MEMORANDUM

TO: Argonne National Laboratory – East Work Group
FROM: SC&A, Inc.
DATE: May 10, 2018
SUBJECT: Current Status of ANL-E Site Profile Findings and Observations

Introduction and Background

The most recent editions of the Argonne National Laboratory – East (ANL-E) site profile technical basis documents (TBDs) are as follows:

- ORAUT-TKBS-0036-2, Revision 00 PC-1, *Argonne National Laboratory – East – Site Description* (2006)
- ORAUT-TKBS-0036-3, Revision 01 PC-1, *Argonne National Laboratories – East – Occupational Medical Dose* (2006)
- ORAUT-TKBS-0036-4, Revision 00, *Argonne National Laboratory – East – Occupational Environmental Dose* (2006)
- ORAUT-TKBS-0036-5, Revision 00, *Argonne National Laboratory – East – Occupational Internal Dose* (2006)
- ORAUT-TKBS-0036-6, Revision 01, *Argonne National Laboratory – East – External Dosimetry* (2014). Revision 01 replaced ORAUT-TKBS-0036-6, Revision 00, of February 9, 2006

SC&A issued a review of the ANL-E TBDs in 2009 (SC&A 2009) and an updated report in 2016 (SC&A 2016). SC&A entered the ANL-E site profile primary findings into the Board Review System (BRS) in February 2017.

There was a telephone conference call between the members of the ANL-E Work Group (WG), the National Institute for Occupational Safety and Health (NIOSH), and SC&A on March 10, 2017, to discuss the current status of the ANL-E issues. Members of the WG, NIOSH, and SC&A toured the ANL-E facilities on March 21, 2017.

SC&A entered the ANL-E site profile observations (formally titled "secondary findings"), and also SC&A's response to Primary Findings 3 and 13, into the BRS in April 2017. SC&A informed the ANL-E WG and NIOSH of these entries in the BRS in an email on April 11, 2017 (SC&A 2017b).

SC&A issued a memorandum, *Current Status of ANL-E Site Profile Findings and Observations*, to the ANL-E WG on July 17, 2017 (SC&A 2017a). NIOSH posted responses to the findings and observations in the BRS on February 9, 2018.

This memorandum is a summary of NIOSH's recent posting to the BRS and SC&A's current response.

Current Status of Findings

The following is a brief summary of the current status of the ANL-E site profile findings, copied from the BRS. Further details are available on the BRS, including discussion of the finding and the resolution of findings that are recommended for closure by SC&A and NIOSH.

Finding 1 – Potential Missed Dose from Lack of Definition of Radionuclide Compositions and Radionuclides Not Addressed in Site Profile

NIOSH BRS Posting, February 9, 2018

> For a research facility with the broad range of activities that were in existence at ANL-E, identifying a "routine" enrichment value for enriched uranium or a sitewide mixture ratio for plutonium isotopes would not be expected. Research into ANL-E records indicates a variety of radionuclides in addition to uranium and plutonium were encountered, and bioassay procedures were implemented to monitor the specific radionuclides from early periods of operation. Records show that analysis results for at least 34 individual radionuclides were included in bioassay analytical reports from 1953 through 1976.
>
> NIOSH acknowledges the difficulty this presents in performing dose reconstructions on mixtures of radionuclides, however, assumptions can be made to allow reasonable and claimant favorable assessments. [See BRS posting concerning Finding 1 for complete description.]
>
> Guidance in the TBD will be modified or added where appropriate based on the available information to aid dose reconstructors in interpreting mixtures of radionuclides. TBD will be revised to provide dose reconstructors with additional definition, assumptions, and details as outlined above, as well as any information derived from recent data capture and interviews, to aid in assessment and interpretation of early bioassay records.

SC&A Response, May 2, 2018

> SC&A will review the revised TBD when released.

Finding 2 – Potential Missed Dose from the Use of Gross Alpha Counting for Bioassay (1946 to 1972)

NIOSH BRS Posting, February 9, 2018

> Gross alpha analysis, also termed "fluoride insoluble" analysis, was used as a screening method to evaluate exposure to several alpha-emitting radionuclides at once. Detection limits for early periods are derived for the TBD using the lowest positive reported amounts found in ANL-E records. Additional record acquisitions and records of previous DOE [U.S. Department of Energy] reported values are being evaluated and will possibly result in refinements to these values. It is noted that a specific procedure for analyzing plutonium may have existed separately from the gross alpha analysis method prior to the earliest period described in the TBD (for example, SRDB Ref. ID 165282 [ANL-E n.d.] includes a record for a [plutonium-239] result of <0.5 [disintegrations per minute] /1500 mL for a urine sample in 1951, along with a positive fecal sample result).
>
> Additional guidance will be provided in the TBD to direct dose reconstructors on how to interpret bioassay data for gross alpha analysis. Current practice has been to apply the bioassay results to all nuclides represented and use the most claimant favorable of the results unless the particular radionuclide can be determined from the records. Based on the programmatic limitations of the bioassay program for this period, this is considered adequate as a claimant favorable approach to interpreting the results.
>
> It is noted that identification of specific nuclides is sometimes available from bioassay information in ANL-E monthly program reports. This source of information will be further evaluated to determine if additional resources can be made available to the dose reconstructors (i.e., in addition to the individual bioassay records provide by DOE) to identify the radionuclide of interest.

SC&A Response, May 2, 2018

> SC&A will review the revised TBD when released. SC&A would like to caution that the use of data obtained from gross counting of bioassay samples to project specific radionuclide intakes (from an assortment of potential radionuclides) presents issues as outlined in SCA's report for Lawrence Berkeley National Laboratory [SC&A 2018].

Finding 3 – Assumption of Default Inhalation Pathway May Not Be Claimant Favorable

SC&A's response of April 4, 2017, on the BRS indicates that this issue has been resolved and recommends closure.

Finding 4 – Insufficient Information on the Calculation of Minimum Detectable Concentrations (MDC) and Uncertainties in Bioassay Methodology

NIOSH BRS Posting, February 9, 2018

> From the review of previous and recently obtained records, it is likely that some refinements in uranium and plutonium MDC values, and their applicable dates, can be made in the TBD. Further analysis of this data will be performed to evaluate whether modifications are possible for MDCs and/or uncertainties of other nuclides as well.

SC&A Response, May 2, 2018

> SC&A will review the revised TBD when released.

Finding 5 – Lack of Guidance for Estimation of Missed Dose for Unmonitored Workers

NIOSH BRS Posting, February 9, 2018

> According to ANL-E records and interviews with former workers and radiological program personnel (SRDB Ref. ID 12632 [ANL-E 1961–1982]), all employees in radiologically controlled areas were monitored; external dosimetry reports, bioassay results, and information in ANL-E monthly reports appear to confirm this. Review of 95 claims with employment dating back to 1946 and extending to 2008 revealed only three claims with no internal or external monitoring, with either short-duration employment (<3 months) or job titles consistent with non-radworkers. Therefore, information from environmental reports incorporated as internal environmental intakes in ORAUT-TKBS-0036-4 are most appropriate for unmonitored workers outside of radiologically controlled areas. These values would be considered overestimating since they include contributions from fallout for early years in addition to potential intakes from ANL-E operations. ORAUT-TKBS-0036-5 will be revised to direct the use of environmental intakes from ORAUT-TKBS-0036-4 to clarify this.

SC&A Response, May 2, 2018

> SRDB Ref. ID 12632 [ANL-E 1961–1982] is a very lengthy document (347 pages) that covers many documents, decades, and situations. It would be helpful in verifying NIOSH's statement that "*all employees in radiologically controlled areas were monitored*" if NIOSH could provide page numbers in that document that provide support for that conclusion. Additionally, SC&A will review the revised TBD when released.

Finding 6 – Failure to Adequately Define and Assess Occupational Medical Exposures in the Pre-1988 Years and Potentially Misses Special Employment Exams

NIOSH BRS Posting, March 8, 2017

> ORAUT-OTIB-0006, Revision 03 PC-1, *Dose Reconstruction from Occupational Medical X-Ray Procedures*, has been revised (to Revision 04 in 2011) since the original SC&A review and the last revision of the TBD. The ANL-E medical TBD will be evaluated and revised as necessary to incorporate ORAUT-OTIB-0006, Revision 04, recommendations regarding special screening exams.

SC&A Response, May 2, 2018

> SC&A will review the revised TBD when released.

Finding 7 – Lacking Techniques and Protocols for Medical Examinations Prior to 1988 Increases the Uncertainty of Dose Conversion Factors Listed in ORAUT-TKBS-0036-3

SC&A's BRS response of February 13, 2017, indicates that this issue has been resolved and recommends closure. NIOSH's BRS response of March 8, 2017, concurs with this recommendation.

Finding 8 – Frequencies and Types of X-Ray Exposures Are Uncertain

NIOSH BRS Posting, February 9, 2018

> Pertinent information from ORAUT-OTIB-0006 will be incorporated in the ANL-E TBD, as stated above.
>
> Evaluation of claimant files supports the SC&A concern that post-1980 X-rays may have been implemented more frequently than every four years. TBD will be revised to assume annual X-rays, rather than at four-year intervals, be applied for workers with no available X-ray records.
>
> Claimant files and other record information will be evaluated to determine whether the ending date for the application of PFG [photofluorography] exam should be extended from 1956 through 1958.

SC&A Response, May 2, 2018

> SC&A will review the revised TBD when released.

Finding 9 – Uncertainty and Undocumented Aspects of the Film Dosimetry Need Reexamination

NIOSH BRS Posting, February 9, 2018

> To date, no additional information has been identified from recently captured documents or from interviews with former ANL-E employees that is expected to

significantly modify or enhance the current descriptions in the TBD. Review efforts will continue to identify more detailed specification information for film and neutron dosimeters for early time periods, including evaluating the need for additional data capture.

SC&A Response, May 2, 2018

SC&A will review the additional data and/or revised TBD when released.

Finding 10 – Neutron Dosimetry Is Inadequately Addressed

NIOSH BRS Posting, February 9, 2018

To date, no additional information has been identified from recently captured documents or from interviews with former ANL-E employees that is expected to significantly modify or enhance the current descriptions in the TBD. Review efforts will continue to identify more detailed specification information for neutron monitoring.

NIOSH will continue efforts to locate and evaluate ANL-E records to develop neutron to photon ratios from available monitoring data, as well as other methods of addressing these deficiencies (e.g., adopting appropriate ratios from sites with similar facilities, see comment below) and will update the TBD information accordingly. Additional data capture efforts targeted at film and neutron dosimeters specifications for early periods may be warranted.

For periods prior to the implementation of neutron dose monitoring (1953), or when neutron films were only read when the gamma dose was above 100 mrem (before 1960), it is suggested that the glovebox neutron to photon ratio developed for Hanford could adequately describe plutonium glovebox work at ANL-E. Since this ratio is more claimant favorable than [neutron to photon] ratios for reactors at Hanford, it would be expected to overestimate neutron doses from sources at ANL-E (primarily test reactors and plutonium gloveboxes) for these periods.

SC&A Response, May 2, 2018

SC&A will review the revised TBD when released.

Finding 11 – Quantification of External Exposures to Unmonitored Workers Outdoors Is Inadequately Justified

NIOSH BRS Posting, February 9, 2018

Current estimates of ambient external dose from ORAUT-TKBS-0036-4 are based on overestimates of airborne exposure to short-lived, gamma emitting nuclides, primarily [argon-41] from the CP-5 reactor releases since onsite measurements of direct radiation based on [thermoluminescent dosimeter] monitors were indistinguishable from offsite measurements given the uncertainty

of the results. The maximum external dose currently assigned for non-monitored workers based on these values is 0.014 rem per year (assumed to be 2600 hours). By contrast, the average value of the maximizing onsite ambient doses from the sites listed in ORAUT-PROC-0060 [Revision 01, 2006] range from around 0.150 rem in 1971 up to 2.7 rem in 1946. Because these values would likely be comparable to, or exceed, average external doses for monitored workers at ANL-E for the same periods, they would be anticipated to be very claimant favorable estimates of doses to non-monitored workers. These ORAUT-PROC-0060 values, or more reasonable estimates, if they can be derived, will be incorporated in the TBD direction to dose reconstructors.

SC&A Response, May 2, 2018

SC&A will review the revised TBD when released.

Finding 12 – Outdoor Inhalation Exposures Associated with Waste Disposal Operations in Area A and from Particulates Released During Accidents Are Not Adequately Addressed

NIOSH BRS Posting, March 8, 2017

According to the TBD (ORAUT-TKBS-0036-2, Section 2.2.2), waste disposal operations at Site A were conducted from 1943 through 1949, with buried waste removed to Site D in 1949. Consequently, all waste disposal operations at Site A were conducted during the period prior to 1954 when the TBD assumptions were considered to be adequate.

SC&A Response, July 17, 2017

SC&A finds that NIOSH's response was supported during the visit to ANL-E on March 21, 2017, and recommends closing the issue.

Finding 13 –Lack of Consideration of Occupational Radiological Exposure at Site A and Plot M

SC&A's BRS response of April 4, 2017, indicates that this issue has been resolved and recommends closure.

Current Status of Observations

The following is a brief summary of the current status of the ANL-E site profile observations, copied from the BRS. Further details are available on the BRS, including discussion of the observations and the resolution of observations that are recommended for closure by SC&A and NIOSH.

Observation 1 – Potential Missed Dose from Skin and Clothing Contamination

NIOSH BRS Posting, February 9, 2018

> TBD revision will incorporate appropriate guidance from, or reference to, ORAUT-OTIB-0017 [Revision 01, 2005] in assessing doses from skin and clothing contamination.

SC&A Response, May 2, 2018

> SC&A will review the revised TBD when released.

Observation 2 – Other Potential Medical Exposures Have Not Been Identified

SC&A's BRS response of April 11, 2017, indicates that this issue has been resolved and recommends closure. NIOSH's BRS response of April 24, 2017, concurs with this recommendation.

Observation 3 – Additional Factors Contribute to Medical Dose Uncertainties

SC&A's BRS response of April 11, 2017, indicates that this issue has been resolved and recommends closure. NIOSH's BRS response of April 24, 2017, concurs with this recommendation.

Observation 4 – Internal Dose to Workers from Radon Exposures Is Not Considered

NIOSH BRS Posting, February 9, 2018

> No records have been identified which indicate worker monitoring for radon was routinely performed; however no major sources of enhanced radon exposure have been identified for the ANL-E site. There were no large quantities of uranium or radium in ore stored or handled at ANL-E.

SC&A Response, May 2, 2018

> In evaluating this issue it would be helpful to know if NIOSH has located any bioassay data for radium and/or its decay products in the NOCTS files they have evaluated; such as the 95 claims previously referred to in Finding 5. If workers were bioassayed for radium and its decay products this would indicate that there was potential exposure from radon and it decay products.

Observation 5 – Lack of Treatment Provided to the Monitoring of Contractors, Transferees, and Visitors

NIOSH BRS Posting, February 9, 2018

> While no documentation has been found describing formal policy or contractual relationships involving radiation protection policy regarding contract workers,

early monthly reports document that contractor company workers were included in monitoring. [SRBD references provided in BRS posting.]

Interview with former ANL-E workers (earliest employment date 1947) verified that contractors were not typically used for work in radiological areas, but that all individuals in these areas were monitored. [SRBD references provided in BRS posting.]

Consequently, there is no indication that visitors, contractors, or transferees would have been excluded from appropriate radiation protection or monitoring procedures.

SC&A Response, May 2, 2018

SC&A reviewed recent interviews and related documents and did not find evidences of subcontractors and visitors being monitored differently than ANL-E employees. Therefore, SC&A recommends closure of this issue.

Observation 6 – Human Radiation Experiments Not Addressed

NIOSH BRS Posting, February 9, 2018

Revised TBD will include explicit direction to dose reconstructors that doses from human radiation experiments are covered exposures to be included in the assessments, and will cite references providing additional information.

SC&A Response, May 2, 2018

SC&A concurs with NIOSH's explanation and will review the revised TBD when release.

Observation 7 – Incidents and Accidents Need to Be Reexamined

NIOSH BRS Posting, February 9, 2018

Review of records has identified ANL-E documentation of minor incidents (spills, contamination, etc.) after 1979, but no compilation or description of major accidents. However, ANL-E documentation demonstrates that even in early periods, exposures associated with significant incidents are noted as such in records. Because major incidents would likely have been tracked by DOE on a site-wide basis during the later period in question, no revision or additions to this section are considered necessary to aid in dose reconstructions.

SC&A Response, May 2, 2018

SC&A's recent search for incidents at ANL-E did not result in any specific documentation of major incidents that would indicate unmonitored exposures. As at other DOE sites, incidents will be handled on any individual bases during dose reconstruction. Therefore, SC&A recommends closure of this issue.

References

ANL-E 1961–1982. *Information about the ANL Dosimetry Program*, Argonne National Laboratory. Various dates, 1961–1982. [SRDB Ref. ID 12632]

ANL-E n.d. *Internal Exposure to Miscellaneous Isotopes at Argonne National Laboratory*, Argonne National Laboratory. No date. [SRDB Ref. ID 165282]

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SC&A 2017a. Memorandum – *Current Status of ANL-E Site Profile Findings and Observations*, SC&A, Inc., Vienna, Virginia. July 17, 2017.

SC&A 2017b. Email from SC&A, Inc., to ANL-E Work Group, Subject: *ANLE Site Profile TBD issues on BRS*. April 11, 2017.

SC&A 2018. *SC&A Evaluation of NIOSH White Paper, "Method to Assess Internal Dose Using Gross Alpha, Beta, and Gamma Bioassay and Air Sampling at the Lawrence Berkeley National Laboratory,"* SCA-TR-2018-SP003, Revision 0, SC&A, Inc., Arlington, Virginia. April 18, 2018.