A now evaluate this issue.

March 6, 2018: In an email response to the DFO's inquiry, SC&A stated that there appeared to be a contradiction between the DRs concerning the results from the two internal dose methods (hypothetical and bioassay), which should be clarified by NIOSH.

March 7, 2018: The DFO sent an email to NIOSH asking them to take a look at this DR and clarify why the use of the hypothetical intake model resulted in the internal dose being only about half of the reworked dose assigned based on bioassays. SC&A was not informed of the outcome of this email or whether NIOSH provided a followup.

October 31, 2018: SC&A presented its subtask 4 review of PER-049 to the Subcommittee for Procedure Reviews (SPR). There were no findings, and the SPR closed the review.

August 18, 2022: SC&A provided a summary of SC&A's review of PER-049, which identified the difference in internal doses in the original DR versus the revised DR. The Board requested that SC&A evaluate the internal dose in more detail and report its findings to the SPR.

September 9, 2022: SC&A provided the SPR with a chronology of the PER-049 review, followup discussions about the internal dose, and an overview of the hypothetical intake model—ORAUT-OTIB-0002, revision 01 PC-2 (ORAUT, 2004)—in a memorandum (SC&A, 2022).

February 16, 2023, SPR meeting: SC&A presented the September 9, 2022, memo to the SPR. The meeting discussed why the bioassay data resulted in double the internal dose as compared to the very conservative hypothetical model. The SPR requested that NIOSH provide SC&A with the details of the DRs, which are outlined in the following section.

Sequence of DRs

2005: NIOSH performed the original overestimating DR using hypothetical intakes recommended in ORAUT-OTIB-0002, revision 01 PC-1 (ORAUT, 2004), and assigned a total internal dose of 18.330 rem, with a POC of 39.40 percent.

March 2016: NIOSH reworked the case because of site profile revisions as outlined in PER-049 (NIOSH, 2016). In the reworked DR, NIOSH used bioassay data input in the Integrated Modules for Bioassay Analysis (IMBA) Program. NIOSH derived the projected intakes using seven acute and three chronic intakes as an efficiency method. This resulted in an overestimate of intakes and projected organ internal doses. As a result, NIOSH assigned a relatively large total internal dose of 33.244 rem, with a POC of 45.43 percent.

February 17, 2023: NIOSH reworked the case using bioassay data in IMBA and reasonable estimating methods that analyzed the potential for nine acute and one chronic intakes in greater detail, resulting in a more uniform fit of the potential intakes. NIOSH derived a smaller total internal dose and a smaller POC. On February 21, 2023, NIOSH provided SC&A with the general results of the reworked DR, but not the details of the DR or the associated calculation

files. SC&A requested more detailed information. In May 2023, NIOSH provided SC&A with the detailed data and associated files.

August 2023: SC&A analyzed NIOSH's 2023 reworked DR. A summary of SC&A internal dose analysis is as follows:

1. SC&A reviewed the NIOSH IMBA modeling for uranium (U)-234, type S. The modeling included one chronic intake and nine acute intakes. SC&A found that the modeling was conservative and overestimated many of the bioassay results; therefore, the fit was favorable to the claimant.

2. SC&A derived the accompanying radionuclide intakes using the U-234 intake values derived from NIOSH's IMBA modeling and the recommended ratios in table 5-2 and table 5-2a of ORAUT-TKBS-0019-5, revision 03 (ORAUT, 2012).

3. The U-234 and accompanying radionuclide intakes were entered into the chronic annual dose tool, and the resulting annual internal doses were derived for use in the Interactive RadioEpidemiological Program (IREP) input table. The total derived internal dose was 14.544 rem.

4. SC&A reran IREP using NIOSH's IREP input table, containing NIOSH's assigned external and internal doses, and confirmed NIOSH's stated POC of 33.86 percent.

Summary

SC&A found that the 2016 DR, which was performed using bioassay data, employed overestimating methods; therefore, the results (33.244 rem, with a POC of 45.43 percent) were greater than the original 2005 DR (18.330 rem, with a POC of 39.40 percent) using hypothetical intakes. The 2023 DR, which used reasonable but still claimant-favorable methods, resulted in a smaller internal dose and POC (14.544 rem, with a POC of 33.86 percent) than either of the previous DRs. SC&A did not have any findings or observations concerning NIOSH's 2023 reworked DR, assigned dose, or final POC.

Conclusions

Based on SC&A's review, it appears that the original case should not have initially used the hypothetical internal intakes derived using ORAUT-OTIB-0002. The case was not a good candidate to use the procedure due to the energy employee's employment date and target organ. In addition, the rework of this case used overestimating methods in assessing the bioassay data. Therefore, SC&A has concluded that it is unlikely the hypothetical intake model would result in an underestimate of dose if more reasonable estimating methods were used to fit the bioassay data. Due to the unique circumstances associated with the calculation of internal dose for this case, SC&A has concluded that it is improbable this issue would impact other cases and recommends closing the issue.

References

National Institute for Occupational Safety and Health. (2016). *Paducah Gaseous Diffusion Plant* (DCAS-PER-049, rev. 0). https://www.cdc.gov/niosh/ocas/pdfs/pers/dc-per49-r0.pdf

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SC&A, Inc. (2022, September 9). *DCAS-PER-049 subtask 4 – Internal dose followup* [Memorandum]. https://www.cdc.gov/niosh/ocas/pdfs/abrwh/scarpts/sca-per49-090922-508.pdf