DCAS-PER-047, Subtask 4: Review of Two Advisory Board-Selected Cases Reworked for the Evaluation of DCAS-PER-047

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Introduction

- The Grand Junction Facilities (GJF) were located in Grand Junction, CO; covered period 1943–2006
- Formerly known as the Grand Junction Operations Office (GJOO)
- The site was under contract to the U.S. Atomic Energy Commission to support uranium processing, assaying, and milling remediation
- Some limited thorium exposures
- 1986 – Start of GJF remedial action project
- 2006 – GJF site released
- Special Exposure Cohort (SEC) 1943 through 1985 due to lack of internal dose reconstructability

GJF dose reconstruction methodology

- Before technical basis document (TBD) issued, NIOSH used a dose reconstruction (DR) methodology and DR template that contained facility-specific data and dose assessment
- During NIOSH's evaluation of the GJOO SEC petition, a substantial body of new information was discovered with the potential for significant impacts on previously completed DRs
- Revised GJOO DR methodology document issued September 5, 2012 (NIOSH, 2012)
- PER-047 issued March 26, 2014 (NIOSH, 2014) to evaluate the effect of these revisions on previous DRs

GJF TBD

- ORAUT-TKBS-0060, revision 00, “Site Profile for Grand Junction Facilities,” issued on May 18, 2018 (ORAUT, 2018)
- TKBS-0060 replaced the DR methodology document and template for the GJF
- SC&A’s review of TKBS-0060 issued August 17, 2021 (SC&A, 2021)

Other GJF documents

- NIOSH's 2015 addendum to the petition evaluation report for SEC Petition SEC-00175 (NIOSH, 2015)
- SC&A's review of NIOSH's addendum to Petition SEC-00175 (SC&A, 2016)
- NIOSH issued DCAS-PER-090 (NIOSH, 2019) on July 17, 2019, to address DR methods modified by issuing the GJF TBD to replace the previous DR documents for GJF
- SC&A has not been tasked to review PER-090

SC&A's subtasks 1–3 review of PER-047

- SC&A issued a subtasks 1–3 review of PER-047 on February 10, 2015 (SC&A, 2015)
- For subtask 4, SC&A suggested cases be selected to cover:
  - Post-1960
  - Post-1975 (sample preparation period)
  - Post-1989 (or the decommission and decontamination period)
- On April 1, 2023, NIOSH provided SC&A with cases A and B

Cases A and B

- Case A was for an energy employee (EE) who worked for a short period during the early operational period (i.e., criterion 1)
- Case B was for an EE who worked for an extended period beginning in 1978 (i.e., criteria 2 and 3)
- SC&A's review was limited to evaluating only those methods and corrective actions related to issues addressed in PER-047

Case A

- EE worked throughout the site
- EE was not monitored for external exposure
- EE had one uranium bioassay
- Initial DR performed in November 2004 with probability of causation (POC) <50%
- NIOSH reworked the case in 2013 per PER-047

Case A 2004 DR: External dose

- NIOSH assigned an overestimate of external dose by using a dose limit of 3.000 rem per quarter
- NIOSH assigned an overestimate of occupational medical x-ray examination dose using the dose values listed in table 4.0-1 of ORAUT-OTIB-0006, revision 02 (ORAUT, 2003)

Case A 2004 DR: Internal dose

- NIOSH assigned an overestimate of internal dose based on a hypothetical intake, assuming an intake of 28 radionuclides per ORAUT-OTIB-0002, revision 01 (now cancelled) (ORAUT, 2004)
- EE's positive bioassay result for uranium did not indicate an internal dose greater than that derived from the hypothetical intake
- Resulting POC <50%

SC&A's review of Case A 2004 DR

- SC&A found that the original 2004 DR assigned significant overestimates for external, medical x-ray, and internal doses
- SC&A did not find any errors in the 2004 DR report for a DR using significant overestimating methods

Case A 2013 DR: External dose

NIOSH assigned:

- External dose per the dose listed in the GJOO DR methodology document (p. 8)
- A full-year dose of 1.500 rem times the appropriate dose conversion factor (DCF)
- A neutron dose using an overestimating DCF of 1.000, an International Commission on Radiological Protection (ICRP) correction factor of 1.91, at the 50th percentile dose per GJOO DR methodology document (p. 10)
- An occupational medical x-ray dose per table A-7 of ORAUT-OTIB-0006, revision 04 (ORAUT, 2011)

Case A 2013 DR: Internal dose

- Urinalysis showed activity greater than the level of detection
- Internal intakes of solubility types F, M, and S uranium-234 were developed from the first day of employment through the date of the bioassay
- Activity fractions for “Tailings” were used as a maximizing assumption
- Additional overestimating efficiency included the daily intake rates assigned for the full year
- 2013 rework used:
  - actual urinalysis measurement result to develop chronic uranium intake rates
  - revised methodology for assigning radium and thorium
- Overestimating assumptions were employed in both 2004 and 2013 DRs

SC&A's evaluation of Case A 2013 DR

- SC&A evaluated external dose assignments NIOSH performed in the reworked DR and found them appropriate and correct for an overestimate
- SC&A performed the internal intake calculations and derivation of the internal doses and found them appropriate and correct for an overestimate
- SC&A re-ran IREP and was able to derive a POC that was approximately the same as NIOSH's
- Although external and internal doses were expected to increase due to revisions in the GJOO DR methodology document, doses decreased in the rework due to the significant overestimating approach used in the 2004 DR
- SC&A has no observations or findings for NIOSH's rework of Case A

Case B

- EE had primarily administrative duties and visited the Colorado radium sites
- EE was not monitored for external exposure during the first and latter part of employment but was monitored during the mid part of employment
- EE was not monitored for internal exposure
- Initial 2004 DR resulted in a POC <50%
- NIOSH reworked the case in 2014 per PER-047

Case B 2004 DR: External dose

Original 2004 DR:

- Used the recorded dose to assign monitored photon dose using an overestimating DCF of 2.0
- Assigned missed photon dose using an overestimate of 12 dosimeter exchanges per year during the monitored period
- Did not assign unmonitored dose for unmonitored periods
- Assessed maximum ambient dose for all years of employment
- Assigned an overestimate of occupational medical x-ray examination dose using the dose values in table 4.0-1 of ORAUT-OTIB-0006, revision 02 (ORAUT, 2003)

Case B 2004 DR: Internal dose

- NIOSH assigned an overestimate of internal dose based on a hypothetical intake, assuming an intake of 28 radionuclides per ORAUT-OTIB-0002, revision 01 (now cancelled) (ORAUT, 2004)
- Resulting POC <50%

SC&A's review of Case B 2004 DR

- SC&A found that the original 2004 DR assigned significant overestimates for external, medical x-ray, and internal doses
- SC&A did not find any errors in the 2004 DR report for a DR using significant overestimating methods

Case B change in modeled organ

- The modeled organ changed in the 2014 DR compared to the 2004 DR due to updated guidance in ORAUT-OTIB-0005, revision 05 (ORAUT, 2012)
- This revision required that both rotational and isotropic exposure geometries be considered in the 2014 DR external dose assignment

Case B 2014 DR: External photon dose

NIOSH's 2014 DR:

- Assigned measured and missed photon dose for the monitored period
- Assigned unmonitored photon dose for the periods the EE was not monitored according to the GJOO DR methodology document (pp. 8 & 9)
- Did not assign occupational medical x-ray dose because the x-rays were taken off site

Case B 2014 DR: External neutron dose

- EE's DOE records did not show any positive recorded neutron dose
- NIOSH assigned missed neutron dose using an ICRP correction factor of 1.91 and an overestimate DCF of 1.0
- NIOSH assigned unmonitored neutron dose for the periods the EE was not monitored according to the GJOO DR methodology document (p. 10)

Case B 2014 DR: Internal dose

- EE did not have internal bioassay records from GJOO employment
- NIOSH used inhalation and ingestion intakes for the appropriate worker category listed in table 6 of GJOO DR methodology document (pp. 15 & 16)
- Based on the EE's duties, unmonitored intakes were assigned using the highest possible annual intake data from table 6
- NIOSH used the selected intake values in the chronic annual dose tool to derive annual internal doses

SC&A's evaluation of Case B 2014 external measured and missed dose

- Measured photon dose – SC&A reviewed the EE's records and NIOSH calculations and concurs with the measured photon dose assignment
- Measured neutron dose – SC&A concurs that the EE's records did not show any positive recorded neutron dose
- Missed photon dose – SC&A reviewed the EE's records and NIOSH calculations and concurs with the missed photon dose assignment
- Missed neutron dose – SC&A reviewed the EE's records and NIOSH calculations and concurs with the missed neutron dose assignment

SC&A's evaluation of Case B 2014 unmonitored photon dose

- SC&A reviewed the EE's dosimetry records and found that the EE was not monitored during some periods of employment
- SC&A derived a total unmonitored photon dose greater than the dose assigned by NIOSH
- **Finding 1:** Unmonitored photon dose for two years appear to be incorrect
  - SC&A found that NIOSH may have used the incorrect fraction of an unmonitored year for assigning unmonitored photon dose (over-assignment)
  - SC&A found that NIOSH assigned an unmonitored photon dose for only one quarter instead of three quarters for one year (under-assignment)

SC&A's evaluation of Case B 2014 unmonitored neutron dose

- SC&A reviewed the EE's dosimetry records and found that the EE was not monitored during some periods of employment
- SC&A derived a total unmonitored neutron dose greater than the dose assigned by NIOSH
- **Finding 2:** Unmonitored neutron dose for two years appear to be incorrect
  - SC&A found that NIOSH may have used the incorrect fraction of an unmonitored year for assigning unmonitored neutron dose (over-assignment)
  - SC&A found that NIOSH assigned an unmonitored neutron dose for only one quarter instead of three quarters for one year (under-assignment)

SC&A's evaluation of Case B 2014 internal dose

- SC&A found that the EE was not monitored for internal exposure
- SC&A used the intakes as recommended in the GJOO DR methodology document to derive internal dose (pp. 15 & 16)
- SC&A derived the same annual internal doses for most of the employment period as NIOSH assigned
- SC&A found that the EE worked part of a year and all of another year for which NIOSH did not assign internal intake
- **Finding 3:** Unmonitored internal doses for two years not assigned
  - Resulted in several rem of internal dose (but small fraction of total dose) being omitted from the DR
  - Since NIOSH performed this DR using an overestimating approach and the POC was less than 50%, this error would not affect the outcome of the case

SC&A's evaluation of Case B 2014 radon dose

- GJOO DR methodology document (p. 17) recommends that a sitewide radon intake of 5.7 picocurie per liter be assigned for the most of the EE's employment period
- NIOSH did not assign radon dose
- Radon dose may not have been assigned in this case because of the target organ
- The reason for not assigning radon dose should have been stated in the DR
- **Finding 4:** Radon dose not assigned
  - According to the GJOO DR methodology document (p. 17), the EE should have been assigned a radon dose
  - This additional dose would not affect the outcome of an overestimated case with a POC of less than 50%

Summary of SC&A's evaluation of Cases A and B

- SC&A evaluated and verified the external and internal dose assignments NIOSH performed in the reworked DRs
- SC&A re-ran IREP and was able to derive POCs that were approximately the same as NIOSH's derived POCs
- SC&A had no observations but had four findings
  - **Finding 1:** Unmonitored photon doses for two years appear to be incorrect
  - **Finding 2:** Unmonitored neutron doses for two years appear to be incorrect
  - **Finding 3:** Unmonitored internal doses for two years not assigned
  - **Finding 4:** Radon dose not assigned

SC&A conclusions

- For each of the two reviewed cases, SC&A provided an overview of the case and a brief comparison of the applicable doses assigned in the original and reworked DRs
- SC&A's audit of these cases focused strictly on external and internal exposures that were affected by the issuance of PER-047
- SC&A found that the doses for Cases A and B (except for the four findings) were reevaluated in accordance with the requirements of PER-047, which addresses changes in the GJOO DR methodology document

Questions?

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