DCAS-PER-083, Subtask 4: Review of Two Advisory Board-Selected Cases Reworked for the Evaluation of DCAS-PER-083

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Weldon Spring site sequence of documents

- ORAUT-TKBS-0028-4, rev. 02, “Weldon Spring Plant – Occupational Environmental Dose,” issued March 29, 2017
- ORAUT-TKBS-0028-4 (TBD-4), rev. 03, “Weldon Spring Plant – Occupational Environmental Dose,” issued September 8, 2017
- ORAUT-TKBS-0028-5, rev. 03, “Weldon Spring Plant – Occupational Internal Dose,” issued March 14, 2017
- ORAUT-TKBS-0028-5 (TBD-5), rev. 04, “Weldon Spring Plant – Occupational Internal Dose,” issued August 31, 2017
- DCAS-PER-083, “Weldon Spring Plant TBD Revision,” issued January 7, 2019, to address changes in dose reconstruction (DR) procedures using revised site profile documents

Weldon Spring facilities

- Weldon Spring Plant (WSP), Weldon Spring Quarry (WSQ), and Weldon Spring Raffinate Pits (WSRP)
- Referred to as “Weldon Spring Plant” in general
- Operated by U.S. Atomic Energy Commission as a feed materials plant to process uranium and thorium ore by Uranium Division of Mallinckrodt Chemical Works

Four periods of site operations

- Site acquisition and development: 1954–1957
- Operational: 1957–1966
- Post-operational: 1967–1985. U.S. Department of Defense, not DOE, controlled:
  - WSP during post-operational period 1967–1985
  - WSRP and WSQ during 1967–1974
- Remediation: 1985–2002

EEOICPA coverage

- WSP employment is covered:
  - Operational period (1957–1966)
  - Remediation period (1985–2002)
- WSQ and WSRP employment is covered:
  - Operational period (1957–1966)
  - Post-operational period (1975–1984)
  - Remediation period (1985–2002)

Radionuclides of dose significance

- Natural uranium (NU) processed 1957–1962
- After 1962, all uranium is assumed to be enriched to 1%
- Natural thorium
- Recycled uranium (RU) was processed beginning in 1961
- Radon-222 and radium-228 considered to be potentially significant for DR

DCAS-PER-083 issued and reviewed

- January 7, 2019: NIOSH issued DCAS-PER-083
- February 16, 2023: Subcommittee for Procedure Reviews (SPR) tasked SC&A to review DCAS-PER-083
- September 22, 2023: SC&A issued Subtasks 1-3 revision 1 of "A Review of NIOSH's Program Evaluation Report DCAS-PER-083, 'Weldon Spring Plant TBD Revision'"

DCAS-PER-083 for Weldon Spring ORAUT-TKBS-0028-4 and -5

- Revisions in TBD-4 and TBD-5 that could increase internal dose assignments:
  - RU intakes beginning in 1961
  - RU contaminant intakes radionuclides
  - Enriched uranium (EU) specific activity of 973 pCi/mg after 1962

SC&A's recommendation for subtask 4 case

- SC&A's subtask 4 selection criteria based on revisions in rev. 03 of TBD-4 and rev. 04 of TBD-5 included:
  - Environmental intakes consisting of exposure to EU (1963–1966) and RU (1961–2001) contaminants
  - Internal intakes consisting of exposure to EU (1963–1966) and RU contaminants (1961–2002)

Subtask 4: Conduct audits of a sample set of reevaluated DRs impacted by DCAS-PER-083

- November 16, 2023 – SPR tasked SC&A with a review of representative cases.
- April 1, 2024 – NIOSH posted data for two cases for SC&A's review.
- Both cases included recommended criteria, except none involved environmental intakes consisting of exposure to uranium, thorium, and RU contaminants. There were no appropriate Weldon Spring cases that involved assigning environmental intakes.
- September 26, 2024 – SC&A provided a written report of the results of DR audit under subtask 4 to SPR.

Case A dose reconstructions

- Energy employee (EE) worked as Operator at WSP
- EE was monitored for external and internal radiation exposure during employment
- Initial DR performed in 2004
- DR revised in 2014 per PER-051
- DR revised in 2018 per PER-083 and involved the following:
  - RU began in 1961
  - Expanded list of RU contaminant radionuclides
  - Change in uranium-specific activity
  - Did not consist of any environmental intakes from rev. 03 TBD-4

Case A DR doses

- 2018 DR report compared 2018 DR doses to original 2004 DR doses, not 2014 reworked DR under PER-051
- All three DRs for Case A resulted in assigned doses producing probability of causation (POC) of <50%

Case A: 2018 assessment of external dose

- SC&A's review of Case A focused on aspects of DR impacted by revisions in TBD-4 and TBD-5
- Only included internal dose assignments
- SC&A noted that 2004 DR:
  - Performed prior to issuance of the Weldon Spring TBDs
  - Used conservative DOE complex-wide data
  - Resulted in a significant overestimate of external and internal doses compared to 2018 DR

Case A: 2004 DR assessment of internal dose

- Did not use bioassay records
- Used conservative DOE complex-wide data
- Assigned internal intakes and resulting doses assuming an intake of 28 radionuclides for a site with a reactor

Case A: 2018 DR assessment of internal dose

- Used bioassay urinalysis results
- Assigned uranium, uranium decay products and impurities (UDPI), RU contaminants, and thorium intakes as follows:
  - Prior to 1961: NU and UDPI, using a specific activity of 683 pCi/mg
  - 1961–1962: NU, UDPI, and RU contaminants using a specific activity of 683 pCi/mg
  - 1963–1966: one-percent EU, UDPI, RU contaminants, and thorium intakes using a specific activity of 973 pCi/mg

SC&A's evaluation of Case A internal dose assignment

- Reviewed EE's files to obtain recorded bioassay data
- Calculated U-234, UDPI, RU contaminant, and thorium intakes for different solubility types
- Found type S uranium provided largest dose
- Verified that NIOSH used correct intake values and parameters in chronic annual dose (CAD) program to derive total internal dose
- Did not identify any findings but did have following observation

SC&A's observation 1

- NIOSH did not provide reasons for (1) assigning or not assigning thorium exposure and (2) selection of work locations
  - 2004 DR and 2014 DR did not assign thorium intake
  - 2018 DR assigned thorium intake
  - SC&A could not determine reason:
    - 2018 DR assigned thorium intake, but it was not assigned in previous two DRs
    - 2018 DR estimated thorium intakes:
      Using 95th percentile ("Refinery – 103") location intake values for 1963 and 1964
      Using 50th percentile ("Unknown" location) intake values for 1965 and 1966
      However, EE's job title remained the same throughout this period

Summary of SC&A's evaluation of reworked Case A

- SC&A did not have any findings but did have one observation concerning NIOSH not providing reasons for (1) assigning or not assigning thorium exposure and (2) selection of work locations for the 2018 reworked DR Case A

Case B dose reconstructions

- EE worked as Operator at WSP
- EE was monitored for external and internal radiation exposure during employment
- Initial DR performed in 2010
- DR revised in 2018 per PER-083 and involved the following:
  - RU began in 1961
  - Expanded list of RU contaminant radionuclides
  - Change in uranium specific activity
  - Did not consist of any environmental intakes from rev. 03 TBD-4

Case B DR doses

- 2018 DR report compared 2018 DR doses to original 2010 DR doses, did not indicate if DR reworked under PER-051
- 2010 and 2018 Case B DRs resulted in assigned doses producing POC of <50%

Case B: 2018 assessment of external dose

- SC&A's review of Case B focused on aspects of DR impacted by revisions in TBD-4 and TBD-5
- Only included internal dose assignments

Case B: DR assessment of internal dose

2010 DR:

- Used EE's bioassay records to assign one chronic internal exposure over entire employment period plus two acute intakes
- Type S U-234 resulted in largest dose
- Included internal dose from:
  - RU contaminants
  - Plutonium-239
  - Neptunium-237
  - Technetium-99

2018 DR:

- Used bioassay urinalysis results to assign two potential chronic intake periods and three acute intakes
- Type S U-234 resulted in largest dose
- Assigned uranium, UDPI, RU contaminants, and thorium intakes as follows:
  - Prior to 1961: NU and UDPI, using a specific activity of 683 pCi/mg
  - 1961–1962: NU, UDPI, and RU contaminants using a specific activity of 683 pCi/mg
  - 1963–1966: one-percent EU, UDPI, RU contaminants, and thorium intakes using a specific activity of 973 pCi/mg

SC&A's evaluation of Case B internal dose assignment

- Reviewed EE's files to obtain recorded bioassay data
- Calculated U-234, UDPI, RU contaminant, and thorium intakes for different solubility types
- Found type S uranium provided largest dose
- Verified that NIOSH used correct intake values and parameters in CAD program to derive total internal dose
- 2018 internal dose included procedural changes in TBD-5, which increased internal dose compared to 2010 DR that did not include UDPI

Summary of SC&A's evaluation of reworked Case B

- SC&A found NIOSH's assumptions to be reasonable and doses correctly calculated
- SC&A did not have any findings or observations concerning 2018 reworked DR Case B

Summary of SC&A's evaluation of PER-083

- SC&A had no findings but had one observation:
  Case A – Observation 1: NIOSH did not provide reasons for assigning or not assigning thorium exposure and their selection of work locations

Questions?