

---

DRAFT

**ADVISORY BOARD ON  
RADIATION AND WORKER HEALTH**

*National Institute for Occupational Safety and Health*

**SC&A'S REVIEW OF REMAINING SITE PROFILE ISSUES  
FOR MOUND LABORATORY RELATED TO CURRENT  
TECHNICAL BASIS DOCUMENTS**

**Contract No. 211-2014-58081**

**Document No. SCA-TR-2016-SP002, Revision 0**

Prepared by  
Joseph E. Fitzgerald, Jr.  
Saliant, Inc.

SC&A, Inc.  
1608 Spring Hill Road, Suite 400  
Vienna, Virginia 22182

Saliant, Inc.  
5579 Catholic Church Road  
Jefferson, Maryland 21755

February 2016

---

***DISCLAIMER***

*This is a working document provided by the Centers for Disease Control and Prevention (CDC) technical support contractor, SC&A for use in discussions with the National Institute for Occupational Safety and Health (NIOSH) and the Advisory Board on Radiation and Worker Health (ABRWH), including its Working Groups or Subcommittees. Documents produced by SC&A, such as memorandum, white paper, draft or working documents are not final NIOSH or ABRWH products or positions, unless specifically marked as such. This document prepared by SC&A represents its preliminary evaluation on technical issues.*

***NOTICE:*** *This report has been reviewed to identify and redact any information that is protected by the Privacy Act 5 U.S.C. § 552a and has been cleared for distribution.*

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 2 of 17
---	----------------------------------	---	----------------------------

**S. COHEN & ASSOCIATES:** *SC&A's Review of Remaining Site Profile Issues for Mound Laboratory Related to Current Technical Basis Documents*

<b>DOCUMENT TITLE:</b>	SC&A's Review of Remaining Site Profile Issues for Mound Laboratory related to Current Technical Basis Documents
<b>DOCUMENT NUMBER/ DESCRIPTION:</b>	SCA-TR-2016-SP002
<b>REVISION NO.:</b>	0
<b>SUPERSEDES:</b>	N/A
<b>EFFECTIVE DATE:</b>	February 11, 2016
<b>TASK MANAGER:</b>	Joe Fitzgerald
<b>PROJECT MANAGER:</b>	John Stiver, MS, CHP
<b>DOCUMENT REVIEWER(S):</b>	John Stiver, MS, CHP

**Record of Revisions**

<b>Revision Number</b>	<b>Effective Date</b>	<b>Description of Revision</b>
0 (Draft)	02/11/2016	Initial issue

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 3 of 17
---	----------------------------------	---	----------------------------

## TABLE OF CONTENTS

Abbreviations and Acronyms .....	4
1.0 Introduction and Background .....	5
2.0 Site Description TBD: ORAUT-TKBS-0016-2, Revision 01 .....	5
3.0 Occupational Medical Dose TBD: ORAUT-TKBS-0016-3, Revision 02.....	6
4.0 Occupational Environmental Dose TBD: ORAUT-TKBS-0016-4, Revision 01 .....	6
5.0 Occupational Internal Dose TBD: ORAUT-TKBS-0016-5, Revision 02 .....	6
5.1. Matrix Issue #5 (Pu-240, 241) .....	7
5.2. Matrix Issue #6 (Tritides) .....	7
5.3. Matrix Issue #9 (High-fired Pu-238) .....	8
5.4. Matrix Issues #11, 12, and 13 (Internal Dosimetry Data Completeness) .....	8
5.4.1. Uncertainties and Low Recovery for Polonium Bioassay Procedures .....	8
5.4.2. Other Radionuclide Data (SC&A Data Comparison) .....	9
5.4.3. Secondary/Other Radionuclide Data (MJW Evaluation) .....	9
5.4.4. Tritium Logbooks Missing for 1976 and 1977 .....	10
5.4.5. Tritium Bioassay Data Adequacy.....	11
5.4.6. Plutonium Data Comparison .....	11
5.4.7. Polonium Data Comparison .....	12
5.4.8. Fecal Bioassay Data .....	12
5.4.9. Tritium (HTO) Data Comparison.....	12
5.4.10. Thorium Bioassay Data .....	13
6.0 References.....	15

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 4 of 17
---	----------------------------------	---	----------------------------

## ABBREVIATIONS AND ACRONYMS

ABRWH	Advisory Board on Radiation and Worker Health
CFR	Code of Federal Regulations
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
HPNO	health physics number
HTO	tritiated water vapor
IMBA	Integrated Modules for Bioassay Analysis
LANL	Los Alamos National Laboratory
MDA	minimum detectable activity
MDC	minimum detectable concentration
MJW	MJW Corporation Inc.
MESH	Mound Environmental Safety and Health
NIOSH	National Institute for Occupational Safety and Health
ORAUT	Oak Ridge Associated Universities Team
OTIB	technical information bulletin
Po	polonium
Pu	plutonium
PORECON	polonium urinalysis bioassay results database
PURECON	plutonium urinalysis bioassay results database
RFP	Rocky Flats Plant
SEC	Special Exposure Cohort
SRDB	Site Research Data Base
SSN	social security number
TBD	technical basis document
Th	thorium
V&V	verification and validation
WG	Work Group

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 5 of 17
---	----------------------------------	---	----------------------------

## 1.0 INTRODUCTION AND BACKGROUND

At its November 18–19, 2015, meeting in Oakland, California, the Advisory Board on Radiation and Worker Health (ABRWH) tasked SC&A, Inc. with a review of revised technical basis documents (TBDs) for Mound Laboratory in the context of remaining site profile issues stemming from the original SC&A review and subsequent Mound Plant Work Group review of the Special Exposure Cohort (SEC) evaluation. SC&A reviewed the four TBDs that had undergone revision subsequent to SC&A’s original site profile review in 2006:

- Site Description TBD: ORAUT-TKBS-0016-2, Revision 01 (revised April 1, 2013)
- Occupational Medical Dose TBD: ORAUT-TKBS-0016-3, Revision 02 (revised March 14, 2013)
- Occupational Environmental Dose TBD: ORAUT-TKBS-0016-4, Revision 01 (revised February 7, 2013)
- Occupational Internal Dose TBD: ORAUT-TKBS-0016-5, Revision 02 (revised April 18, 2013)

The Occupational External Dose TBD, ORAUT-TKBS-0016-6, Revision 00 (August 11, 2004), has not yet been revised and was not reviewed. In its review, SC&A compared its original 2006 site profile findings and any subsequent site profile-type issues stemming from ABRWH work group deliberations for the SEC with the treatment that is afforded these issues in the current, revised TBDs. The baseline for this review comes from various issue matrices that were developed for the Work Group, from Work Group meeting transcripts, and from the extensive white papers and reviews that were generated during SEC deliberations. Where adequate treatment was found to be given, closure is recommended to the Mound Plant Work Group for consideration. Where such treatment is not adequate or is unclear, further follow-up with the National Institute for Occupational Safety and Health (NIOSH) is recommended.

## 2.0 SITE DESCRIPTION TBD: ORAUT-TKBS-0016-2, REVISION 01

This TBD essentially has the same content as the previous version (ORAUT-TKBS-0016-2, Revision 00, March 30, 2004), with (as noted by NIOSH) revisions to incorporate SEC Petitions SEC-00090, SEC-00171, and SEC00207, including SEC-related information pertaining to the SW (“Semi-Works”) Building and an update to Table 2-1 to add information for 2003 and 2010. While SC&A has no specific comments about the scope and content of this TBD, which we had found acceptable, our original site profile comments in 2006 provided this cautionary note:

*One interviewee said that in spite of these extensive listings, some room numbers and the isotopes used in these rooms had not made it into these summaries. It is also apparent from worker interviews that D&D characterization studies may have shown the presence of radionuclides in certain facilities not identified as such by the King report. [SC&A 2006a]*

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 6 of 17
---	----------------------------------	---	----------------------------

Given its lengthy operational history and the complexity and diversity of radionuclide use at Mound Laboratory, it continues to be important to remind dose reconstructors that the King report, and other surveys like it, represented operational “snapshots” and compiled histories and likely did not match all potential exposure source terms with time and location.

### **3.0 OCCUPATIONAL MEDICAL DOSE TBD: ORAUT-TKBS-0016-3, REVISION 02**

In SC&A’s site profile review of the Pantex Plant (SC&A 2006b) Occupational Medical Dose TBD (ORAUT 2006), SC&A found that “other examinations should be included, such as special job exams (e.g., respiratory protection, beryllium workers, asbestos workers, etc.) and termination exams.” SC&A further noted that the Occupational Medical Dose TBD “does not recognize this change from the previous Revision 2 of OTIB-0006 (Kathren and Shockley 2005), and also assumes that special chest radiography for respirator certification, beryllium and asbestos workers, and food handlers are accomplished as part of the annual physical, if these jobs are defined as ‘at-risk’ workers.” The SC&A review concluded that “NIOSH should review its interpretation of included medical exposure, and should reasonably adopt a broader interpretation of occupational medical dose, as provided in the most recent version of OTIB-0006 (Kathren and Shockley 2005).”

This concern appears to be only partially addressed in the 2013 version of the Mound Occupational Medical Dose TBD (ORAUT 2013b), with asbestos and “at-risk” workers categorized as receiving annual x-rays. However, no mention is made of beryllium workers and those requiring respiratory fittings (this differs from the approach taken for the medical occupational TBDs for Los Alamos National Laboratory (LANL) and the Rocky Flats Plant (RFP), where both of these categories were explicitly called out and are presumably based on the same OTIB-0006 guidance). If these and other medical x-ray categories are to be included in the “at-risk” category in Table 3-1, that clarification should be provided for the dose reconstructor in this TBD. (This is a minimum recommendation, as it would remain unclear why these categories should not be explicitly listed consistent with the approach taken for LANL and RFP medical exposure frequencies.)

### **4.0 OCCUPATIONAL ENVIRONMENTAL DOSE TBD: ORAUT-TKBS-0016-4, REVISION 01**

SC&A has no comments on this TBD.

### **5.0 OCCUPATIONAL INTERNAL DOSE TBD: ORAUT-TKBS-0016-5, REVISION 02**

At the request of the Mound Plant Work Group, SC&A prepared and issued (on May 25, 2012) a Mound Site Profile Issues Matrix (SC&A 2012a) that contained a tracking list for remaining site profile issues stemming from the SEC evaluation report review for Petition SEC-00090. This list was based on an assessment of the following:

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 7 of 17
---	----------------------------------	---	----------------------------

- The NIOSH Evaluation Report dated December 20, 2007
- The Mound SEC Petition SEC-00090
- A review of Site Research Database (SRDB) documents
- SC&A’s Site Profile Review (SC&A 2006a)
- Work Group meetings (as referenced below)
- Joint interviews of April 6, 2010
- Secure NIOSH/SC&A working sessions held in Germantown, Maryland, June 30, 2009, and April 7, 2010
- Past SEC Issues Matrices and listings developed by SC&A (SC&A 2011, 2012a, and 2012b)

NIOSH responded to an earlier SC&A memo report on internal dose adequacy and completeness (SC&A 2012b), as well as this matrix list, in a May 29, 2012, set of comments (acknowledging in the process some confusion over the status of these “open” issues, i.e., whether they were of an SEC or site profile nature) in advance of a June 5, 2012, Mound Plant Work Group meeting (NIOSH 2012). These items were discussed as an agenda item during that meeting, and this current review reflects that discussion as well. (Note that the issue numbers and titles in the discussion below follow the format used in SC&A’s (2012b) site profile matrix listing.) This particular Work Group exchange stands as the most recent discussion of record regarding outstanding Mound site profile issues and their respective status.

### **5.1. MATRIX ISSUE #5 (PU-240, 241)**

A remaining action was identified for this SEC matrix item when the Work Group closed it out: for NIOSH to confirm a bounding intake for plutonium-241 (Pu-241) for use in the dose reconstruction program. (ABRWH 2008a, Work Group (WG) transcripts pp. 147–158; ABRWH 2008b, WG transcripts, pp. 227–228). During the June 5, 2012, Work Group discussion, NIOSH (Jim Neton) agreed that this remained an open item for consideration in the then-upcoming Internal Dose TBD revision (ABRWH 2012, WG transcripts, p. 194). SC&A was unable to locate consideration of this issue within the revised TBD and suggests further clarification by NIOSH of its disposition.

### **5.2. MATRIX ISSUE #6 (TRITIDES)**

During the Work Group discussion of this SEC issue, NIOSH acknowledged that some consideration was needed by dose reconstructors of “intermediate solubility class” tritium compounds (ABRWH 2009, WG transcripts, pp. 239–256; NIOSH 2009a). During the June 5, 2012, Work Group discussion, NIOSH (Jim Neton) agreed to address the inclusion of guidance on intermediate solubility class compounds (such as titanium tritide) in a more formal response for the Work Group (ABRWH 2012, WG transcripts, p. 198). SC&A was unable to locate any formal NIOSH response on this issue or any specific treatment within the revised TBD or in the supporting document, ORAUT-RPRT-0057, Revision 00, *A Method for*

Effective Date:	Revision No.	Document No./Description:	Page No.
February 11, 2016	0 (Draft)	SCA-TR-2016-SP002	8 of 17

*Estimating Stable Metal Tritide Exposures to Tritium Ancillary Workers Based on Swipe Data in Rooms SW-8, SW13, SW-150 and R-108 at the Mound Laboratory 1968 to 1989* (Jessen et al. 2013). SC&A suggests further clarification of NIOSH’s position on this item.

### 5.3. MATRIX ISSUE #9 (HIGH-FIRED PU-238)

In Work Group discussions, as reflected in the Mound SEC issues matrix (SC&A 2011), NIOSH was to provide “additional review and a commitment to make dose reconstructors aware of available solubility-based excretion models (i.e., Type J); the Work Group closed this issue as an SEC issue.” The remaining action noted in the matrix was that NIOSH was to complete its review and add a “Type L” excretion model to those already available to dose reconstructors. In the June 5, 2012, Work Group discussions, NIOSH (Jim Neton) acknowledged the commitment and indicated that it would consider how to include some consideration of a “Type L” model in the then-upcoming TBD revision (ABRWH 2012, WG transcripts, p. 200). SC&A, in its review of the TBD revision, found NIOSH referenced a Type L model as follows:

*The type L model developed from Mound site data is unlikely to be typical of Mound site exposures to 238Pu, but each potential exposure should be evaluated for applicability of this model. Type L is modeled using specific IMBA input parameters in Table 5-15 later in this document. [ORAUT 2013d]*

SC&A recommends closure of this site profile item.

### 5.4. MATRIX ISSUES #11, 12, AND 13 (INTERNAL DOSIMETRY DATA COMPLETENESS)

#### 5.4.1. Uncertainties and Low Recovery for Polonium Bioassay Procedures

This issue was raised originally in SC&A’s white paper, *Mound Internal Dosimetry Data Completeness* (SC&A 2009a), in Section 3.1, as it pertained to “questionable effectiveness of early radiobioassay at Mound.” The Work Group saw a need for more treatment of this specific Mound bioassay limitation. Illustrative of questionable effectiveness are the low recovery for polonium urinalysis (an average of about 10%) and reduced recoveries in samples with higher activities. While the broader issue of early Mound radiobioassay limitations was addressed in various NIOSH responses, this specific question apparently was not. In the June 5, 2012, Work Group meeting, NIOSH (Jim Neton) agreed that it could be readily addressed (ABRWH 2012: WG transcripts, p. 204).

The revised Occupational Internal Dose TBD includes the following discussion in Attachment B, “Uncertainty Assessment” (ORAUT 2013d, page 59):

*Uncertainties associated with analytical procedures Mound used throughout the history of bioassay measurements are significant. Early analytical procedures resulted in large errors and MDAs in relation to required regulatory dose limits. Reductions in regulated body burdens for 210Po required modifications to improve analytical sensitivities. Positive bioassay detections would therefore*



<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 9 of 17
---	----------------------------------	---	----------------------------

*correspond to significant worker dose commitments at the lower end of detection in urine for some radionuclides.*

*Systematic errors occurred in analytical procedures in the early years due primarily to ineffective plating techniques and low recoveries. Low recoveries were due largely to colloidal plating of metabolized 238,239Pu and 210Po from raw urine onto sample containers. Polonium-210 recovery in the early years before sample acidification could have resulted in an order of magnitude correction for 210Po urinalysis results.*

SC&A recommends closure of this site profile item, with clarification as to whether these limitations are reflected in dose reconstruction workbooks and guidance.

#### **5.4.2. Other Radionuclide Data (SC&A Data Comparison)**

This issue was raised originally in SC&A’s white paper, *Mound Internal Dosimetry Data Completeness* (SC&A 2009a), in Section 3.6. In its May 2012 response (NIOSH 2012), NIOSH noted that it had “responded in detail to these concerns in its November, 2009 report, *NIOSH Evaluation of Data Adequacy and Completeness Issues at the Mound Laboratory* (NIOSH 2009b), and again in its August 2011 report, *NIOSH Evaluation of Data Adequacy and Completeness Issues at the Mound Laboratory* (NIOSH 2011). During the June 5, 2012, Work Group meeting (ABRWH 2012, WG transcripts, p. 205), SC&A acknowledged NIOSH’s responsiveness to two of the sub-issues regarding “~95% of data found for selected individuals was collected in 1990 and later...Pre-1990 results included uranium, thorium, and curium” and “Majority of pre-1990 results not available in MESH” and recommends that the Work Group close these sub-issues. For the other issues—recognizing that data comparison is rendered difficult due to units and radionuclides not always matching and that volume corrections were not possible in many cases—SC&A views these as enhancements, for clarity sake, that NIOSH can consider for future TBD revisions. Overall, SC&A recommends closure of this site profile item.

#### **5.4.3. Secondary/Other Radionuclide Data (MJW Evaluation)**

In SC&A’s *Mound Internal Dosimetry Data Quality Assurance* (April 2009b), a review was conducted of the previous data analysis completed during the pre-1989 dose reconstruction effort by MJW Corporation Inc. NIOSH used this review, coupled with the *History of the Mound Bioassay Program* (Meyer 1992), as the basis for demonstrating the level of quality in the Mound bioassay program and data. SC&A found that for “other” radionuclides, “the scarceness of data infers that these analyses were not performed routinely and often enough to generate much quality assurance data,” an issue for which similar concerns were raised by MJW in its pre-1989 review. Those concerns included the following:

*Many difficulties were encountered in attempting to interpret the available bioassay records and reports of the other radionuclides. Some of the results were not associated with a name, social security number (SSN), or health physics*

Effective Date:	Revision No.	Document No./Description:	Page No.
February 11, 2016	0 (Draft)	SCA-TR-2016-SP002	10 of 17

*number (HPNO). Often times there not units associated with a result.*  
[MJW 2002, Appendix C]

MJW further found that,

*The intake and dose assessments for “other” radionuclides done during the project based on limited, and on occasion conflicting, information. In some cases, it appears that the same bioassay results were repeatedly reported for two, or sometimes three, different radionuclides.* [MJW 2002, Appendix C]

These and other quality assurance issues cited in MJW’s pre-1989 report were addressed in NIOSH’s response #12 of its August 2011 paper, *NIOSH Evaluation of Data Adequacy and Completeness Issues at the Mound Laboratory* (NIOSH 2011). To summarize, NIOSH disputed SC&A’s characterization of the MJW assessment, noting that the MJW report referred to these “other” radionuclides as “relatively minor players in the Mound facility operations,” that 369 dose assessments for these “other” radionuclides actually had been performed, and that the “other” radionuclides were part of small, episodic programs involving laboratory research involving relatively few workers. In toto, NIOSH agrees that “other” radionuclides should not be ignored but asserts that the scale of exposure potential is very small for affected workers.

During the June 5, 2012, Work Group meeting, NIOSH (Jim Neton) agreed that any remaining questions about the MJW findings for “other” radionuclides should be addressed in the context of the TBD (ABRWH 2012, WG transcripts, p. 209).

SC&A agrees with NIOSH’s 2011 conclusion (NIOSH 2011) that the scale of workers affected is relatively small, given the research context of this laboratory work, but continues to contend that NIOSH needs to reconcile these original MJW quality findings for “other” radionuclides with how it is approaching dose reconstruction for them in the Occupational Internal Dose TBD. Although the number of workers was small relative to tritium and plutonium production operations, research was a prime mission of Mound and needs to be addressed accordingly in terms of the adequacy of bioassay data being used in reconstructing doses for those workers. If they are not to be ignored in the dose reconstruction program for Mound, how are such doses being assigned?

#### **5.4.4. Tritium Logbooks Missing for 1976 and 1977**

Based on NIOSH findings, SC&A confirmed that tritium logbooks (but not corresponding tritium reported dose in Mound Environmental Safety and Health (MESH)) were missing for certain years. SC&A noted, at the June 5, 2012, Work Group meeting, that its originally reported years were in error; the periods for which logbooks are missing are September 1, 1972, through December 31, 1972; and for January 1, 1975, through December 31, 1976. (ABRWH 2012, WG transcripts, p. 172). At that work group meeting, SC&A observed that the then-proposed NIOSH model for bounding tritide dose based on entries in these logbooks could not be accomplished for those years. In response, NIOSH (Jim Neton) indicated that his office was moving forward on an 83.14 petition process for defining an SEC class for those time periods (ABRWH 2012, WG transcripts, pp. 172–173). SC&A has confirmed that Petition SEC-00207 was filed,

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 11 of 17
---	----------------------------------	---	-----------------------------

recommended by the Advisory Board, and formally designated on January 17, 2013, rendering this issue moot. SC&A recommends closure of this site profile item.

#### **5.4.5. Tritium Bioassay Data Adequacy**

SC&A originally raised this concern in its 2009 report, *Mound Internal Dosimetry Data Adequacy* (SC&A 2009c), and further elaborated it in another 2009 report, *Response to Modeling of Intakes for Special Tritium Compounds* (SC&A 2009d). In these reports, SC&A raised the concern that the algorithm used to determine early tritium dose was adopted from a LANL procedure based on estimating whole-body dose from tritium in water. This procedure, as applied at Mound through 1981, indicates that all annual tritium dose is based on tritiated water vapor (HTO) and that other tritium compounds were not considered, although it clear that such compounds as special tritium compounds and organically bound tritium were present. In its May 2012 response to SC&A’s draft site profile matrix (NIOSH 2012), NIOSH noted that it had obtained tritium bioassay logbooks (with the exception of the time periods noted in Section 5.4.4 above) and had access to the requisite raw data from which tritium dose reconstruction could be performed.

NIOSH has addressed the question of tritium compounds other than HTO before 1982 in its bounding methodology for special tritium compounds (tritides) that was conceptually proposed in *Responses to Action Items Introduced During the Mound Work Group Meeting of June 5, 2012* (Chew et. al., 2012), and formally issued as *A Method for Estimating Stable Metal Tritide Exposures to Tritium Ancillary Workers Based on Swipe Data in Rooms SW-8, SW13, SW-150 and R-108 at the Mound Laboratory 1968 to 1989* (Jessen et al. 2013). The successive treatment of this issue over several years, culminating in available tritium logbooks being obtained for purposes of accessing original tritium bioassay data (coupled with an 83.14 SEC class being defined for time periods lacking such logbooks) and the development of a bounding method for special tritium compounds, addresses SC&A’s original concern. SC&A recommends closure of this site profile item.

#### **5.4.6. Plutonium Data Comparison**

In its 2009 report, *Mound Internal Dosimetry Data Completeness*,” SC&A (2009a) found that, of the total records used in the comparison of MESH data versus bioassay card data, about 15% did not have bioassay card data, with alternate sources of hardcopy records available in only some of the cases. Approximately 3% of the MESH and individual exposure files did not have data that were listed in the logsheets. This concern stems from the reliance of the U.S. Department of Energy’s (DOE’s) electronic records for Mound on MESH printouts.

Based on further sampling of 25 former Mound employees for internal data completeness, SC&A recommended to the Work Group that further validation be performed by NIOSH on the completeness of bioassay records for dose reconstruction. In the context of what has become known as verification and validation (V&V) of records databases, this has typically involved some degree of records sampling and comparison (e.g., electronic versus hardcopy) for internal and external dose. It is not clear to what extent such V&V was completed for Mound in the course of the SEC evaluation. SC&A recommends that the Work Group request that NIOSH

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 12 of 17
---	----------------------------------	---	-----------------------------

provide a summary of how it conducted such validation of Mound's internal and external dose databases.

#### **5.4.7. Polonium Data Comparison**

In its 2009 report, *Mound Internal Dosimetry Data Completeness*, SC&A (2009a) found that about 3% of the total records had no bioassay card data and about 2% had no data in the electronic POLON\_DATA file, itself. As noted in the SC&A report:

*Where the bioassay card and PORECON database results were both available, ~99 % of the electronic data was consistent with the data on the bioassay card. Of the total records, ~3% of the records had no bioassay card data and ~2% had no data in POLON\_DATA. Where the bioassay card and PORECON results were both available, ~99% of the electronic data was consistent with the data on the bioassay card. Of the total records, ~3% of the records had no bioassay card data and ~12% had no data in PORECON. There were individuals with data in PORECON that were not found in POLON\_DATA and vice versa. In other cases, only partial records were available in the electronic and/or hardcopy data source.*

As recommended in Section 5.4.6 above, the Work Group should request that NIOSH provide a summary of how it conducted a validation of Mound's internal and external dose databases.

#### **5.4.8. Fecal Bioassay Data**

In its 2009 report, *Mound Internal Dosimetry Data Completeness*, SC&A (2009a) found that there are relatively few fecal results in the plutonium urinalysis bioassay results database (PURECON) (i.e., total of 29 fecal samples for 12 individuals for the entire Mound worker population) and that there is poor overlap of data with corresponding logbooks for the same time periods. A majority of the data found in the logbooks were not found in the individual exposure files. As many of these samples were likely collected as a result of an incident or suspected plutonium exposure, the data can be critical to best-estimate dose reconstruction.

When SC&A mentioned this data completeness concern during the June 5, 2012, Work Group meeting, NIOSH pointed out that it does not intend to make use of the fecal sampling records, rendering moot the incompleteness of these records (ABRWH 2012, WG transcripts, p. 214). SC&A recommends that the Work Group request confirmation from NIOSH that Mound fecal data have no use in dose reconstruction.

#### **5.4.9. Tritium (HTO) Data Comparison**

In its 2009 report, *Mound Internal Dosimetry Data Completeness*, SC&A (2009a) found that, for 25 individuals sampled for internal dose completeness validation, approximately 4,900 tritium bioassay results were located in the HP\_TRITIUM database ranging from October 1981 to July 2003. Log bioassay values for limited, specific time periods were located at the time in the SRDB. One issue noted at the time was that some individuals (of the 25 sampled) had tritium bioassay data prior to 1982, yet there was no tritium dose listed in MESH for the years in

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 13 of 17
---	----------------------------------	---	-----------------------------

question. The extent of this discrepancy was not known because a comprehensive V&V had not been performed. During the June 5, 2012, Work Group meeting, NIOSH (Jim Neton) noted that, with an electronic reproduction of the entire available set of tritium logbooks, such a comparison would be feasible (ABRWH 2012, WG transcripts, p. 214).

As for the findings in Sections 5.4.6 and 5.4.7 above, SC&A recommends that the Work Group request that NIOSH provide a summary of how it conducted a validation of Mound's internal and external dose databases in this context.

#### **5.4.10. Thorium Bioassay Data**

In its 2009 report, *Mound Internal Dosimetry Data Adequacy*, SC&A (2009c) concluded the following:

*In summary, the limited amount of data and the shortcomings associated with data interpretation remains for thorium beyond the established SEC period ending on February 29, 1959. Although urinalysis data exist for thorium prior to 1970, procedures on how these samples were analyzed and interpreted are not available. The data infers that at least a portion of the thorium analysis was analyzed by the radium extraction and differential counting method to measure the radium daughter of the thorium. If this is the case, then, as noted by MJW, there are a lot of questionable assumptions that need to be made is using an excreted daughter to estimate the intake of a parent...the lack of bioassay procedure information can make the derivation of the MDA or MDC, which forms the basis for NIOSH's proposed method of assigning missed doses, difficult.*

An additional concern is the potential for Class YY insoluble thorium being handled at Mound. In 1996–1997, a particle sizing and solubility (chemical form) study was performed at Mound by James and Weaver (1997). While the studies were performed in a limited area of the laboratory, information was collected that “for Th-228 and Th-232 samples analyzed to date, it is apparent that approximately 100% of the radionuclide is in the very insoluble class YY form in the sampled contamination” (this study was performed during decontamination and decommissioning (D&D)). With these results and other indications, SC&A found that there were significant uncertainties introduced during modeling of thorium dose because of the absence of information on the age and chemical solubility of thorium. In its 2009 report, SC&A recommended further consideration be given to the impact of the assessment of highly insoluble thorium (i.e., Class YY) identified at Mound (SC&A 2009c).

After the 2009 and 2010 SC&A data adequacy and completeness reports, NIOSH and SC&A exchanged white papers on the thorium issue (Ulsh and Stewart 2012; SC&A 2012c).

During the June 5, 2012, Work Group discussion of this topic, these two white papers were discussed and the Work Group agreed that, while reliance needs to be placed on Mound's historic bioassay program administration, there was no evidence that the program had not been adequately administered (ABRWH 2012, WG transcripts, pp. 159–171). The Work Group subsequently closed all but the question of Class YY solubility, an issue that NIOSH (Jim Neton)

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 14 of 17
---	----------------------------------	---	-----------------------------

believed had been addressed in terms of dose reconstruction methodology at other DOE sites being reviewed; this was to be confirmed and a consistent approach for handling highly insoluble thorium applied to Mound (ABRWH 2012, WG transcripts, p. 216). SC&A recommends that the Work Group confirm that NIOSH has addressed this question at other DOE sites and whether such an approach has been made available for Mound dose reconstructors.

<b>Effective Date:</b> February 11, 2016	<b>Revision No.</b> 0 (Draft)	<b>Document No./Description:</b> SCA-TR-2016-SP002	<b>Page No.</b> 15 of 17
---	----------------------------------	---	-----------------------------

## 6.0 REFERENCES

- ABRWH 2008a. Advisory Board on Radiation and Worker Health, Mound Work Group meeting, April 1, 2008, transcripts (pp. 147–158).
- ABRWH 2008b. Advisory Board on Radiation and Worker Health, Mound Work Group meeting, July 14, 2008, transcripts (pp. 227–228).
- ABRWH 2009. Advisory Board on Radiation and Worker Health, Mound Work Group meeting, May 27, 2009, transcripts (pp. 239–256).
- ABRWH 2012. Advisory Board on Radiation and Worker Health, Mound Work Group meeting, June 5, 2012.
- Chew et al. 2012. Mel Chew, Billy Smith, and Bryce Rich, *Responses to Action Items Introduced During the Mound Work Group Meeting of June 5, 2012*, ORAUT white paper. August 22, 2012.
- James and Weaver 1997. W.R. James and R.P. Weaver, *Mound Particle Size and Chemical Form/Solubility Study*, Mound Applied Technologies. September 30, 1997.
- Jessen et al. 2013. Karin A. Jessen, Samuel L.T. Chu, Robert L. Morris, Leo G. Faust, Melton H. Chew, Eugene W. Potter, and Billy Smith, *A Method for Estimating Stable Metal Tritide Exposures to Tritium Ancillary Workers Based on Swipe Data in Rooms SW-8, SW13, SW-150 and R-108 at the Mound Laboratory 1968 to 1989*, ORAUT-RPRT-0057, Revision 00. March 7, 2013.
- Kathren and Shockey 2005. R. Kathren and V.E. Shockley, *Technical Information Bulletin: Dose Reconstruction from Occupationally Related Diagnostic X-ray Procedures*, ORAUT-OTIB-0006, Revision 03, Oak Ridge Associated Universities, Oak Ridge, Tennessee. December 21, 2005.
- Meyer 1992. H.E. Meyer, *History of Mound Bioassay Programs*, Volume 1, MLM-MV-93-93-0003, EG&G Mound Applied Technologies, Mound Facility, Miamisburg, Ohio. September 1992. [SRDB Ref ID: 1962]
- MJW 2002. Pre-1989 Dose Assessment Project Phase I and II Final Reports, MJW Corporation, Inc. April and June 2002.
- NIOSH 2007. *SEC Petition Evaluation Report*, Petition SEC-00090, Mound Plant, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. December 20, 2007.
- NIOSH 2009a. *NIOSH Evaluation of Special Tritium Compound Dose-Reconstruction Issues at the Mound Laboratory*, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. October 2009.

Effective Date:	Revision No.	Document No./Description:	Page No.
February 11, 2016	0 (Draft)	SCA-TR-2016-SP002	16 of 17

NIOSH 2009b. *NIOSH Evaluation of Data Adequacy and Completeness Issues at the Mound Laboratory*, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. November 2009.

NIOSH 2011. *NIOSH Evaluation of Data Adequacy and Completeness Issues at the Mound Laboratory*, Brant Ulsh, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. August 2011.

NIOSH 2012. *NIOSH Response to SC&A's January 12, 2012 Memo Report on Adequacy and Completeness of Mound Internal Dosimetry*, National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. May 29, 2012.

ORAUT 2004a. *Technical Basis Document for the Mound Site – Site Description*, ORAUT-TKBS-0016-2, Revision 00, Oak Ridge Associated Universities Team, Cincinnati, Ohio. March 30, 2004.

ORAUT 2004b. *Technical Basis Document for the Mound Site – Occupational External Dose*, ORAUT-TKBS-0016-6, Revision 00, Oak Ridge Associated Universities Team, Cincinnati, Ohio. August 11, 2004.

ORAUT 2006. *Technical Basis Document for the Pantex Plant – Occupational Medical Dose*, ORAUT-TKBS-0016-3, Revision 01, Oak Ridge Associated Universities Team, Cincinnati, Ohio. March 31, 2006.

ORAUT 2013a. *Technical Basis Document for the Mound Site – Site Description*, ORAUT-TKBS-0016-2, Revision 01, Oak Ridge Associated Universities Team, Cincinnati, Ohio. April 1, 2013.

ORAUT 2013b. *Technical Basis Document for the Mound Site – Occupational Medical Dose*, ORAUT-TKBS-0016-3, Revision 02, Oak Ridge Associated Universities Team, Cincinnati, Ohio. March 14, 2013.

ORAUT 2013c. *Technical Basis Document for the Mound Site – Occupational Environmental Dose*, ORAUT-TKBS-0016-4, Revision 01, Oak Ridge Associated Universities Team, Cincinnati, Ohio. February 7, 2013.

ORAUT 2013d. *Technical Basis Document for the Mound Site – Occupational Internal Dose*, ORAUT-TKBS-0016-5, Revision 02, Oak Ridge Associated Universities Team, Cincinnati, Ohio. April 18, 2013.

SC&A 2006a. *Review of the NIOSH Site Profile for the Mound Laboratory Site*, S. Cohen and Associates, Inc., Vienna, Virginia. July 16, 2006.

SC&A, 2006b. *Review of the NIOSH Site Profile for the Pantex Plant*, S. Cohen and Associates, Inc., Vienna, Virginia. July 16, 2006.



<b>Effective Date:</b>	<b>Revision No.</b>	<b>Document No./Description:</b>	<b>Page No.</b>
February 11, 2016	0 (Draft)	SCA-TR-2016-SP002	17 of 17

SC&A 2009a. *Mound Internal Dosimetry Data Completeness* [Preliminary Draft for the Mound Plant Work Group Review], S. Cohen and Associates, Inc., Vienna, Virginia. April 2009.

SC&A 2009b. *Mound Internal Dosimetry Data Quality Assurance* [Preliminary Draft for the Mound Plant Work Group Review], S. Cohen and Associates, Inc., Vienna, Virginia. April 2009.

SC&A 2009c. *Mound Internal Dosimetry Data Adequacy* [Preliminary Draft for the Mound Plant Work Group Review], S. Cohen and Associates, Inc., Vienna, Virginia. April 2009.

SC&A 2009d. *Response to Modeling of Intakes for Special Tritium Compounds* [Preliminary Draft for the Mound Working Group Review], Revision 0, S. Cohen and Associates, Inc., Vienna, Virginia. April 2009.

SC&A 2011. *Mound SEC Issues Matrix – for SEC Petition SEC-0009*, S. Cohen and Associates, Inc., Vienna, Virginia. November 2, 2011.

SC&A 2012a. *Mound Work Group – Site Profile Issues Stemming from SEC Review (2008–2012)*, S. Cohen and Associates, Inc., Vienna, Virginia. May 25, 2012.

SC&A 2012b. *Adequacy and Completeness of Mound Internal Dosimetry – Work Group Issues*, memorandum from Joseph Fitzgerald, SC&A, to Mound Work Group, January 12, 2012.

SC&A 2012c. Ron Buchanan, *SC&A'S Evaluation of NIOSH's April 2012 Mound Laboratory Th-232 White Paper*, S. Cohen and Associates, Inc., Vienna, Virginia. May 2012.

Ulsh and Stewart 2012. B.A. Ulsh and D.N. Stewart, *Retrospective Dose Reconstruction for Thorium-232 Activities at the Mound Laboratory*, National Institute for Occupational Safety and Health. April 2012.