



MEMORANDUM

TO: Kansas City Plant Work Group
FROM: SC&A, Inc.
DATE: January 30, 2017
SUBJECT: SC&A Review of Site Profile for the Kansas City Plant, ORAUT-TKBS-0031, Revision 01

Revision 01 to ORAUT-TKBS-0031, *Site Profile for the Kansas City Plant*, was issued by the National Institute for Occupational Safety and Health (NIOSH) on January 6, 2017 (effective date) (NIOSH 2017; also referred to as the technical basis document [TBD]). SC&A reviewed this revision based on a comparison with commitments made by NIOSH to the Work Group in NIOSH's memorandum to the Work Group (WG) of March 14, 2016 (NIOSH 2016a), as well as action items contained in the final issues matrix for remaining site profile issues, "NIOSH Response: Kansas City Plant Site Profile Issues Matrix," of March 14, 2016 (NIOSH 2016b).

Review Based on NIOSH March 14, 2016, Memorandum

In its March 14, 2016, memorandum to the Work Group (NIOSH 2016a), NIOSH observed that it intended to incorporate information collected as part of data capture during its Special Exposure Cohort (SEC) work for the Kansas City Plant (KCP) into a revised site profile (i.e., the TBD). NIOSH included an itemized list of the information that would be added (NIOSH 2016a); it is provided below along with SC&A's review finding.

- *Natural Uranium Operations from 5/1/50 to 2/28/55, bounded using Battelle TBD-6000 methodology* – In TBD Section 5.2.1, NIOSH provides information and guidance for these operations, concluding:

Therefore, dose reconstructors can estimate KCP worker intakes during natural uranium operations from 1951 to December 31, 1955, using Battelle-TBD-6000 Table 7.8 for inhalation intakes and Table 7.9 for ingestion intakes.
[NIOSH 2017]

SC&A finds that this issue has been addressed.

- *Post Operations Period from 3/1/55 to 8/11/59, bounded using the maximum gross-alpha air sample, 49 pCi/m³* – In TBD Section 5.2.2, NIOSH provides information and guidance for the Post Operations Period, indicating that:

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The best method for estimating internal exposure at KCP after natural uranium operations ceased in 1955 until the start of the KCP urinalysis program in 1959 is to use the maximum gross-alpha measured air sample (49 pCi/m³) from before the start of large-scale DU [depleted uranium] machining and assume that concentration remained constant during this postoperations period.
[NIOSH 2017]

SC&A finds that this issue has been addressed.

- *Tritium Water Operations (tritium monitors) bounding scenario uses 400 ml bottle of tritiated water spilled over a work year and absorbed by a worker (6.66 mrem/year dose applied to all workers), and Nickel 63 Operations (no dose assigned) from 1/1/59 to 12/31/75 – In TBD Section 5.2.7.2, NIOSH provided information and guidance consistent with this commitment.*

SC&A finds that this issue has been addressed.

- *Magnesium Thorium Alloy Operations from 8/23/61 to 3/31/63 and from 8/28/70 to 12/31/77, bounded using administrative airborne limit of $3E-11$ μ Ci/ml and OCAS-TIB009 ingestion rate. TBD-6000 methodology used for worker classes with less exposure potential than machine operators. However, SC&A finds that the period from 1963 to 1970 remains an issue for continued follow-up to ensure operations were, in fact, suspended. –*

In TBD Section 5.2.4, NIOSH provides guidance for these operational periods for magnesium-thorium (Mg-Th) alloy operations at KCP:

To assess exposures from Mg-Th operations, the analysis assigned the engineering control limit of 3×10^{-11} μ Ci/mL alpha as a constant distribution to estimate an exposure rate for identified Mg-Th workers (e.g., Mg-Th on the worker's medical card). In addition, the analysis used the method in Battelle-TBD-6000 (NIOSH 2011) to determine air concentrations for classes of workers that had less exposure potential or spent less time in the Mg-Th machining areas (Department 20 or the Model Shop, a.k.a. D-823 and D851) than the machine operators. The exposure rate to general laborers is half of the operator's exposure rate, and the exposure to supervisors is half that of general laborers. For all other worker types, such as those with primarily administrative and clerical duties and no reason to enter the restricted, radiological areas, the exposure rate is 10% of that for supervisors.

The TBD also applies the OCAS-TIB-009 (NIOSH 2004) ingestion rate to estimate internal doses. **SC&A finds that this issue has been addressed.**

- *Post Operations Period from 1/1/78 to 5/31/84, bounded using maximum surface contamination from DU and D&D [decontamination and decommissioning] operations, and ORAUT-OTIB-0070 – In TBD Section 5.2.3, NIOSH provides information and guidance for the postoperations period (albeit for 1972–1984), noting that:*

The maximum measured surface contamination survey during DU operations provided the basis to model a starting point air concentration for this period.
[NIOSH 2017]

SC&A finds that this issue has been addressed.

- *Organically Bound Tritium Operations (hi-lo switch plates) from 1/1/63 to 12/31/68, bounded using maximum surface contamination transferred to skin and absorbed; 1.77 mrem/year dose applied to all workers* – In TBD Section 5.2.7.1, NIOSH provided information and guidance consistent with this commitment. **SC&A finds that this issue has been addressed.**
- *D&D from 6/1/84 through 9/3/86 bounded using Rockwell dosimetry data* – In TBD Section 5.2.9, NIOSH provides information and guidance regarding the D&D operations that took place in the mid-1980s at KCP. NIOSH notes in the site profile that

[The Rockwell] report states no personnel received radiation exposure and no internal deposition of radioactive material occurred as a result of the decontamination of the classified waste and machining areas (Rockwell 1985).
[NIOSH 2017]

The TBD provides for an alpha inhalation rate of 6.76 pCi/day and an ingestion intake rate of 0.135 pCi/day, based on “*the air sample control level of 1×10^{-12} μ Ci/mL, a breathing rate 1.2 m³/hr, and a period of 2,000 hr/yr*” (NIOSH 2017). **SC&A finds that this issue has been addressed.**

- *NIOSH and the WG evaluated operations associated with routine rad waste handling, rad-area maintenance, housekeeping and decontamination, and agreed to bound doses to all unmonitored personnel performing this work using the TBD’s DU coworker model.* – In TBD Section 5.2.5, NIOSH provides background information and guidance for these routine operations, directing that:

To assign doses to unmonitored personnel doing this work, dose reconstructors should use the guidance in Section 5.1.4 [Unmonitored Workers] and assigning them to exposure category 2 (i.e., workers with occasional exposure).
[NIOSH 2017]

SC&A finds that this issue has been addressed.

The March 14, 2016, NIOSH memo also noted that:

NIOSH determined, and the WG agreed, that KCP accurately transferred dosimetry information from raw exposure records into an electronic format. Therefore, the electronic database used by NIOSH to develop a coworker model presented in the TBD is sufficiently accurate. [NIOSH 2016a]

SC&A review the revised site profile, ORAUT-TKBS-0031, Revision 01, and found that each specific operation and corresponding exposure bounding method has been incorporated as stated. It should be

noted that for Mg-Th operations, NIOSH will carry a commitment forward for “*the period from 1963-1970 [which will] remain an issue for continued follow-up to ensure operations were in fact suspended*” (NIOSH 2016a). This commitment reflects the Work Group’s concern that while there is no evidence of continued Mg-Th operations, there is also no clear operational documentation regarding the cessation of those operations for that period of time.

Review Based on Site Profile Issues Matrix

SC&A also reviewed the revised site profile against the actions cited in the last KCP site profile issues matrix (NIOSH 2016b). The following is SC&A’s review for each TBD action item in the issues matrix.

SEC2: Worker Location, Job Category, and Coworker Model – In the revised TBD, Section 5.1.4 provides guidance for different categories of workers for DU intakes. Sections 5.2.1–5.2.9 provide guidance for different categories of workers and time periods for other radionuclide intakes. Attachment B provides external coworker assignment guidelines. **SC&A finds that this issue has been addressed.**

SEC3: Chronic vs. Acute – The revised TBD states in Section 5.1, page 27: “*A chronic exposure pattern best approximates the true exposure conditions for most workers with a potential for intakes. In addition, a chronic exposure pattern approximates a series of acute intakes, which makes it appropriate when there is no specific information for a given individual.*” This is in accordance with Battelle-TBD-6000, Revision 1. **SC&A finds that this issue has been addressed.**

SEC10: Non-penetrating Dose – Section 6.4.1, page 47, of the revised TBD addresses SC&A’s concerns with the use of recorded dose units. **SC&A finds that this issue has been addressed.**

SP1: AMAD – The NIOSH response of May 28, 2015, given in the issues matrix (NIOSH 2014b) states:

In ICRP [International Commission on Radiological Protection] modeling, with no site-specific data on particle size distribution, the default value for AMAD is 5 μm. The site profile currently has a detailed specification for the uranium oxide used in the 1959 - 1971 DU campaign (Specification Control No. 4542260-00 SRDB 14693). The specifications from this document will be used (AMAD, density, solubility type, etc.) for this period for uranium work. All bioassay is affected, so dose reconstruction methodology and the coworker study will be reassessed. For other time periods and radionuclides, the default AMAD of 5 μm will be used. Site profile sections affected: Sections 5.1.3 and 5.1.4.

The revised TBD also includes the following guidance:

KCP had substantial quantities of UO₂ on the site at various times. Order number ICO-020757 (Bendix 1962) shows that UO₂ was ordered in 10,000-lb lots. The relevant specifications from Specification Control No. 4542260-00 (Allied-Signal 1998) were that the minimum density should be no less than 10.8 g/cm³, the surface area of the powder should be no greater than 1.1 m²/g, at least 97% by weight of the material should be less than 10 μm in diameter, and 100% by weight should be less than 15 μm in diameter.

These specifications are consistent with a powder having an activity median aerodynamic diameter (AMAD) of 1.175 μm and a Sigma-G of 2.48.

In fitting bioassay data, dose reconstructors may wish to start with a 1- μm AMAD, a GSD of 2.5, a density of 10.97 g/cm³, a lung solubility Type S, and f1 of 0.002 (ICRP [1994]). However, it is not known what impact processes at KCP had on the particle size of uranium. Use of the default 5- μm AMAD particle size is also acceptable unless it is known that the intake was of unaltered UO₂ powder. When using the 5- μm AMAD particle size and other default parameters, dose reconstructors should evaluate solubility types M and S and apply the highest [sic] dose.

SC&A finds that the application of these detailed specifications for uranium oxide during the operational period in question, combined with above specific guidance, satisfies the original concern. **SC&A finds that this issue has been addressed.**

SP3: Bioassay Data – This issue was resolved by the revised coworker data and validation and verification per page 19 of the revised TBD. **SC&A finds that this issue has been addressed.**

SP5: Admin Codes – Job titles and categories are included in the revised TBD, i.e., Tables 5-6 and 5-7, page 34, and Table 5-8, pages 35–37. **SC&A finds that this issue has been addressed.**

SP20: Photon Calib. – The revised TBD provides coworker shallow doses in Table B-2, pages 76–77, and recommends the use of the complete list of dose conversion factors in OCAS-IG-001, Revision 3, *External Dose Reconstruction Implementation Guideline* (NIOSH 2007), instead of the abbreviated list in Table 21 of the previous TBD. Opened window readings are to be assigned as <30 keV photons. **SC&A finds that this issue has been addressed.**

SP13: Mg-Th Alloy operations – The revised TBD provides information on this issue in Section 2.2.2, page 13, and inhalation and ingestion intake rates by job category and time periods in Tables 5-9 through 5-14 (pages 37–39). **SC&A finds that this issue has been addressed.**

Conclusion

SC&A finds that the remaining site profile issues for Kansas City Plant have been resolved in Revision 01 to ORAUT-TKBS-0031 and recommends to the Work Group that these issues be closed (albeit continued scrutiny of the 1963–1970 operational period for evidence of Mg-Th operations should continue as agreed during Work Group discussions).

References

Allied-Signal 1998. *Uranium Dioxide Powder (U)*, 4562260-00, Issue H, Kansas City Plant, Kansas City, Missouri, October. [SRDB Ref. ID 14693]

Bendix 1962. Purchase Order ICO-020757 to Union Carbide and Nuclear Corporation for 10,000 pounds of uranium-dioxide powder, Kansas City Plant, Kansas City, Missouri. July 19, 1962. [SRDB Ref. ID 14683]

ICRP 1994b. *Dose Coefficients for Intakes of Radionuclides by Workers*, Publication 68, International Commission on Radiological Protection, Ann. ICRP 24 (4), 1994. [SRDB Ref. ID 22731]

NIOSH 2004. *Estimation of Ingestion Intakes*, OCAS-TIB-009, Revision 0, Office of Compensation Analysis and Support, Cincinnati, Ohio. April 13, 2004.

NIOSH 2007. *External Dose Reconstruction Implementation Guideline*, OCAS-IG-001, Revision 3, Office of Compensation Analysis and Support, Cincinnati, Ohio. November 21, 2007.

NIOSH 2011. *Site Profiles for Atomic Weapons Employers that Worked Uranium Metals*, Battelle-TBD-6000, Revision 1, Division of Compensation Analysis and Support, Cincinnati, Ohio. June 17, 2011.

NIOSH 2016a. Memorandum from Peter Darnell, DCAS, et al., to Kansas City Plant (KCP) Working Group, "Revision to KCP Site Profile," National Institute for Occupational Safety and Health, Cincinnati, Ohio. March 14, 2016.

NIOSH 2016b. *NIOSH Response: Kansas City Plant Site Profile Issues Matrix*, National Institute for Occupational Safety and Health, Cincinnati, Ohio. March 14, 2016.

NIOSH 2017. *Site Profile for the Kansas City Plant*, ORAUT-TKBS-0031, Revision 01, National Institute for Occupational Safety and Health, Cincinnati, Ohio. January 6, 2017.

Rockwell 1985. *Waste Trenches and Machining Area Decontamination Final Report*, RI/RD85-265-1, Rocketdyne Division, Canoga Park, California. October 30, 1985. [SRDB Ref. ID 123905]