ORAUT-OTIB-0017
Interpretation of Dosimetry Data for Assignment of Shallow Dose

Report from the Subcommittee for Procedure Reviews (SCPR)

Presented to the

Advisory Board on Radiation and Worker Health
Oak Ridge, Tennessee
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ORAUT-OTIB-0017, "Interpretation of Dosimetry Data for Assignment of Shallow Dose"

- ORAUT-OTIB-0017 provides guidance for assigning shallow doses to the skin, testes, and breast from non-penetrating radiation, including beta exposures and exposures to low-energy photons.
- Revision 01 issued October 11, 2005.
- SC&A review report issued June 6, 2006, contained 15 findings (on BRS).
- SCPR, NIOSH, and SC&A worked on resolutions 2006–2008.
- 14 findings closed, 1 finding in abeyance.

Finding 1: It is suggested that the dose reconstructor check whether the site was reporting dose due to electrons or photons, and whether the dosimetry system had been calibrated for that type of radiation.

- SC&A explained that the OTIB needs to provide additional guidance on how to interpret film badge data with respect to beta vs. low-energy photon exposure for the purpose of reconstructing shallow doses.
- NIOSH explained that this OTIB is to be used together with the site profile and other OTIBs on a case-by-case basis.
- *Resolution as of October 2, 2007: The SCPR found NIOSH's response acceptable and closed this finding.*

Finding 2: The protective clothing used for each case was known in the majority of cases. Clothing-specific transmission factors should be used.

- NIOSH explained that there is language in the OTIB that allows the dose reconstructor to choose the appropriate clothing shielding factors based on whether a minimizing, maximizing, or a realistic analysis of beta dose is being performed.
- SC&A and SCPR concur with this response.
- *Resolution as of October 2, 2007: The SCPR closed this finding.*

Finding 3: It is SC&A's opinion that individual monitoring for beta particles only works on a "yes/no" basis.

- NIOSH: OCAS and ORAUT disagree with this position. Consideration of geometry issues is discussed in the OTIB in the section on "Exposure Geometry" (see p. 7) and is discussed in the dose reconstruction (DR) reports on a case-by-case basis.
- SC&A's main concern is the potential for direct deposition of a hot particle on the worker's skin that is not detected, or localized undetected beta exposure.
- NIOSH explained that whether such exposures might have occurred is determined based on frisking data (for hot particles) and knowledge of the working conditions at the facility
- SC&A recommends that Finding 3 be closed, not because everything is resolved, but because OTIB-0017, although weak technically, cannot in SC&A's opinion be improved much further. SC&A suggests the following:
  - When the cancer site is on the hands, lower arm, or face, consider workplace monitoring data.
  - When the cancer site is on the thorax, use individual monitoring data.
  - When the cancer site is on the lower legs or feet, consider both.
- *Resolution as of October 14, 2008: The SCPR closed this finding. It should be noted that, due to findings identified in an SC&A DR review, many of SC&A's concerns were ultimately addressed to SC&A's and the SCPR's satisfaction under overarching issues (NIOSH-OVER-0009).*

Finding 4: It is possible to state definitely where the cancer site is, but not where the contamination was.

- Discussion about Finding 3 applies to this issue.
- *Resolution as of October 2, 2007: The SCPR transferred this item because it is being addressed and ultimately closed under Finding 3.*

Finding 5: A skin dose due to hot particle exposure will not be detected because of the localized nature of the exposure.

- Discussion about Finding 3 applies to this issue.
- *Resolution as of October 2, 2007: The SCPR transferred this item because it is being addressed and closed under Finding 3.*

Finding 6: If dosimetry recorded a limit of detection (LOD), then this value should be used as the basis for the missed dose calculation.

- Based on the following quote from a subsequent white paper prepared by SC&A on OTIB-0017, it appears that SC&A and NIOSH agree:

  > If it is known that the film badge dosimeter overstated the dose from low-energy photons, and if it can be further ascertained that the LOD was expressed in terms of this overstated dose rather than the corrected dose, then we agree that it is appropriate to apply a correction factor to the LOD in assigning a missed dose from low-energy photons.

- *Resolution as of December 11, 2007: Issue resolved to the satisfaction of the SCPR, who closed the finding.*

Finding 7: It is not claimant favorable to consider that the employee had 4 mm of clothing thickness.

- NIOSH: Due to the location of the organ of concern, the 4-millimeter assumption was made for pants and an undergarment – not a lab coat.
- SC&A and SCPR found this explanation acceptable.
- *Resolution as of October 2, 2007: The SCPR closed this finding.*

Finding 8: Attachment A provides a correction factor for the breast, penis, and testicle using a source that was modeled as a 10-cm^2 infinitely thin disc source located 2 cm away from the skin. For the breast area, the film dosimeter would give a reasonable dose estimate. If the source was near the testicles, the film dosimeter would not measure anything.

- There was extensive discussion about other documents that address this issue. NIOSH explained that it currently relies on quality assurance and training to ensure that the full array of guidance documents are being correctly employed in individual dose reconstructions.
- *Resolution as of October 2, 2007: The SCPR concluded that the guidance provided in the OTIB with respect to this issue is adequate and closed Finding 8.*

Finding 9: Tables A-1 and A-2 list correction factors for non-penetrating doses based on radionuclide. In nearly all real cases, it is not possible to state the radionuclides that are responsible for the beta dose.

- NIOSH: The table provides benchmark correction factors for a range of beta energies. Site profile documents will typically provide information that will help the dose reconstructor determine the proper energy range to use. In addition, the OTIB itself provides guidance with respect to uranium daughter products.
- SC&A and SCPR agreed with NIOSH's response.
- *Resolution as of November 7, 2007: The SCPR agreed and closed this finding.*

Finding 10: For low-energy beta radiation, the dosimeters were likely incapable of furnishing accurate doses.

- NIOSH: DR staff would have to consider this on a case-by-case basis. The purpose of the OTIB is to provide general information for the DR staff to use along with other sources of information. If necessary, the hierarchy of data sources listed in IG-001 (Table 1.1) and PROC-0006 (Table 5.2) includes the use of source term modeling.
- SC&A and SCPR agreed with NIOSH's response.
- *Resolution as of November 7, 2007: SCPR closed this finding because no further action was required.*

Finding 11: It is not clear why the two tables providing examples of skin dose assignments on pages 21 and 24 give the recommendation to assign 30–250 keV for missed dose to the skin for 0 "OW reading" and 0 "S reading."

- NIOSH: This radiation type and energy range was chosen because it is, in fact, claimant favorable compared to assigning the dose as electron dose (see IREP Technical Document).
- SC&A and SCPR agreed with NIOSH's response.
- *Resolution as of November 7, 2007: The SCPR closed this finding because no further action was required.*

Finding 12: The logical order of the information in Chapter 3, "General Approach," could be improved.

- NIOSH agreed with SC&A's finding. NIOSH will revise OTIB-0017 in the future.
- SC&A and SCPR agreed with NIOSH's response.
- *In Abeyance as of November 11, 2007, awaiting a revision to OTIB-0017.*

Finding 13: The OTIB does not identify any cases where a possibly high probability of causation (POC) can be determined early in the investigation.

- NIOSH: PROC-0006, not OTIB-0017, is the document that would be used by DR staff to quickly triage a claim to determine the potential for high POC. It is important to consider the use of OTIB-0017 in the overall context of the DR process. In addition, OTIB-0017 does give guidance on the topic of low/high POC potential on page 6, items a, b, and c.
- SC&A and SCPR agreed with NIOSH's response.
- *Resolution as of November 7, 2007: No further action was required; therefore, the SCPR closed this finding.*

Finding 14: The OTIB is not claimant favorable in instances of unknown parameters affecting dose estimates. (Typically, the dosimeter location has no relationship to skin dose at the point of cancer incidence.)

- NIOSH: OCAS and ORAUT disagree with this position. Consideration of geometry issues is discussed in the OTIB and is addressed on a case-by-case basis. In addition, the OTIB makes a recommendation (i.e., dose conversion factor (DCF) = 1) to accommodate potential inaccuracies due to exposure geometry. The OTIB is claimant favorable in its recommendations regarding DCF, LOD, attenuation, and radiation type/energy range.
- SC&A and SCPR agreed with NIOSH's response.
- *Resolution as of November 7, 2007: The SCPR also concurred with NIOSH's response and closed this finding.*

Finding 15: The OTIB does not employ scientifically valid protocols for reconstruction of doses regarding (a) assignment of non-penetrating dose, (b) assumption of 4 mm clothing thickness, and (c) treatment of hot particles.

- NIOSH: DCAS and ORAUT disagreed with this position and provided discussion of SC&A's concerns as follows:
  a) The guidance is given in order to assign the non-penetrating dose as electrons or low-energy photons as necessary to complete a valid dose reconstruction using IREP. Dose is often given as "OW" and "S" or "shallow" and "deep" – not beta and gamma.
  b) Since the organ discussed in this section of the OTIB is the penis, the 4-mm assumption was made for pants and an undergarment – not a lab coat (although that could have been added), sweater, or shirt as recommended in the general comments section.
  c) Non-uniform dose can be considered by the DR using the guidance in the OTIB along with tools such as VARSKIN and guidance from site profile documents regarding the potential for hot particle exposure.
- SC&A and SCPR agreed with NIOSH's response.
- *Resolution as of November 7, 2007: The SCPR concurred with NIOSH's response and closed this finding. It should also be noted that the non-uniform dose was ultimately adequately addressed under NIOSH-OVER-0009.*

Questions?