Closeout of TBD Issues on the Internal Exposure Coworker Model for United Nuclear Corporation

Uranium Refining Atomic Weapons Employers (AWE) Work Group

Henry A. Anderson, MD (Chair)
R. William Field, PhD
David Kotelchuck, PhD, MPH

Presented to:
The Advisory Board on Radiation and Worker Health
Idaho Falls Meeting
August 9–10, 2016

United Nuclear – Site Description

- Located in Hematite, Missouri
- Manufactured uranium metal and uranium compounds from natural and enriched uranium for use as nuclear fuel for U.S. Navy and commercial customers
- Manufactured Th-U oxide pellets in 1964
- Operations Period from 1958 to 1973
- Residual Period from 1974 to 2009

United Nuclear Corporation (UNC) TBD Chronology

- March 2008: NIOSH issued Appendix D to Battelle-TBD-6001 (Battelle 2008) – Site Profile for United Nuclear, Rev. 0.
- September 2009: SC&A issued its review of Battelle-TBD-6001, Appendix D.
- April 2010: NIOSH issued Revision 1 of Appendix D, Battelle-TBD-6001.
- June 2010: SC&A issued *A Critical Review of Revision 1 of the NIOSH Site Profile for the United Nuclear Corporation, Missouri, Addendum to SC&A-TR-SP2009-0004.*
- March 2011: NIOSH issued DCAS-TKBS-0008, Rev. 0, as its stand-alone TBD for UNC as a replacement for Battelle-TBD-6001.

UNC Work Group Meetings

- Between July 7, 2010, and September 7, 2012, the Uranium Refining AWE Work Group conferred on seven separate occasions for discussions and resolutions of findings pertaining to UNC as well as other AWE facilities.
- Status for each of the six UNC findings identified by SC&A were presented by the Uranium Refining AWE Work Group to the Advisory Board on September 18–20, 2012, in Denver, Colorado.
- Complete resolution/closure of findings was recommended by the Work Group for all but Finding 4, which pertains to NIOSH's Internal Coworker Model.

UNC Work Group Meetings (cont.)

- Partial resolution regarding Finding 4 included NIOSH's decision to make the following changes:
  1) Provide guidance for use of the 95th percentile value of the coworker model.
  2) When sufficient bioassay data are available, these data will be used to estimate intake; conversely, coworker model data will be used only when bioassay data are either absent or inadequate.
- While significant progress had been made toward the complete resolution of Finding 4 at the time of the full Board meeting held September 18–20, 2012, some peripheral issues identified only days earlier in a Work Group meeting held on September 7, 2012, remained.

Summary Review of Finding 4

- SC&A's initial review of Battelle-TBD-6001 critically compared UNC air monitoring data and urinalysis data for consistency with the proposed internal coworker model.
- SC&A's review of UNC monitoring records showed there was a limited correlation between air monitoring and urinalysis data, which provided the technical basis for NIOSH's coworker model for assignment of daily inhalation values of uranium.
- Since bioassay results are given the highest priority, when available, SC&A focused its review on bioassay data for assessing the credibility of the NIOSH internal coworker model.

Summary Review of Finding 4 (cont.)

- For this assessment, SC&A deliberatively selected the monitoring records of two operators, whose bioassay data represented high-end exposures, in order to determine if the coworker model would be bounding for these workers.
- Bioassay-derived inhalation intakes for the two UNC operators yielded values that were far above the originally recommended geometric mean (GM) and geometric standard deviation (GSD) values cited in Battelle-TKBS-6001, Appendix D.
- Based on this discrepancy, Finding 4 concluded that uranium intakes recommended by NIOSH for the pre-June 1963 period would significantly underestimate the potential internal exposures for the two UNC operators, as well as other (unmonitored) workers.

Finding 4: Outstanding Peripheral Issues and Their Resolution

- During a September 7, 2012, Work Group teleconference, NIOSH's intention to use the 95th percentile values for high-end unmonitored personnel was "conditionally" recommended.
- This conditional recommendation was based on the ability of NIOSH to (1) confirm the high bioassay-derived intakes for the two operators evaluated by SC&A and (2) determine whether the bioassay data representing the two operators had been included in the coworker model data.
- NIOSH issued a White Paper in February 2014 that addressed these outstanding issues regarding the internal coworker model.

Summary Data and Conclusions Contained in NIOSH's White Paper of February 2014

- For the two UNC operators (Operators "AAA" and "BBB"), NIOSH identified 68 and 71 urinalyses, respectively, between December 1962 and end of 1965.
- Urine bioassay data for each operator were entered into IMBA to derive corresponding daily inhalation values for solubility Types M and S uranium and for two time periods shown in Table 1 (next slide).

Summary Data and Conclusions Contained in NIOSH's White Paper of February 2014 (cont.)

Table 1. Estimated intakes from two highly exposed workers' bioassay results and comparison to the coworker model				
	Operator AAA		Operator BBB	
	Pre-June 1963			
	Type S (dpm/d)	Type M (dpm/d)	Type S (dpm/d)	Type M (dpm/d)
NIOSH analysis	437,900	13,803	187,800	5,940
Site Profile GM	12,590	872	12,590	872
Site Profile 95th	89,277	6,183	89,277	6,183
Ratio*	4.9	2.2	2.1	0.96
	Post-June 1963			
NIOSH analysis	6,445	319	6,809	349
Site Profile GM	7,662	560	7,662	560
Site Profile 95th	46,681	3,412	46,681	3,412
Ratio*	0.13	0.09	0.15	0.1

* Ratio between NIOSH analysis result and the 95th percentile of the Site Profile intake.

Regarding NIOSH's Inclusion of Operators AAA and BBB Bioassay Data in the Coworker Model

- NIOSH assessed bioassay data used to derive intakes for each of the two UNC Operators and compared these against the top 10 bioassay results that define the coworker model for pre-1963.
- Their results in Table 2 (next slide) show that 50% or 7 bioassay data points representing the two operators were not included in the coworker model data set. (The reason for the omission of most of these data points is not clear.)

Regarding NIOSH's Inclusion of Operators AAA and BBB Bioassay Data into the Coworker Model (cont.)

Table 2. Comparison of 10 highest values used for "Operator Pre 06/1963" data set in site profile and corresponding data from operators AAA and BBB, indicating some missing values. Bold values are missing from coworker model.

Top 10 Bioassay results from pre 06/1963 data set (dpm/L)	Worker AAA results (dpm/L), pre 06/1963	Worker AAA results (dpm/L), pre 06/1963
320	662	44
403	1518	649
432	887	320
474	974	**2380**
649	**1100**	**217**
662	**399**	**173**
887	**580**	
974	**376**	
1518		
1800		

NIOSH's Conclusions

- Bioassay-derived uranium intake values cited by NIOSH for Operators AAA and BBB were consistent with those previously derived by SC&A.
- The elevated bioassay-derived pre-June 1963 intakes for the two operators are likely the result of (1) inclusion of bioassay results deemed contaminated or false positives; and (2) these two workers represent exposures above the 95th percentile.
- Failure to include the 7 bioassay data points (representing the two operators) did not significantly affect the GM and the 95th percentile values of the coworker model due to the discovery of new bioassay data with lower values.

Path Forward

- The Work Group requested that SC&A review and respond to NIOSH's White Paper addressing the UNC's coworker model. SC&A issued its response in a memorandum dated June 3, 2016.
- The memorandum concludes that, after a thorough reevaluation of all previous documentation pertaining to Finding 4, SC&A agrees with NIOSH's recommendations that the selective use of the 95th percentile value for unmonitored workers classified as operators is appropriate and recommends closure of Finding 4.

References

Battelle-TBD-6001, Appendix D. 2008. *Site Profiles for Atomic Weapons Employers the Refine Uranium and Thorium – Appendix D United Nuclear Corporation*, Revision 0, National Institute for Occupational Safety and Health. March 14, 2008.

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DCAS-TKBS-0008. 2011. *Technical Basis Document for the United Nuclear Corporation Hematite, Missouri*, Revision 0, National Institute for Occupational Safety and Health. March 21, 2011.

NIOSH 2014. *White Paper Addressing Issues on the Coworker Model for United Nuclear Corporation*, National Institute for Occupational Safety and Health, Cincinnati, Ohio. February 2014.

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SC&A 2016. *Memorandum: SC&A's Review of NIOSH's White Paper Addressing Issues on the Coworker Model for United Nuclear Corporation*, SC&A, Inc., Vienna, Virginia. June 3, 2016.