



Dose Reconstruction Methodology and Case Review for Amchitka Island Nuclear Explosion Site

Douglas Farver, CHP, SC&A, Inc.

Advisory Board on Radiation and Worker Health,
Subcommittee for Procedure Reviews

March 14, 2024



Background information

- ◆ **February 16, 2023:** SC&A tasked to review the dose reconstruction (DR) template of Amchitka Island Nuclear Explosion Site (AINES), Amchitka, Alaska
- ◆ Review also includes an assessment of two adjudicated cases to determine if NIOSH's template is consistent with the DR methodology document

Facility description

- ◆ **Observation 1:** Unable to verify time periods in DR methodology
 - The DR methodology document gives the time periods of interest as “1965 - September 1973; May 25, 2001 - October 13, 2001 (remediation)”
- ◆ **Observation 2:** Unable to verify dates of:
 - Remediation
 - Beginning of Cannikin drilling
 - Demobilization of drilling equipment
- ◆ **Observation 3:** Facility information in DR methodology document is less complete than information in DR template
 - DR template contains additional radiological emission information that is not contained in the DR methodology document

Special Exposure Cohort

- ◆ Special Exposure Cohort (SEC) was established by The Act for energy employees (EEs) employed before January 1, 1974, on Amchitka Island, Alaska
- ◆ SC&A reviewed the EEOICPA and verified the establishment of the AINES SEC

External dose

- ◆ SC&A reviewed external dose information in DR methodology document:
 - Dosimeter type
 - Photon
 - Electron
 - Neutron doses
 - Ambient doses
 - Occupational medical doses
- ◆ Review identified two findings:
 - One associated with electron dose
 - One associated with occupational medical dose

Photon doses

- ◆ DR methodology document states penetrating doses should be assumed 100% 30–250 keV photons
- ◆ SC&A found both the Nevada Test Site (NTS) technical basis document (TBD), ORAUT-TKBS-0008-6, and ORAUT-OTIB-0088, “External Dose Reconstruction,” support using a photon energy distribution of 100% 30–250 keV to assign penetrating missed and recorded dose

Electron dose

Finding 1: Electron energy of <15 keV in DR methodology document is inconsistent with DR template and current NIOSH guidance

- ◆ DR methodology document (p. 2) states, “Shallow doses should be assigned as 100% <15 keV electrons”
- ◆ DR template and ORAUT-TKBS-0008-6 state electrons should be assigned as >15 keV

Neutron dose

- ◆ The DR methodology and template contain similar wording:
 - Neutron dose is assigned ONLY to those workers associated with activities involving neutron sources. This section is RESERVED at this time. If an energy employee had neutron dosimetry and had a potential for neutron exposure, then contact the AINES site lead and/or principal dosimetrist for external dosimetry for further guidance.
- ◆ SC&A considers this reasonable since all the detonations at AINES were contained in the detonation-formed cavities, and guidance specifies the dose reconstructor should contact AINES site lead for neutron dosimetry and potential neutron exposure

Onsite ambient dose

- ◆ Environmental monitoring after the shots indicate environmental levels comparable to background
- ◆ Actual environmental survey data are not available
- ◆ Maximum average NTS onsite ambient dose will be used as surrogate data
- ◆ SC&A believes this approach is reasonable

Occupational medical dose

Finding 2: DR methodology document contains occupational medical information that conflicts with DR template

- ◆ DR methodology states:

- “There is no indication that there was a medical facility on-site that could administer routine medical X-rays. In accordance with the Technical Information Bulletin: Guidance on Assigning Occupational X-Ray Dose Under EEOICPA for X-Rays Administered Off Site, no medical X-ray dose will be assigned associated with Amchitka.”

- ◆ DR template states:

- “Due to evidence there was a medical X-ray machine on site (Camp Huskey), the claimant-favorable assumption was made that Mr. Last Name received an annual posterior-anterior (PA) chest X-ray for each partial year worked at AINES, and that he did not work at another facility and receive screening X-rays elsewhere.”

Internal dose

- ◆ SC&A reviewed internal dose information in DR methodology document:
 - Bioassay monitoring
 - Doses from tritium
 - Environmental sources
- ◆ SC&A identified two observations:
 - One related to bioassay data
 - One related to tritium assessments

Bioassay monitoring

Observation 4: Clarity is needed regarding whether there were positive bioassay results

- ◆ DR methodology and template state:
 - “Air samples for the Long Shot analyzed for gross gamma were comparable to normal background. For the Milrow and Cannikin shots, bioassay for gross gamma and tritium was performed by an EIC [Eberline Instrument Corporation] monitor and if high was then administered to other crews. There was no case of elevated levels to the EIC monitors.”
- ◆ DR template also states:
 - “The text and associated options in the Internal Dose section of this template apply to the majority of AINES cases (for which no internal dosimetry records are available). For energy employees with positive dosimetry results and bioassay monitoring (indicating a higher exposure potential), contact the AINES site lead for assistance.”

Environmental dose

- ◆ DR methodology and DR template list environmental inhalation and ingestion intake rates used in the DR
- ◆ SC&A found inhalation intake rates in table 4-7 and ingestion intake rates in table 4-11 of ORAUT-TKBS-0008-4 (NTS TBD-4)
- ◆ SC&A has no concerns with the environmental doses

Tritium dose

Observation 5: Tritium dose information in DR methodology document differs from DR template

- ◆ DR methodology states:
 - “The assessment of environmental tritium resulted in an annual organ doses less than 2 mrem/yr. Therefore, an annual dose of 2 mrem/year will be assigned to bound potential tritium exposures.”
- ◆ DR template states:
 - “In the previous version of this dose reconstruction, an environmental tritium dose of 0.002 rem was assigned, based on missed tritium dose guidance for the Nevada Test Site. However, with the revision of the Technical Basis Document for the Nevada Test Site – Occupational Environmental Dose, . . . it was determined that the possible tritium doses would be inconsequential to the estimates of causation and do not need to be included in this dose reconstruction. This resulted in a decrease in the assigned tritium dose.”

Case 1 background

- ◆ DR completed in 2019
- ◆ EE worked at AINES for a short employment period
- ◆ EE was diagnosed with a qualifying cancer after employment termination
- ◆ EE was monitored for photons, was not bioassayed

Case 1 photon dose

- ◆ All EE's recorded dosimeter results were zero
- ◆ NIOSH assigned missed photon dose based on 4 zero dosimeter cycles
- ◆ SC&A verified missed photon doses were calculated correctly and has no concerns related to the missed doses

Case 1 onsite ambient dose

- ◆ EE was not monitored for most of employment period
- ◆ NIOSH assigned the maximum average ambient dose of 0.207 rem per year multiplied by organ dose conversion factor and adjusted for partial years of employment
- ◆ SC&A has no concerns with the ambient dose assigned

Case 1 occupational medical dose

- ◆ NIOSH made claimant-favorable assumption EE received an annual PA chest x-ray for each partial year worked at AINES
- ◆ Table 3-2 of ORAUT-OTIB-0079, rev. 02, lists Amchitka as a covered facility that administered occupational x-rays on site
- ◆ SC&A has no concerns with the occupational medical doses

Case 1 internal dose

- ◆ EE was not bioassayed at AINES
- ◆ NIOSH assigned EE's internal environmental doses based on NTS TBD-4 environmental airborne concentrations
- ◆ NIOSH assigned environmental dose from tritium to account for potential exposure from venting emissions following nuclear tests
- ◆ NIOSH's approach is consistent with guidance in TBD-4, rev. 03, which was in effect at the time the DR was completed



Case 2 background

- ◆ DR completed in 2022
- ◆ EE worked at AINES for a brief employment period
- ◆ EE diagnosed with qualifying cancer after employment termination
- ◆ EE monitored for photons, was not bioassayed

Case 2 external dose

Finding 3: Justification for neutron exposure is inconsistent with DR methodology document and DR template

- ◆ DR report states:
 - “To maximize the probability of causation, an energy distribution of 100% 30–250 keV photons and 100% 100 keV – 2 MeV neutrons (based on the reported deep dose measurements) have been applied.”
- ◆ No indication that the EE worked with neutron sources
- ◆ Notation in AINES calculation workbook reads: “Neutrons added for drill back operations”
- ◆ Based on guidance in DR methodology document, DR template, and ORAUT-TKBS-0008-6, SC&A does not believe EE had potential for exposure to neutrons from drill back operations

Case 2 photon dose

- ◆ All EE's recorded dosimeter results were zero
- ◆ NIOSH assigned missed photon and neutron dose based on 4 zero dosimeter cycles

SC&A's review of Case 2 photon dose

Finding 4: NIOSH underestimated EE's missed photon and neutron doses

- ◆ EE's DOL and DOE records show EE was issued five dosimeter zero readings, rather than four used by NIOSH

Case 2 onsite ambient dose

- ◆ Because the EE was monitored, NIOSH did not assess onsite ambient doses
- ◆ SC&A concurs that onsite ambient dose should not be assigned to employees at AINES based on guidance in ORAUT-PROC-0060 and NTS TBD-4

Case 2 occupational medical dose

- ◆ NIOSH made the claimant-favorable assumption that the EE received an annual PA chest x-ray for each partial year worked at AINES
- ◆ Table 3-2 of ORAUT-OTIB-0079, rev. 02, lists Amchitka as a covered facility that administered occupational x-rays on site
- ◆ SC&A has no concerns with the occupational medical doses

Case 2 internal dose

- ◆ EE was not bioassayed at AINES
- ◆ NIOSH assigned the EE's internal environmental doses based on NTS TBD-4 environmental airborne concentrations
- ◆ NIOSH did not assign environmental dose from tritium based on NTS TBD-4, rev. 04, guidance

Concerns: DR methodology (1 / 2)

- ◆ **Finding 1:** Electron energy of <15 keV in the DR methodology document is inconsistent with current NIOSH guidance
- ◆ **Finding 2:** DR methodology document contains occupational medical information that conflicts with DR template
- ◆ **Observation 1:** Unable to verify time periods in DR methodology
- ◆ **Observation 2:** Unable to verify dates of remediation, Cannikin began drilling, and demobilization of drilling equipment

Concerns: DR methodology (2/2)

- ◆ **Observation 3:** The facility information in the DR methodology document is less complete than information in the DR template
- ◆ **Observation 4:** Clarity is needed regarding whether there were positive bioassay results
- ◆ **Observation 5:** Tritium dose information in DR methodology document differs from DR template



Concerns: DR cases

- ◆ **Finding 3:** Justification for neutron exposure is inconsistent with the DR methodology document and DR template
- ◆ **Finding 4:** NIOSH underestimated the EE's missed photon and neutron doses



Questions?