



Peek Street Facility Case Reviews

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Subcommittee for Procedure Reviews

November 16, 2023



Background Information

- ◆ [January 29, 2019](#): SC&A submitted its review of the Peek Street Facility (PSF) dose reconstruction (DR) template
 - Review identified eight findings and three observations
- ◆ September 29, 2022, Subcommittee on Procedure Reviews (SPR) meeting:
 - PSF findings and observations were discussed
 - Status of five findings and two observations was placed in abeyance awaiting a revision to the PSF DR template
- ◆ SC&A tasked to review two PSF DR cases for purpose of addressing the remaining three findings and one observation
- ◆ October 10, 2023: SC&A submitted its review of the two PSF DR cases
 - Review identified four findings

Review limited to findings 1, 3–4, and observation 2 from 2019 PSF review

- ◆ **2019 finding 1:** The assumption of 100% 30–250 keV for the penetrating photon energy distribution is unsupported and inconsistent with assumptions used in the Hanford technical basis document (TBD).
- ◆ **2019 finding 3:** SC&A was unable to verify the neutron-to-photon ratio (N:P) of 1.2 using the cited references.
- ◆ **2019 finding 4:** The dosimeter limit of detection (LOD) used in the DR template is not specified in the template, and the LOD value of 0.050 rem assumed for photon missed dose based on NIOSH's calculation is not consistent with the Hanford dosimeter information.
- ◆ **2019 observation 2:** The natural uranium physically significant level (PSL) in the DR template is not consistent with information in “Excerpts from KAPL Radiological History Report” and is not referenced.



Case 1

- ◆ DR completed in 2011
- ◆ Energy employee (EE) worked Peek Street Facility (PSF) and two other facilities for many years
- ◆ EE was diagnosed with two qualifying cancers after employment termination
- ◆ EE was monitored for photons and electrons and bioassayed for natural and enriched uranium

Case 1 photon energy

- ◆ Computer-assisted telephone interview indicates the EE worked with uranium. Based on work history and bioassay data, it appears EE worked primarily with uranium material.
- ◆ Table 6-7 of ORAUT-TKBS-0006-6, rev. 04, recommends a photon energy distribution of 100 % 30–250 keV photons for fuel fabrication facilities at Hanford.
- ◆ NIOSH applied an uncertainty factor of 1.3 to the photon doses and references ORAUT-TKBS-0006-6, rev. 04. Table 6-25 of ORAUT-TKBS-0006-6 lists the systematic uncertainty for the two-element film dosimeter as 1.2.
- ◆ While the DR references the ORAUT-TKBS-0006-6, rev. 04, uncertainty value, neither the DR text nor the tool used to calculate the external doses, PSF Calc Wrkbk 1.00 F (prototype), was updated to contain the correct uncertainty value (finding 2 in SC&A's PSF DR template review).

Case 1 neutron dose

- ◆ To determine an appropriate neutron-to-photon ratio, NIOSH reviewed TBDs for other reactor and critical assembly sites: Hanford, Savannah River Site, Oak Ridge National Laboratory, Idaho National Laboratory, Los Alamos National Laboratory, Argonne National Laboratory East, Brookhaven National Laboratory, Energy Technology Engineering Center.
- ◆ Based on the information provided in these TBDs, NIOSH determined a N:P value of 1.2:1 is likely claimant favorable for facilities with critical assemblies and small-scale research reactors.
- ◆ The PSF Calc Wrkbk 1.00 F contains a N:P value of 1.2. A note attached to the N:P value cell reads “Based on ratios for research reactors and graphic piles at LANL and X-10.”
- ◆ SC&A agrees with using a N:P value of 1.2 but believes the basis should be provided in the DR or a technical document (finding 3 of SC&A’s DR template review).

Case 1 missed photon dose findings

- ◆ **Finding 1:** NIOSH did not use the actual number of dosimeter cycles to calculate missed photon dose for one cancer for 1 year.
 - EE's dosimeter records indicate 81 dosimeter cycles where both the penetrating and non-penetrating results were zero or less than half the non-penetrating LOD.
 - NIOSH calculated missed photon dose based on 52 dosimeter cycles.
- ◆ **Finding 2:** NIOSH did not use the correct nonpenetrating LOD listed in attachment C of ORAUT-TKBS-0006-6, rev. 04, to calculate the missed doses to one cancer.
 - Table 6-13 of ORAUT-TKBS-0006-6, rev. 04 (2010), lists the LOD of the two-element film dosimeter as 0.040 rem. It does not specify if the LOD is for penetrating or nonpenetrating photons.
 - Attachment C of ORAUT-TKBS-0006-6 gives for 1944–1971: 50 mrem for nonpenetrating, 40 mrem for penetrating.

Case 1 enriched uranium intake

- ◆ EE submitted one urine bioassay that was analyzed for natural uranium and seven urine bioassays that were analyzed for enriched uranium.
- ◆ EE was not monitored with urine bioassay at PSF but did submit several urine bioassays while employed at a related site.

Case 1 enriched uranium intake finding

- ◆ **Finding 3:** NIOSH used the enriched uranium PSL instead of the natural uranium PSL for the bioassay.
 - EE's DOE records shows the result and the PSL for each sample in units of mass.
 - Page 120, figure 5-23, of "Excerpts from KAPL Radiological History Report" show units of $\mu\text{g}/\text{day}$.
 - NIOSH's calculations show the PSL was not converted from units of mass to units of activity before being entered in IMBA.



Case 2

- ◆ DR completed in 2013
- ◆ EE worked at PSF and one other facility for many years
- ◆ EE diagnosed with qualifying cancer after employment termination
- ◆ EE monitored for photons and electrons at PSF, was not bioassayed at PSF
- ◆ EE monitored for photon and electron and bioassayed for natural enriched uranium, plutonium, and fission products at the other facility

Case 2 photon energy

- ◆ Because EE was monitored for plutonium via urine bioassay, 100% of the nonpenetrating doses were assumed to be attributed to <30 keV photons, in accordance with ORAUT-OTIB-0017. In addition, 100% of the penetrating doses were assumed to be attributed to 30–250 keV photons.
- ◆ EE was not bioassayed at PSF. SC&A found no information on the EE's work location or whether the EE would have been exposed primarily to uranium or plutonium.
- ◆ Table 6-7 of ORAUT-TKBS-0006-6, rev. 04, gives the photon energy distribution for fuel fabrication facilities as 100% 30–250 keV photons and for radiochemical processing facilities as 25% 30–250 keV and 75% >250 keV photons.
- ◆ SC&A calculated the EE's recorded photon doses using both photon energy distributions. The 100% 30–250 keV photon energy distribution produced the most claimant-favorable probability of causation.
- ◆ NIOSH applied an uncertainty factor of 1.3 instead of 1.2 per TBD.

Case 2 neutron dose

- ◆ NIOSH reviewed the TBDs of other reactor and critical assembly sites to determine an appropriate N:P: Hanford, Savannah River Site, Oak Ridge National Laboratory, Idaho National Laboratory, Los Alamos National Laboratory, Argonne National Laboratory East, Brookhaven National Laboratory, and the Energy Technology Engineering Center.
- ◆ Based on the information gathered in the reviewed TBDs, NIOSH determined an N:P of 1.2:1 is likely claimant favorable for facilities with critical assemblies and small-scale research reactors.
- ◆ PSF Calc Wrkbk 1.00 F contains an N:P of 1.2. A note attached to the N:P cell reads “Based on ratios for research reactors and graphic piles at LANL and X-10.”
- ◆ SC&A believes the basis should be provided in the DR or a technical document, as stated in finding 3 of our DR template review.

Case 2 missed photon and shallow dose

- ◆ EE was assigned missed photon dose at PSF and missed neutron dose at another facility.
- ◆ Although not stated in the DR, NIOSH used a dosimeter LOD of 0.040 rem, which is consistent with the LOD values for the Hanford two-element film dosimeter as shown in table 6-13 of ORAUT-TKBS-0006-6.
- ◆ NIOSH counted 73 dosimeter cycles for penetrating dose and 1 dosimeter cycle for nonpenetrating dose.

Case 2 fission product intake

- ◆ EE not monitored for fission products at PSF.
- ◆ EE submitted urine bioassays that were analyzed for fission products.
- ◆ DOE records show the EE's bioassay results and the PSL for each measurement. All the EE's fission product bioassay results were less than the PSL of 50 dpm/24 hours.
- ◆ This is the same value given in figure 23, page 120, of "Excerpts from KAPL Radiological History Report."
- ◆ SC&A concludes that NIOSH used the fission product PSL consistent with PSF historical documentation.

Case 2 plutonium intake

- ◆ EE not monitored for plutonium at PSF.
- ◆ EE submitted urine bioassays that were analyzed for plutonium.
- ◆ DOE records show the EE's bioassay results and the PSL for each measurement. All the EE's plutonium bioassay results were less than the PSL of 0.33 dpm/24 hours.
- ◆ This is the same value given in figure 23, page 120, of "Excerpts from KAPL Radiological History Report."
- ◆ SC&A concludes that NIOSH used the plutonium PSL consistent with PSF historical documentation.

Case 2 enriched uranium intake

- ◆ EE not monitored for uranium at PSF.
- ◆ EE submitted three urine bioassay that were analyzed for enriched uranium.
- ◆ EE's first enriched uranium result and PSL are given as 0.04 dpm/liter and 5 dpm/liter, respectively.
- ◆ EE's second and third enriched uranium results are both 0.02 dpm/24 hours with a PSL of 5 dpm/24 hours.
- ◆ Figure 23 of "Excerpts from KAPL Radiological History Report" shows 5 dpm/24 hours as the PSL for enriched uranium. This has no impact on the case since NIOSH used a hypothetical sample result on the EE's last day of employment.

Case 2 enriched uranium intake finding

- ◆ **Finding 4:** NIOSH did not enter one-half the enriched uranium PSL into IMBA as stated in the DR.
 - The value NIOSH entered in IMBA is 5 dpm/day, which equals the enriched uranium PSL and not the PSL/2.
 - This results in an overestimate of the enriched uranium intake.

Conclusions

- ◆ Since both cases contained external and internal monitoring data, SC&A was able to review:
 - the applicability and basis of assuming a photon energy distribution of 100% 30–250 keV photons
 - the basis of using a neutron-to-photon ratio of 1.2
 - the photon LOD used in the recorded and missed dose calculations
 - how the PSLs are used in the internal dose calculations
- ◆ Both cases assumed a photon energy distribution of 100% 30–250 keV photons.
- ◆ Both cases assumed a neutron-to-photon ratio of 1.2 and contain the same wording as the PSF DR template.
- ◆ Both cases use a penetrating photon film dosimeter LOD of 0.040 rem as listed in table 6-13 of the ORAUT-TKBS-0006-6, rev. 04.

Concerns

- ◆ **Finding 1:** NIOSH did not use the actual number of dosimeter cycles to calculate missed photon dose for one cancer in Case 1.
- ◆ **Finding 2:** NIOSH did not use the correct nonpenetrating LOD listed in attachment C of ORAUT-TKBS-0006-6, rev. 04, to calculate the missed photon doses in Case 1.
- ◆ **Finding 3:** NIOSH used the enriched uranium PSL instead of the natural uranium PSL for Case 1 bioassay.
- ◆ **Finding 4:** NIOSH did not enter one-half the enriched uranium PSL in IMBA as stated in the DR for Case 2.



Questions?