

Review of Site Profile for DuPont Deepwater Works, Deepwater, NJ

Work Group on Uranium Refining AWEs
Presented at ABRWH Meeting
March 25–26, 2015
Richland, WA

DuPont Deepwater Operations

- Early 1942 – Laboratory research on producing UF_6
- February 13, 1943 – Production started
- Production processes included:

U_3O_8 from scrap

$U_3O_8 \rightarrow UO_2$

$UO_2 \rightarrow UF_4$

$UF_4 \rightarrow U$

$UF_4 \rightarrow UF_6$

DuPont Deepwater Operations

(continued)

- 1948 – Site Decontamination
- December 31, 1948 – Final Site Survey
- 1949 through March 2011 – Residual Period

Chronology of Site Review Activities

- 1/3/2008 – Appendix B (DuPont Deepwater Works) to TBD-6001 issued by DCAS (OCAS 2008).
- 2/15/2011 – Technical Basis Document (TBD) for DuPont issued as free-standing site profile to replace Appendix B (DCAS 2011). TBD revised 3/8/2011.
- 8/12/2011 – SC&A issues review of TBD documenting 7 Findings (SC&A 2011).
- 9/7/2012 – SC&A Findings discussed at Work Group Meeting.

Chronology of Site Review Activities (continued)

- 3/18/2013 – DCAS provides critique of SC&A Findings (Neton 2013)
- 6/6/2013 – SC&A submits response to DCAS critique (SC&A 2013)
- 9/27/2013 – DCAS critique and SC&A responses to initial Findings reviewed at Work Group meeting
- 10/16/2013 – Chair of Work Group presents status report to ABRWH on resolution of SC&A initial Findings (Anderson 2013)

Chronology of Site Review Activities (continued)

- 12/13/2013 – NIOSH/DCAS issues Revision 1 to TBD reflecting prior reviews and comments (DCAS 2013)
- 11/21/2014 – SC&A provides white paper describing extent to which earlier Findings have been resolved in Revision 1 of TBD (SC&A 2014)
- 1/22/2015 – Based on teleconference, Work Group determines that all issues related to DuPont Deepwater have been resolved

Chronology of Site Review Activities (continued)

- 1/22/2015 – DCAS informed Work Group that, contrary to teleconference discussion, the calculation of the ingestion dose as presented in TIB-009 is dependent on hours worked. This correction would result in a small increase (9%) in the daily ingestion rate. NIOSH indicated that this change would be made in a revision to the TBD. This approach was acceptable to SC&A and the Work Group.

Work Group Recommendation

- The Uranium Refining AWE Work Group considers that all Findings related to the TBD for DuPont Deepwater have been resolved and recommends that the site profile documented in Revision 1 dated December 13, 2013, be approved with the caveat that the document be amended to ensure that calculation of ingestion doses be consistent with TIB-009.

References

- OCAS 2008. *Site Profiles for Atomic Weapons Employers that Refined Uranium and Thorium Appendix B – DuPont Deepwater Works*. Rev. 1, January 3, 2008.
- DCAS 2011. *Technical Basis Document for the DuPont Deepwater Works Deepwater, New Jersey*. DCAS-TKBS-0006. Rev. 0. February 15, 2011.
- SC&A 2011. *Review of the NIOSH Site Profile for DuPont Chambers Works, Deepwater, NJ*. Contract No. 200-2009-28555, SCA-TR-SP2011-0035. August 12, 2011.

References (continued)

- Neton, James W., 2013. *DuPont Deepwater Works, NIOSH's Response to Findings in SC&A's Review, Dated August 12, 2011.* March 18, 2013.
- SC&A 2013. *SC&A Response to NIOSH's Commentary on Findings Regarding the Site Profile for DuPont Deepwater Works.* Contract No. 200-2009-28555. June 6, 2013.
- Anderson, Henry, 2013. *DuPont Deepwater Works, Deepwater, New Jersey, Status of Site Profile Issues Resolution.* October 16, 2013.

References (continued)

- DCAS 2013. *Technical Basis Document for the DuPont Deepwater Works, Deepwater, New Jersey*. DCAS-TKBS-0006, Rev. 1. December 13, 2013.
- SC&A 2014. *Resolution of SC&A Findings Developed during Review of DCAS-TKBS-0006, Rev. 00*. Contract No. 211-2014-58081. November 21, 2014.

SC&A Findings

- Finding: The site profile should discuss the degree to which the air sampling data, which were collected in 1944 and 1945, can be used to reasonably bound doses in the earlier years of operation (e.g., 1942–1943).
- Resolution: The first air samples taken in April 1944 were collected near the beginning of full-scale operation, but not in the startup and testing phases where production rates, and associated airborne levels, were lower.

SC&A Findings (continued)

- Finding: We would request that the site profile discuss the levels of surface contamination at the facility and explain that, at these levels, the default ingestion rate of 0.5 mg/day, which is inherent to TIB-009, applies to this facility. NIOSH should also describe how the ingestion intake in Table 1 was calculated.
- Resolution: TIB-009 has subsequently been approved for DR calculations. NIOSH explained that they do not vary the number of work days per year, but always assume 250 workdays in converting work-days to calendar-days. The hours worked per day will vary depending on the operational timeframe.

SC&A Findings (continued)

- Finding: It appears that uranium metal was produced at the site using the UF_4 -to-U magnesium bomb reduction process, which, because of the Putzier effect, could have produced uranium ingots that were associated with external beta radiation fields that were 10 to 20 times greater than those adopted in the site profile.
- Resolution: This issue was studied by the TBD-6000 Work Group resulting in a revision to Battelle-TBD-6000 that discussed this effect. The discussion, which can be found in Section 3.3.1 of TBD-6000, indicates that this effect does not appear to occur during the metal reduction process. Rather, it is the uranium recasting process where the phenomenon has been observed. While DuPont did perform metal reduction, there is no indication that they performed metal recasting.

SC&A Findings (continued)

- Finding: There seems to be a substantial disparity between the explanation of how the annual photon doses to operators were derived and the actual values employed in the site profile.
- Resolution: In Rev. 1 to the TBD, NIOSH changed the methodology for calculating photon exposure to operators. In the revised TBD, NIOSH calculated the photon exposure rate to operators as a function of distance from drums of various sizes containing uranium compounds. The new approach is scientifically sound.

SC&A Findings (continued)

- Finding: There seems to be a substantial disparity between the explanation of how the annual contact doses to operators were derived and the actual values employed in the site profile. In addition, justification should be provided as to why TBD-6000 default values should not be used at DuPont, since no site data are available for external exposure during the operating period.
- Resolution: In Rev. 1 to the TBD, NIOSH altered the calculational approach using the measured decay of beta dose as a function of distance from a yellowcake source. NIOSH then determined that the beta dose could be approximated by a lognormal distribution with a geometric standard deviation (GSD) of 5 and a median value of 1 mrem/hr at 100 cm from the source. Since TBD-6000 deals with exposure to large uranium metal masses, its use is not appropriate for the uranium compounds processed at DuPont. These changes resolved the Finding issues.

SC&A Findings (continued)

- Finding: Assuming 50% of the beta/gamma dose rate measured at 3 ft from a surface is 50% from gamma and 50% from beta does not appear to be appropriate. In addition, beta dose cannot contribute significantly to whole-body dose.
- Resolution: The photon exposure in Rev. 1 is based on the calculated exposure at 100 cm from a 55-gallon drum of uranium (0.28 mR/hr), and is assumed to be the median exposure for a lognormal distribution with a GSD of 5. The beta exposure is based on taking measured values at various distances from a yellowcake source and approximating this measured distribution by a lognormal distribution with a geometric mean (GM) of 1 mrem/hr (at 100 cm) and assuming a GSD of 5. The revised approach in Rev. 1 addresses prior concerns and is acceptable.

SC&A Findings (continued)

- Finding: The development of the photon dose is convoluted and not scientifically sound. A simpler approach would be to assume the deep dose rate was 0.05 mrad/hr, based on measurements at 3 ft from contaminated surfaces, and pro-rate this dose rate between beta and gamma based on Table 3.10 of TBD-6000.
- Resolution: In Rev. 1 of the TBD, the photon exposure rate was based on MicroShield calculations (adjusted to include Bremsstrahlung), assuming that the operator was at various distances from a 55-gallon drum of uranium during the work day. The approach used to develop the photon exposure is a significant improvement over that in Rev. 0 and is scientifically sound.