

# **TBD-6000 Work Group**

## **Report on Resolution of Findings for SC&A Review of Appendix BB, Rev. 2**

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# Background on Activities Related to Appendix BB, Rev. 2

- May 26, 2016: NIOSH issued Appendix BB, Rev. 2
- Sept. 6, 2016: SC&A issued memo discussing their review of Rev. 2.
- Nov. 4, 2016: NIOSH Response to SC&A review of Appendix BB, Rev. 2
- Dec. 9, 2016: SC&A Reply to NIOSH Response paper
- Dec. 14, 2016: Dr. Daniel McKeel submitted Critique of Appendix BB, Rev. 2, including comments on subsequent SC&A review and follow-up of DCAS response.
- Work Group met December 14, 2016

# Background on Activities Related to Appendix BB, Rev. 3

- February 9, 2017: Appendix 3 Issued by NIOSH
- February 22 2017: SC&A was tasked to “identify any questions or concerns you might have regarding the resolution of issues covered by this revision.”
- February 23, 2017: SC&A completed “preliminary” review of Rev. 3. They stated: “All but one of the substantive issues that can have an impact on future DRs of GSI workers have been addressed. The outstanding issue is the failure to identify the neutron doses in Tables 5, 6, 8, and 9 as ambient dose equivalents ( $H^*[10]$ ).
- The Work Group has not been involved in this recommended wording change.

# Issues Identified in SC&A Memo of September 6, 2016

- SC&A reviewed all of the 10 previously closed findings from Rev. 1 to assure that they had been correctly implemented in Rev. 2.
- SC&A agreed that Findings 2 through 9 had been appropriately implemented.
- For Finding 1, dealing with neutron dose rates, SC&A recommended that NIOSH assign doses based on actual neutron energies rather than the simplifying assumption that all neutrons were in the 100 keV to 2 MeV range.
- For Finding 10, SC&A recommended that the footnotes to Tables 8 & 9 be revised to clarify which DCF's are to be used. They also recommended that the maximum DCF from the <30 keV photon range should be used for betatron operator dose.

# Details for Finding 1

- NIOSH indicated that neutron doses derived from MCNPX simulations should be assumed to originate from neutrons with energies in the range of 100 keV to 2 MeV.
- SC&A found that using more exact energy ranges resulted in 45% higher neutron doses to the lungs of a betatron operator during uranium radiography and 37% higher doses during steel radiography. For a layout man, doses were 20% higher.
- Although doses were quite small in both cases, SC&A recommended use of the more claimant favorable values.

# Resolution for Finding 1

- NIOSH/DCAS indicated that because neutron doses are small, it is not necessary to assign the four neutron energy intervals proposed by SC&A.
- They proposed using one energy range, the 2 to 20 MeV range. This results in a claimant favorable simplification.
- SC&A pointed out that for certain organs, the 2 to 20 MeV range was not claimant favorable. They noted use of the 0-10 keV range would be most favorable when all organs are considered.
- NIOSH/DCS agreed with this approach and the Work Group concurred.

# Details for Finding 10

- The original finding addressed the use of effective doses from hypothetical residual radiation after betatron shutdown. No DCF's were provided.
- Rev. 2 used air kerma and provided DCF's. However, the dosimetric quantity was not identified as air kerma, leading to ambiguity as to which DCF's were to be used.
- Also, since the residual radiation was hypothesized to have an energy of 30 keV, the maximum DCF rather than the average for  $<30$  keV should be used.

# Resolution for Finding 10

- NIOSH reviewed the DCF's and realized that the appropriate value would be that of a 30 keV mono-energetic photon rather than from the zero to 30keV range. The 30 keV mono-energetic DCF corresponds to the maximum DCF for the 30 keV range.
- Using the 30 keV DCF then changes the limiting exposure scenario for the skin of the hands and forearms. As a result, the Table 9 values in Appendix BB will change to the Betatron operator values instead of the layout man for 1964-1966.

# Resolution for Finding 10 (continued)

- Based on the DCF discussion, NIOSH/DCAS recommended the following changes to Appendix B:
  1. Change the footnote of Table 8 and the text on page 15 from <30 keV to 30 keV.
  2. Change the Betatron Operator Dose values for the last three years (1964-1966) in Table 9.
  3. Change the footnote for Table 9 to indicate 30 keV.
  4. Change the paragraph following Table 9 to reflect the above changes.
- SC&A agreed with these changes and the WG concurred.

# Work Group Recommendation to Board

1. The TBD-6000 Work Group recommends that the ABRWH approve the proposed resolutions and closure of all findings for the revision of Appendix BB.