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Draft White Paper

**Resolution of SC&A Findings on Appendix C (Dow Madison)  
of Battelle-TBD-6000**

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## INTRODUCTION

At the February 5, 2010, meeting of the SEC Issues Work Group, SC&A was tasked by Chairman Melius to prepare an outline to insure that all the relevant points related to Special Exposure Cohort (SEC) issues at Dow Madison have been addressed. Based on the discussions at the meeting, SC&A determined that this request has two parts. The first was to delineate the extent to which surrogate data are used for dose reconstruction, based on the most recent NIOSH position presented in Appendix C of Battelle-TBD-6000, and the second is to summarize the extent to which SC&A's findings [based on its August 24, 2009, review of Appendix C (SC&A 2009a)] have been addressed by NIOSH. These two items are covered in separate brief white papers. This white paper describes SC&A's understanding of the extent to which its findings from a review of Appendix C have been resolved.

## RESOLUTION ON SC&A'S APPENDIX C FINDINGS

Subsequent to the publication of the three petition evaluation review reports (NIOSH 2007a, 2007b, and 2008), NIOSH released Appendix C to TBD-6000 (Battelle 2006) on September 8, 2008, which specifically deals with the Dow Madison site. Appendix C tabulates and consolidates data and guidance that can be used to calculate internal (inhalation and ingestion) and external doses from uranium exposures during both the operating and residual periods. Appendix C also provides data that can be used to calculate external thorium exposures during the operating period, and both external and internal (inhalation, ingestion, and thoron) exposures during the residual period. NIOSH determined that it was not feasible to reconstruct internal thorium doses during the operating period.

Each of SC&A's *Findings* from its review of Appendix C is listed below, together with NIOSH's comments made at the February 5<sup>th</sup> meeting (Transcript 2010) and additional input by SC&A for this white paper. In summary, SC&A believes that all issues have been resolved or have been transferred for review as generic issues.

*Finding 1: NIOSH has proposed the use of geometric mean data to calculate internal uranium exposures during the operating period. The geometric mean is based on only two measurements and, since NIOSH's stated goal is to estimate maximum doses, we believe that use of the 95<sup>th</sup> percentile is a more appropriate metric for this situation.*

NIOSH pointed out that this is not an SEC issue, since workers exposed during the operating period have already been added to the SEC. Therefore, the finding only relates to dose reconstruction for non-presumptive cancers. NIOSH thought that the POC might actually go down when using the 95<sup>th</sup> percentile, as compared to using the estimated geometric mean (GM) and an assumed geometric standard deviation (GSD) of 5 proposed by NIOSH (Transcript 2010, p. 23).

The question of the proper metric to be used for bounding calculations has been discussed on many occasions in the past. The question was recently considered by the TBD-6000 Work Group at its December 16, 2009, meeting, where NIOSH adopted the position that use of the

GM/GSD approach was claimant favorable, and SC&A felt that use of the 95<sup>th</sup> percentile was more appropriate for bounding calculations. At that meeting, the Work Group requested that SC&A make some hypothetical Interactive RadioEpidemiological Program (IREP) calculations to clarify the situation. SC&A modeled two hypothetical **external** exposure cases; in one, the POC was >50% for both approaches, and in the other, the POC was >50% using the 95<sup>th</sup> percentile and <50% using GM/GSD (SC&A 2009b). So the question remains unanswered. Perhaps, the matter could be resolved for Dow by some hypothetical IREP modeling of **internal** dose.

NIOSH was also of the opinion that use of the 95<sup>th</sup> percentile would result in implausible uranium intakes during the operation period (Transcript 2010, p. 24). The uranium operation with the highest dust level modeled in Appendix C involved rod straightening, with a GM daily weighted average value of 1,690 dpm/m<sup>3</sup> (Battelle 2006, Table 7.7). Assuming a GSD of 5, the 95<sup>th</sup> percentile value would be 23,860 dpm/m<sup>3</sup>. The maximum dust exposure reported in TBD-6000 for any uranium fabrication operation is 13,700 dpm/m<sup>3</sup> (for a roughing roll operator). Based on that information, we agree that NIOSH's approach to bounding internal uranium exposures during the operating period is reasonable. Hence, SC&A recommends closing this issue.

*Finding 2: The resuspension factor used by NIOSH for estimating uranium dust concentrations in air could be low by 1 to 2 orders of magnitude. NIOSH should revisit the use of a value of  $1 \times 10^{-6}/m$ .*

NIOSH and SC&A agreed that this was an overarching issue that needs to be resolved in a broader context than just Dow, since it affects a number of different appendices and approaches (Transcript 2010, p. 24). Hence, SC&A believes that this issue is being addressed as a generic issue and will be held in abeyance as it applies to Dow, until this issue is resolved generically.

*Finding 3: NIOSH should consider developing an exponential decay function for uranium removal during the residual period based on guidance in ORAUT-OTIB-0070 [ORAUT 2008].*

NIOSH indicated that a better approach would be one which is consistent with the approach used for thorium; namely, using an exponential decay function. NIOSH said that they would look into changing the uranium modeling approach to be similar to thorium (Transcript 2010, p. 25).

*Finding 4: There appear to be data entry errors in Table C.2 for the residual period.*

NIOSH agreed that the last line in Table C.2 was incorrect (Transcript 2010, p. 25). In a March 10<sup>th</sup> e-mail from LaVon Rutherford of NIOSH to W.C. Thurber of SC&A, Rutherford stated that the correct values for uranium exposure during the residual period were 0.86 mr/yr for the photon dose, 8.6 mrem/yr for the shallow dose to the skin other than the hands and arms, and 8.6 mrem/yr to the hands and arms. The skin dose was independent of body location, because workers would not be handling uranium during the residual period.

We presume that the photon dose is based on information in Table 6.4 of TBD-6000 for a “scrap recovery” operator<sup>1</sup> who received a dose of 2.358E-03 mr per calendar-day, or 0.86 mr/yr from a contaminated floor surface. We further presume that the shallow dose was assumed to be 10 times the deep dose. This is consistent with the guidance in Section 6.3 of TBD-6000, which states that, “For dose to other skin on the worker’s body that is not in direct contact with uranium metal, but is nearby (for example, a worker’s neck and face when the hands are in contact with metal), a dose relation can be used that estimates this dose to be 10 times the photon dose rate at 1-foot. This relation, [is] based on a review of film badge data, ...”

Based on the information provided by NIOSH, SC&A believes that this finding is appropriately resolved. SC&A recommends closing this issue.

*Finding 5: NIOSH should focus additional attention on insuring the transparency of the dose reconstruction guidance.*

This finding was not discussed, nor was discussion necessary. The development of dose reconstruction parameters is often complex and this finding is simply intended to reflect the fact that, with minimal additional effort, the dose reconstruction guidance could be clarified. It is often difficult to trace the assumptions to their source or to understand how the cited assumptions were actually implemented. In some cases, units of measurement are not clear.

## REFERENCES

Battelle 2006. *Site Profiles for Atomic Weapons Employers that Worked Uranium and Thorium Metals*. Battelle-TBD-6000. Battelle Team Dose Reconstruction Project for NIOSH.

NIOSH (National Institute for Occupational Safety and Health) 2007a. *SEC Petition Evaluation Report Petition SEC-00079*. April 13, 2007; SRDB Ref ID: 39873.

NIOSH (National Institute for Occupational Safety and Health) 2007b. *Addendum 1 to SEC Petition Evaluation Report Petition SEC-00079*. August 6, 2007.

NIOSH (National Institute for Occupational Safety and Health) 2008. *Addendum 2 to SEC Petition Evaluation Report Petition SEC-00079*. June 3, 2008.

ORAUT (Oak Ridge Associated Universities Team) 2008. *Dose Reconstruction During Residual Radioactivity Periods at Atomic Weapons Employer Facilities*. ORAUT-OTIB-0070, Revision 00. Cincinnati, Ohio. 2008.

SC&A 2009a. *Focused Review of Appendix C to TBD-6000 – Dow Chemical Company (Madison Site)*. SC&A, Inc., Vienna, Virginia, and Saliant, Inc., Jefferson, Maryland. August 24, 2009.

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<sup>1</sup> This job description included rod straightening.

SC&A 2009b. *Review of NIOSH Issue 1 White Paper Dated December 10, 2009*. Prepared for the TBD-6000 Work Group by SC&A, Inc., Vienna, Virginia, and Saliant, Inc., Jefferson, Maryland. December 23, 2009.

Transcript 2010. *Transcript of SEC Issues Work Group Meeting, February 5, 2010*. <http://www.cdc.gov/niosh/ocas/pdfs/abrwh/2010/wgtr020510.pdf>.