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**ADVISORY BOARD ON  
RADIATION AND WORKER HEALTH**

*National Institute for Occupational Safety and Health*

**SC&A RECOMMENDATIONS REGARDING ISSUES  
RESOLUTION FOR THE SITE PROFILE FOR ARGONNE  
NATIONAL LABORATORY–EAST**

**Contract No. 211-2014-58081  
SCA-TR-2016-SP005, Revision 1**

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**SC&A, INC.:**

***Technical Support for the Advisory Board on Radiation & Worker Health Review of NIOSH Dose Reconstruction Program***

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## ABBREVIATIONS AND ACRONYMS

ABRWH	Advisory Board on Radiation Worker Health
ANL-E	Argonne National Laboratory – East
AP	anterior posterior
DCF	dose conversion factor
EEOICPA	Energy Employee Occupational Illness Compensation Program Act of 2000
LAT	lateral
Met Lab	Metallurgical Laboratory
NIOSH	National Institute for Occupational Safety and Health
NTA	nuclear track emulsion, type A (film)
ORAU	Oak Ridge Associated Universities
ORAUT	Oak Ridge Associated Universities Team
PFG	photofluorography
rem	Roentgen equivalent man
TBD	technical basis document

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## 1.0 INTRODUCTION AND BACKGROUND

SC&A, Inc. reviewed the Argonne National Laboratory – East (ANL-E) site profile and delivered its report to the Advisory Board on Radiation and Worker Health (ABRWH or “the Board”) on March 11, 2009 (SCA 2009). The site profile is composed of six technical basis documents (TBDs) that at the time of SC&A’s review were all dated 2005 or 2006. SC&A’s review of the TBDs contained 13 primary findings, 7 secondary issues, and a number of questions, listed in Attachment 3 of the review. However, at that time, no action was taken to address those findings. Since then, the National Institute for Occupational Safety and Health (NIOSH) has issued Revision 01 of ORAUT-TKBS-0036-6, *Argonne National Laboratory – East – External Dosimetry*, on October 16, 2014.

The Board recently initiated the process of addressing the findings during its meeting in Tampa, Florida, on March 23 and 24, 2016. The Board asked SC&A to prepare a status report and recommendations on issues resolution for the ANL-E site profile for use at a yet-to-be scheduled ANL-E work group meeting. This report is provided in response to that request.

The primary objective of this report is to determine the degree to which the 13 findings and other issues identified in SC&A’s 2009 review of the ANL-E site profile have been addressed and, therefore, perhaps can be closed as a result of activities that have taken place since the publication of SC&A’s site profile review. The following types of activities that have taken place since 2009 might affect the findings:

1. *The issuance of revised TBDs for ANL-E may address issues raised by SC&A.* As noted above, NIOSH issued a revision to the external dose TBD in 2014 (ORAUT-TKBS-0036-6, Revision 01). This report addresses the degree to which the revised TBD addresses the issues raised by SC&A in 2009.
2. *Issues resolution completed in other Board venues might also apply to the issues raised by SC&A.* There have been a number of reviews of other site profiles, such as the Mound site profile and Special Exposure Cohort petition evaluation report, where similar issues were raised and resolved. These reviews may be useful in closing out issues raised in SC&A’s 2009 site profile review for ANL-E.
3. *New or revised procedures that address and perhaps resolve issues raised by SC&A.* One example is the issuance of Revision 04 of ORAUT-OTIB-0006, *Dose Reconstruction from Occupational Medical X-Ray Procedures*, in 2011, which addresses occupational medical exposures.

The following sections address the degree to which the 13 findings and other issues identified in SC&A’s 2009 review of the ANL-E site profile have been addressed and could possibly be closed based on the three categories of activities described above. In addition, given the number of years that have passed since the publication of SC&A’s 2009 review, the sections that follow also identify new issues that might need to be addressed.

The occupational internal dose TBD (ORAUT-TKBS-0036-5, 2006) for ANL-E has not been revised, but many of the issues identified by SC&A have been addressed in Attachment 4 of

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SC&A's 2009 site profile review and also in other venues. Section 2 of this report summarizes the issues, identifies the degree to which internal dose issues may have been addressed to some degree in Attachment 4 of SC&A's 2009 site profile review of ORAUT-TKBS-0036-5 and other venues, and whether consideration should be given to closing any of these issues.

The ANL-E occupational medical exposure TBD (ORAUT-TKBS-0036-3, Revision 01 PC-1, March 2006) has not been revised since our 2009 site profile review. However, in 2011, Revision 04 of ORAUT-OTIB-0006 was issued, and, as will be discussed in Section 3, the occupational medical exposure issues have been resolved with the issuance of the revisions. SC&A believes that all that is required to close out these issues is for ORAUT-TKBS-0036-3 to be revised to refer to guidance provided in the latest revision of ORAUT-OTIB-0006 (Revision 04) and also to revise the frequency of occupational medical exposures as determined by worker interviews, which were held in support of the preparation of the TBD review.

The TBD that addresses external exposures at ANL-E, ORAUT-TKBS-0036-6, *Argonne National Laboratory – East – External Dosimetry*, was revised in 2014. Section 4 explores the degree to which the revised TBD addresses external dose issues associated with external beta/gamma doses and neutron doses.

In each section, a brief description is provided of the original finding or issue from SC&A's 2009 review of the site profile. This material is followed by a discussion of whether the issues and findings have been addressed by one or more of the three types of activities described above since SC&A's 2009 review of the ANL-E site profile, or as part of the discussions held between SC&A and NIOSH as part of the process of preparing the site profile review (i.e., see Attachment 4 of SC&A 2009).

## 2.0 FINDINGS ASSOCIATED WITH INTERNAL DOSIMETRY

ORAUT-TKBS-0036-5, *Argonne National Laboratory – East – Occupational Internal Dose*, has not been revised since the original issue in March 2006. SC&A reviewed this ANL-E TBD and identified five findings and one secondary issue related to internal dose (SC&A 2009):

- Finding 1: Lack of Definition of Radionuclide Compositions and Radionuclides Not Addressed in the Site Profile
- Finding 2: Potential Missed Dose from the Use of Gross Alpha Counting for Bioassay (1946 to 1972)
- Finding 3: Assumption of Default Inhalation Pathway May Not Be Claimant Favorable
- Finding 4: Insufficient Information on the Calculation of Minimum Detectable Concentrations and Uncertainties in Bioassay Methodology
- Finding 5: Lack of Guidance for Estimation of Missed Dose for Unmonitored Workers
- Secondary Issue 4: Internal Dose to Workers from Radon Exposure Is Not Considered

Detailed discussion of these findings can be found on pages 34 through 42 of SC&A 2009.

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Attachment 4 of SC&A's 2009 site profile review of ORAUT-TKBS-0036 summarizes SC&A's discussions with NIOSH about the findings; these are applicable to this review of the internal dose TBD. At the time of the preparation of our review of ORAUT-TKBS-0036, these types of discussions were held as part of the site profile review process to help clarify our understanding of the TBD. Based on this material, SC&A is able to recommend closing certain findings. However, some of the discussions below expand upon and help clarify findings that we believe still need to be addressed by NIOSH.

## **2.1 ATTACHMENT 4 OF THE 2009 SC&A REVIEW OF ORAUT-TKBS-0036-5, REVISION 00**

Though NIOSH has not issued any revisions to the site profile or material that might be useful in closing these five findings, Attachment 4 of SC&A's 2009 site profile review (pages 96–99) provides NIOSH's discussion of eight "key questions" raised by SC&A pertaining to the occupational internal dose TBD (ORAUT-TKBS-0036-5); those key questions are itemized in Attachment 3 of the 2009 review (pages 88–89). These key questions can be summarized as follows:

- Item 1. Lack of adequate source terms including potential ingestion
- Item 2. Use of early nonspecific radionuclide gross alpha counting
- Item 3. Default assumptions are needed for differentiating beta emitters
- Item 4. Information needed on handling exposure to radon, actinon, and thoron
- Item 5. Direction needed for exotic nuclides
- Item 6. Insufficient uncertainty information
- Item 7. Insufficient minimum detectable activity
- Item 8. Guidance for missed dose when bioassays unavailable

The Attachment 4 discussions of these key questions are helpful in further refining the issues that still require investigation. There are also concerns that we believe can be closed as a result of these discussions.

At this time, no official record of resolutions has been documented. However, it appears that Item 6 (uncertainty) and Item 8 (unmonitored workers) have been resolved in Attachment 4; the remaining original key questions are still applicable.

## **3.0 FINDINGS ASSOCIATED WITH OCCUPATIONAL MEDICAL EXPOSURES**

SC&A's 2009 review included a review of the occupational medical dose guidance in ORAUT-TKBS-0036-3, Revision 01 PC-1, *Argonne National Laboratories – East – Occupational Medical Dose*. SC&A had three findings and two secondary issues pertaining to occupational medical dose. Some of these can be closed, some will require additional discussion, and others have effectively been resolved with the issuance of Revision 04 to ORAUT-OTIB-0006 in 2011.

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There is discussion throughout ORAUT-TKBS-0036-3 about the limited occupational medical information available to NIOSH and Oak Ridge Associated Universities (ORAU) when they developed this TBD. In addition, at the time of the preparation of SC&A's review of the TBD in 2009, SC&A interviewed site experts and also held discussions with NIOSH about some of the questions and concerns we had with the TBD. Our 2009 site profile review of ORAUT-TKBS-0036 includes Attachment 4 that summarizes this material. As discussed below, some of the material in this attachment fully addresses many of our issues. As a result, SC&A recommends that these issues can be considered in abeyance until such time that NIOSH revises ORAUT-TKBS-0036-3.

There appears to be sufficient site-specific occupational medical information from 1988 to the present. Since there is limited information about the X-ray screening program at ANL-E prior to 1988, NIOSH recommends that dose reconstructors use the guidance in ORAUT-OTIB-0006. The occupational medical dose TBD (ORAUT-TKBS-0036-3) was published in 2006 and references the 2005 Revision 03 of ORAUT-OTIB-0006. Revision 04 of ORAUT-OTIB-0006 was published in 2011 and constitutes a total rewrite of the document. Although ORAUT-TKBS-0036-3 has not been revised, the dose reconstruction guidelines rely heavily on the information in ORAUT-OTIB-0006, Revision 03. It should be noted that SC&A has already reviewed and approved both Revision 03 and Revision 04 of ORAUT-OTIB-0006 and all findings pertaining to those reviews have been closed (SC&A 2007). The implications with respect to ORAUT-TKBS-0036-3 are that there is a need for NIOSH to incorporate into this TBD material that has been provided in the attachments to our 2009 site profile review and replace the material in the TBD that makes use of a dated version of OTIB-0006 (Revision 03, 2005) with reference to the current (2011) Revision 04 of ORAUT-OTIB-0006. In addition, there are certain findings and issues in our 2009 site profile review that can be closed due to the issuance of the 2011 version of ORAUT-OTIB-0006, but there are also some issues and findings that need to be discussed with the work group, but which we believe can be readily resolved.

SC&A compared the doses in ORAUT-TKBS-0036-3 to the recommended doses in Revision 04 of ORAUT-OTIB-0006 and found that the conventional X-ray doses have not changed, but there are changes to the recommended photofluorography (PFG) and lumbar spine doses. Therefore, the occupational medical dose TBD needs to be revised in order to incorporate the changes made in Revision 04 of ORAUT-OTIB-0006. Those changes in dose assignments are presented in Tables 1 and 2.

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**Table 1. Comparison of Occupational Medical Doses from PFGs**

<b>Organ</b>	<b>TBD 2006 (Table 3-5) 1946–1956 (rem)</b>	<b>ORAUT-OTIB-0006 (2011) Table A-7 through 1970 (rem)</b>
Thyroid	5.22E-1	3.94E-1
Eye/brain	9.60E-2	7.25E-2
Liver/gall bladder/spleen	1.35E0	1.02E0
Lungs (male)	1.26E0	9.50E-1
Lungs (female)	1.35E0	1.02E0
Thymus	1.35E0	1.02E0
Esophagus	1.35E0	1.02E0
Stomach	1.35E0	1.02E0
Bone surfaces	1.35E0	1.02E0
Remainder	1.35E0	1.02E0
Female breast	1.47E-1	1.11E-1
Bone marrow (male)	2.76E-1	2.09E-1
Bone marrow (female)	2.58E-1	1.95E-1
Skin	4.05E0	3.06E0

**Table 2. Comparison of Occupational Medical Doses to the Lumbar Spine**

Organ	TBD 2006 (Table 3-5) 1946–1956 (rem)		ORAUT-OTIB-0006 (2011) Table A-10 through 1970 (rem)	
	AP	LAT	AP	LAT
Thyroid	8.00E-4	1.00E-4	2.88E-4	3.79E-5
Eye/brain	8.00E-4	1.00E-4	2.88E-4	3.79E-5
Ovaries	1.12E0	1.52E0	5.60E-1	7.10E-1
Liver/gall bladder/spleen	2.48E-1	1.00E-1	2.30E-1	1.17E-1
Urinary bladder	1.12E0	1.52E0	2.30E-1	1.17E-1
Colon/rectum	1.12E0	1.52E0	2.30E-1	1.17E-1
Testes	5.40E-2	1.12E+1	2.70E-2	5.60E-2
Lungs (male)	2.48E-1*	1.00E-1*	8.93E-2	3.79E-2
Lungs (female)	—	—	8.93E-2	3.79E-2
Thymus	2.48E-1	1.00E-1	8.93E-2	3.79E-2
Esophagus	2.48E-1	1.00E-1	8.93E-2	3.79E-2
Stomach	2.48E-1	1.00E-1	2.30E-1	1.17E-1
Bone surfaces	2.48E-1	1.00E-1	2.30E-1	1.17E-1
Remainder	2.48E-1	1.00E-1	2.30E-1	1.17E-1
Female breast	7.20E-2	9.50E-2	4.78E-3	7.58E-3
Uterus	8.68E0	2.00E-1	3.12E-1	7.58E-1
Bone marrow (male)	9.60E-2*	1.50E-1*	3.46E-2	5.69E-2
Bone marrow (female)	—	—	3.46E-2	5.69E-2
Skin	5.28E0	1.32E+1	1.90E0	5.00E0

\*Gender not specified in this document.

SC&A and the Advisory Board conducted interviews with ANL-E site experts and employees in Argonne, Illinois, on February 25–28, 2008. The information gathered from the interviews is summarized in Attachment 2 of SC&A 2009 and covers facility activities and health physics programs up to 1953. The information gathered from these interviews helped SC&A identify the concerns regarding occupational medical dose raised in the 2009 site profile review.

SC&A is revisiting the findings from the ANL-E site profile review (SC&A 2009) in order to determine if the changes made in Revision 04 of ORAUT-OTIB-0006 have any effect on the

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resolution of the findings. The following are the original findings and issues provided in SC&A's 2009 review of the ANL-E site profile:

- Finding 6: Failure to Adequately Define and Assess Occupational Medical Exposures in the Pre-1988 Years and Potentially Missed Special Employment Exams
- Finding 7: The Lack of Techniques and Protocols for Medical Examinations Prior to 1988 Increases the Uncertainty of DCFs Listed in ORAUT-TKBS-0036-3
- Finding 8: Frequencies and Types of X-ray Exposures Are Uncertain
- Secondary Issue 2: Other Potential Medical Exposures Have Not Been Identified
- Secondary Issue 3: Additional Factors Contribute to Medical Dose Uncertainties

In revisiting these findings and issues, we found a degree of overlap among the findings and elected to reorganize them in a way that helps to facilitate our discussion and resolution of these matters. For clarification, we have condensed the findings and issues into six topics.

1. Special screening exams
2. Frequency of exams
3. X-ray equipment used prior to 1988 (includes issues pertaining to beam quality, calibration, protocols, and techniques used to calculate doses)
4. Use of PFGs
5. Uncertainty
6. Use of other medical equipment that could add to radiation dose to workers

### **3.1 SPECIAL SCREENING EXAMS**

Both NIOSH and SC&A indicated that ORAUT-OTIB-0006 (Revision 03) recommends that special screening exams, such as for respiratory protection, beryllium workers, asbestos workers, etc., are included in the dose reconstruction prior to 1988. ORAUT-TKBS-0036-3 simply needs to be updated to include and document these changes.

### **3.2 FREQUENCY OF EXAMS**

ORAUT-TKBS-0036-3 states that X-ray exams were limited after 1980, and that dose reconstructors should only assign occupational medical dose every 4 years after this time. SC&A included the issue of exam frequency in its findings following discussion with ANL-E workers and site experts. As indicated in Attachment 2 of our site profile review (SC&A 2009), site experts stated that annual physicals were required at ANL-E, and that these included X-rays which were performed on site. Annual X-rays were performed from 1950 through the 1990s. Beginning in the 1990s, workers had X-ray exams as part of their physicals every 2 years. **The issue of exam frequency was raised in Finding 6 and Finding 8, and SC&A recommends that these findings remain open for discussion.**

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### 3.3 X-RAY EQUIPMENT

In Finding 7 and Secondary Issues 3 and 4, SC&A was concerned with the lack of knowledge of the type of X-ray equipment used at ANL-E prior to 1988, along with the beam quality, calibration, protocols, and techniques used for dose calculations. Since ORAUT-TKBS-0036-3 references ORAUT-OTIB-0006, Revision 03 for this information, and SC&A has reviewed and approved this document, including the information pertaining to equipment, the doses derived from these assumptions are claimant favorable. **Therefore, SC&A recommends closing Finding 7.**

### 3.4 USE OF PFGS

As was previously mentioned, some of the PFG doses have changed from Revision 03 to Revision 04 of ORAUT-OTIB-0006; therefore, ORAUT-TKBS-0036-3 needs to be updated. In ORAUT-TKBS-0036-3, NIOSH recommends assigning PFG doses for the years 1946 to 1956. SC&A suggested that dose assignment from PFGs should extend to 1958. At the time the site profile review was written, SC&A referenced Januska and Smith 1961, which suggests that the equipment used through December 1958 would be capable of photofluoroscopy. In Attachment 4 of SC&A's 2009 site profile review, SC&A and NIOSH both respond to this issue, but it is not part of a formal issues resolution process. Therefore, **the issue of PFGs is raised in Finding 8 and SC&A recommends that this finding remain open for discussion.**

### 3.5 UNCERTAINTY

As with the X-ray equipment, ORAUT-TKBS-0036-3 references ORAUT-OTIB-0006, Revision 03 for this information, and SC&A has reviewed and approved this document, including the information pertaining to assignment of uncertainty. Therefore, the doses derived from these assumptions are claimant favorable. **SC&A recommends closing of Secondary Issue 3.**

### 3.6 USE OF OTHER MEDICAL EQUIPMENT

In Secondary Issue 2, SC&A raises the issue that ANL-E workers could have been exposed to radiation from medical equipment other than X-rays. During the worker interviews summarized in Attachment 3 of SC&A 2009, it seems clear that this was not a possibility. Attachment 3 states: *"There are no teletherapy units or radiation generating devices in the medical department except the x-ray units. There has been no administration of radioactive material for diagnostic or therapeutic reasons."* **Therefore, SC&A recommends closing Secondary Issue 2.**

## 4.0 FINDINGS ASSOCIATED WITH EXTERNAL DOSE

SC&A's 2009 review, which included a review of the external dose guidance in ORAUT-TKBS-0036-6, *Argonne National Laboratory – East – Occupational External Dosimetry*, Revision 00 (2006), had two findings and one secondary issue pertaining to external dose. As discussed below, these issues were left largely unaddressed in the revised ORAUT-TKBS-0036-6 (Revision 01).

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#### 4.1 FINDING 9: UNCERTAINTY AND UNDOCUMENTED ASPECTS OF THE FILM DOSIMETRY NEED RE-EXAMINATION

This issue has to do with the fact that the technology and/or service provider for the dosimetry program changed at least 12 times during the period that film emulsion was used as the beta-gamma detection medium. SC&A's concern with the approach in ORAUT-TKBS-0036-6, Revision 00 is that, while it is stated that the badges were similar to the badges used at Idaho National Laboratory and Argonne National Laboratory–West, no reference or documentation to support this conclusion is offered. The full description of Finding 9 is available in SC&A's 2009 site profile review on pages 18–19.

The revised external dose TBD, ORAUT-TKBS-0036-6, Revision 01, makes only minor revisions to the sections on film badge dosimetry. No part of the revision addresses the concerns raised in Finding 9. Furthermore, the revised external dose TBD makes no reference to the statement in Attachment 4 of SC&A's 2009 site profile review where NIOSH responded to SC&A's Key Question #7 concerning external doses (page 101). In that response, NIOSH agreed to consider simplifying the approach presented in ORAUT-TKBS-0036-6 for dose reconstructors, such as providing a table that lists applicable parameters broken down by time period for each dosimeter technology. Revision 01 of the TBD does not present dose reconstructors with unambiguous and technically supported guidance to reconstruct doses measured from historical film dosimetry. Further justification is needed to support the assumptions in the TBD guidance.

SC&A finds that a detailed review of the ANL-E workbook in comparison with the guidance presented in ORAUT-TKBS-0036-6 would help in the assessment of the degree to which the guidance provided in the revised TBD is scientifically sound and complete. A cursory review of the workbook indicates that additional review is warranted. In SC&A 2009, when the original TBD review was completed, the workbook for ANL-E did not contain the level of detail contained in the current version of the external dose TBD. Since this workbook is used in most, if not all, ANL-E cases, it is imperative that the method used in the workbook be technically sound and consistent with the TBD. **This cannot be confirmed without additional tasking to perform a detailed review of the workbook.**

#### 4.2 FINDING 10: NEUTRON DOSIMETRY IS INADEQUATELY ADDRESSED

At ANL-E, fast-neutron nuclear track emulsion, type A (NTA) film was introduced by 1953, and a thermal-neutron film program was introduced by either 1967 or 1971. NTA film was used for recorded neutron doses through 1988. SC&A has expressed concerns with the handling of neutron dosimetry by ORAUT-TKBS-0036-6, Revision 00 in the SC&A 2009 site profile review, and presently finds that ORAUT-TKBS-0036-6, Revision 01 does not address these issues. The major issues are as follows:

1. The TBD fails to provide guidance to the dose reconstructor for the period 1946–1953, during which it appears that neutron monitoring results are not available.
2. The correction factors presented in Table 6-16 of the TBD to account for the NTA film energy response limitations, and corresponding under-reporting of neutron dose, are

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estimated “based on experience,” with no other explanation given for these values. The correction factors in Table 6-16 range in value from 1.25 to 4.0; however, Section 6.7.3.2 of the TBD mentions a situation in which the correction factor would need to be approximately 20 or more to account for the under-response of NTA film.

3. NIOSH states in Section 6.7.4 of the TBD that no correction for angular dependence is needed; this requires more technically based explanation.
4. NIOSH states in Section 6.7.5.1 of the TBD that no adjustment factor for fading of NTA film is needed because they were exchanged on a monthly cycle at ANL-E; however, Mound Labs also had a monthly exchange cycle and fading was an issue there.

Details of Finding 10 are available in SC&A’s 2009 site profile review, pages 19–20.

In addition to the above four issues, we also note that page 29 of ORAUT-TKBS-0036-6, Revision 01 explains that neutron spectra information from the 800 mega-electron volt proton beam at Los Alamos National Laboratory Meson Physics Facility can be used as a surrogate for the Zero-Gradient Synchrotron 12.5 giga-electron volt proton accelerator at ANL-E. **There is a need to assess whether the use of these surrogate data meets the Board’s five surrogate data criteria.** This is a new finding that was not raised in SC&A’s 2009 review of the site profile because, at the time, those surrogate data criteria had not yet been established.

ORAUT-TKBS-0036-6, Revision 01, includes only minor editorial revisions to the sections on neutron dosimetry, and the revisions do not address any of the issues discussed in Finding 10 of SC&A’s 2009 site profile review. ORAUT-TKBS-0036-6, Revision 01 also does not consider the discussions between SC&A and NIOSH in Attachment 4 of the SC&A 2009 site profile review with regard to neutron dosimetry and dose reconstruction. Specifically, NIOSH’s response to Question 2 (page 100) for the external dose TBD states that NIOSH will determine if information comparing rem meter measurements with neutron badge measurement was considered, and if “*the information could then also be used in any future TBD revisions.*” Also, NIOSH’s response to Question 4 (page 100) indicates that, for neutron doses prior to 1956, “*a feasible option would be to apply a neutron-to-photon dose ratio since the photon dose is available for all years of operation.*” However, ORAUT-TKBS-0036-6, Revision 01 does not respond to either of these topics.

SC&A believes that a thorough review of the neutron dose correction factors in Table 6-16 of ORAUT-TKBS-0036-6, and other correction factors for NTA film, is warranted. SC&A previously conducted a review of NTA film correction factors for Mound in 2010 (SC&A 2010). This review involved the use of Monte Carlo N-Particle calculations to investigate the relationship between doses inferred from NTA films at Mound and the actual doses received by the worker due to external neutron radiation. SC&A believes ORAUT-TKBS-0036-6 would benefit from a similar detailed review of the NTA correction factors for ANL-E.

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### **4.3 SECONDARY ISSUE 1: POTENTIAL MISSED DOSE FROM SKIN AND CLOTHING CONTAMINATION**

NIOSH has addressed this issue in a number of venues and has developed a protocol for assigning skin dose, not only for direct deposition on skin (as provided in ORAUT-OTIB-0017, Revision 01, *Interpretation of Dosimetry Data for Assignment of Shallow Dose*), but also for contaminated clothing. On this basis, we believe this issue can be readily resolved by a revision to ORAUT-TKBS-0036-6 for ANL-E that makes appropriate reference to this guidance for reconstructing beta exposure of skin from direct deposition and clothing contamination.

## **5.0 ENVIRONMENTAL DOSE FINDINGS**

SC&A's 2009 site profile review, which included a review of the environmental dose guidance in ORAUT-TKBS-0036-4, *Argonne National Laboratory – East – Occupational Environmental Dose*, Revision 00, had two findings pertaining to environmental dose. As discussed below, these findings have not yet been addressed by NIOSH.

### **5.1 FINDING 11: QUANTIFICATION OF EXTERNAL EXPOSURES TO UNMONITORED WORKERS OUTDOORS IS INADEQUATELY JUSTIFIED**

For time periods prior to 1972, there are virtually no data characterizing the external radiation fields outdoors. This finding has to do with remaining concerns SC&A has pertaining to the quality of data used to support the method used to estimate dose to outdoor unmonitored workers. Further description of this finding can be found on pages 47–49 of SC&A's 2009 review. **This finding still needs to be addressed in its entirety by NIOSH.**

### **5.2 FINDING 12: OUTDOOR INHALATION EXPOSURES ASSOCIATED WITH WASTE DISPOSAL OPERATIONS IN AREA A AND FROM PARTICULATES RELEASED DURING ACCIDENTS ARE NOT ADEQUATELY ADDRESSED**

The site profile concludes that the potential for inhalation exposures to particulates outdoors in Site A up to 1954 was negligible. Our review reveals that NIOSH's conclusions about this matter are reasonable; however, some additional discussion is needed regarding the potential for short-term, but possibly large, inhalation exposures associated with the waste disposal operations in Area A and whether exposures to particulates that might have been released during accidents could have contributed significantly to the outdoor inhalation dose. Additionally, some discussion is needed about the exposures that some workers may have experienced during accidents where large amounts of radionuclides might have been released to the atmosphere over short periods of time. Further description of this finding can be found on pages 49–50 of SC&A's 2009 site profile review. **This finding still needs to be addressed by NIOSH.**

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## 6.0 GENERAL SITE PROFILE FINDINGS

SC&A's 2009 review had one finding and three secondary issues pertaining to the broader site profile. These are addressed below.

### 6.1 FINDING 13: LACK OF CONSIDERATION OF OCCUPATIONAL RADIOLOGICAL EXPOSURE AT SITE A AND PLOT M

The operations at Palos Park Site A and Plot M from 1943 through June 30, 1946, are not adequately considered in the ANL-E site profile. The site description TBD (ORAUT-TKBS-0036-2) provides some discussion of Site A and Plot M, but the scope is specifically defined as beginning on July 1, 1946. In the Attachment 4 NIOSH responses on page 91 of SC&A's 2009 site profile review, NIOSH indicates that these facilities are part of the Metallurgical Laboratory (Met Lab) and will be addressed outside of the ANL-E TBD. There is currently no Met Lab TBD; however, SC&A located an internal guidance document that instructs dose reconstructors how to perform a dose reconstruction at the site (NIOSH 2012). This guidance document makes no mention of Plot M and only a vague mention of Site A. SC&A confirmed that the Met Lab covered periods begin in 1942, earlier enough to cover Site A and Plot M; however, **SC&A recommends that this issue be transferred to the Board work group that oversees Met Lab so that this finding can be addressed in that forum.**

### 6.2 SECONDARY ISSUE 6: HUMAN RADIATION EXPERIMENTS NOT ADDRESSED

Human radiation experiments are not covered under the current TBD; SC&A's investigation revealed that current Energy Employee Occupational Illness Compensation Program Act of 2000 (EEOICPA) guidance does not clearly document if human medical experimentation involving radioactive materials qualifies as a covered exposure under EEOICPA. Because an answer was not immediately apparent, SC&A has raised the matter with the Advisory Board for its consideration. If exposure due to human radiation experiments should be included in the dose reconstruction, the TBD would benefit from inclusion of information related to these experiments. SC&A also has concerns if participation in experiments of that nature would be included in the energy employees' medical files; further research on this issue would be needed to determine if medical experiment participation is available and provided with employee medical files.

### 6.3 REMAINING SECONDARY ISSUES

The remaining secondary issues still need to be addressed by NIOSH:

- Secondary Issue 5: Lack of Treatment Provided to the Monitoring of Contractors, Transferees, and Visitors.
- Secondary Issue 7: Incidents and Accidents Need to Be Reexamined

Further information on these secondary issues can be found in SC&A's 2009 site profile review on pages 53–55.

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