Responses to SCA-TR-2019-PR004, Revision 0, *Dose Reconstruction Template Review for the Peek Street Facility, Schenectady, New York*

Response Paper

National Institute for Occupational Safety and Health

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Mutty M. Sharfi
Oak Ridge Associated Universities Team

Reviewed by Angelica Gheen
Division of Compensation Analysis and Support

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."

NIOSH Response:

Given the various source terms at the Peek Street Facility (PSF) described below, NIOSH believes that the default assumption of 100% 30–250 keV for the penetrating photon energy is not only consistent with current guidance, it is the assumption more favorable to the claimant.

The Peek Street Facility processed natural uranium, enriched uranium, plutonium, encapsulated radium, polonium, and even fission products, which can be associated with a variety of photon energy distributions. The PSF also had and operated a critical assembly and/or zero-pile reactor. Unlike Hanford, the PSF was very small and most of the radiation sources were inside a single building (the main building). In most instances, it cannot be determined which radiation source(s) a worker was exposed to in that building. Because the bulk of the radioactive material at the PSF was natural and enriched uranium, most if not all PSF workers were likely externally exposed to uranium during periods of their employment. Table 6-7 in revision 4 of ORAUT-TKBS-0006-6, *Hanford Site – Occupational External Dose* [ORAUT 2010], recommends a photon energy distribution assumption of 100% 30–250 keV photons for fuel fabrication facilities, which were uranium facilities at Hanford.

FINDING 2

"The assumption of an uncertainty factor of 1.3 is unsupported and inconsistent with the cited reference."

NIOSH Response:

The uncertainty value of 1.3 in the dose reconstruction (DR) Template reflects the uncertainty factor that was in revision 03 of ORAUT-TKBS-0006-6 [ORAUT 2007c] (see Section 6.10), which has since been revised. NIOSH agrees that revision 04 of ORAUT-TKBS-0006-6 [ORAUT 2010] reduced the uncertainty factor for the years of 1947 to 1954 to 1.2. The revised uncertainty value and technical basis document (TBD) reference will be updated as part of the next revision to the DR Template.

FINDING 3

"SC&A was unable to verify the neutron-to-photon ratio of 1.2 using the cited references."

NIOSH Response:

The basis for the neutron-to-photon (N:P) ratio was developed back in 2009 when the DR Template was first created. At that time, the TBDs for the following reactor and critical assembly sites were reviewed to determine an appropriate N:P ratio for the PSF: Hanford, Savannah River Site, Oak Ridge National Laboratory (ORNL), Idaho National Engineering Laboratory, Los Alamos National Laboratory (LANL), Argonne National Laboratory-East, Brookhaven National Laboratory, and the Energy Technology Engineering Center. Given that the neutron sources at the PSF were only from a critical assembly and/or zero-pile reactor, only the N:P ratios for reactors and critical assemblies were considered in the PSF evaluation.

At ORNL, the N:P ratios for reactors ranged from 0.1:1 to 1:1 (see Attachment C of ORAUT [2007a]).

At LANL, the N:P ratios for a critical assembly ranged from 0.67:1 to 1.2:1 for distances of 5.9 m (19 ft) to 19.8 m (65 ft) (see Table 6-18 in ORAUT [2007b] and ORAUT [2013]). Table 6-18 of the LANL TBD also provide N:P ratios at distances beyond 19.8 m, but those ratios were extrapolated values versus the measured values. Because neutron exposures beyond distances of 19.8 m would have been unlikely for a small facility like the PSF, the extrapolated ratios for the farther distances were not used for the PSF evaluation.

For Hanford, Table 6-22 in ORAUT [2007c] indicated that the geometric means of the N:P ratios for reactors were 0.06:1 (N-Reactor) and 0.41:1 (other 100 Area reactors). However, those ratios were based on nuclear track emulsion, type A (NTA) film dosimeter data that were later adjusted using an assumed adjustment factor to account for the fraction of neutron dose that wasn't measured by the dosimeter. Instead of using the N:P ratios based on NTA film results that were adjusted with an estimated adjustment factor, the PSF evaluation focused on the measured neutron data in Table 6-18. In Table 6-18 of ORAUT [2010], the N:P ratios for the period before 1961 were based on neutron dose measurements rather than NTA film (see Peterson and Smalley [1960] for more details). Those measurements were also performed at the front faces to each of Hanford's eight production reactors. For the period before 1961 (i.e., before any additional shielding was added), the N:P ratios ranged from 0.2:1 to 1.2:1. In addition, N:P ratios based on measurements close to the reactor are more representative of the potential exposures at the PSF. At the PSF, workers with the potential to receive neutron doses from the source material, critical assembly, and/or zero pile were likely within 10 m (33 ft) of the neutron radiation source.

Based on the information at the time of the PSF DR Template development, the N:P ratios that were considered representative ranged from 0.06:1 to 1.2:1. Of those N:P ratios, the 1.2:1 ratio

was selected for the PSF because it resulted in the estimates most favorable to the claimants and would ensure that the unmonitored PSF neutron doses were not underestimated.

Since the development of the PSF DR Template, the N:P ratio information in the external TBD for Hanford has changed, and Table 6-18 and its N:P ratio data are no longer in that TBD. However, the neutron and photon dose measurement data in Peterson and Smalley [1960] on which N:P ratios were based are still considered to be applicable to the PSF. Therefore, NIOSH believes the 1.2:1 N:P ratio being used for the PSF is still valid.

It should also be noted that the N:P ratio is being applied to all photon dosimeter results even though neutron exposures at the PSF would have been intermittent. Research reactors and critical assemblies only operate intermittently, and neutron exposures were only possible during operations. When not being used, neutron generating source material would have been shielded for criticality safety reasons. Therefore, not accounting for the intermittent nature of those neutron exposures should result in an additional level of favorability to the claimant in the estimation of neutron dose.

FINDING 4

"The dosimeter LOD used in the DR Template is not specified in the template, and the value of 0.050 rem assumed based on NIOSH's calculation is not consistent with the Hanford dosimeter information."

NIOSH Response:

As noted in the response to Finding 2, the "0.050 rem" value in the DR Template is a placeholder value and is designed to be updated during the development of the dose reconstruction. NIOSH identified that PSF used a Hanford-type dosimeter throughout its entire operating period. Therefore, the dosimeter information from ORAUT [2010], including limits of detection (LOD), will be referenced as defaults as part of the next revision to the DR Template.

FINDING 5

"SC&A was unable to verify the PSF annual maximum ambient dose value using the cited reference."

NIOSH Response:

NIOSH identified that an incorrect value of 1.550 rem was originally used for the 1949 ORNL dose when the average maximum annual ambient dose value was originally calculated. The 1949 ORNL dose value should have been 1.555 rem. Correcting that results in an updated average value of 0.433 rem, versus the 0.423 rem in the DR Template, which matches SC&A's calculated value. However, NIOSH plans on reevaluating and revising this section with more

current information in order to provide a more accurate estimate of onsite ambient dose as part of the next revision to the DR Template.

FINDING 6

"The DR Template occupational medical dose basis contains incorrect information and outdated references."

NIOSH Response:

NIOSH will investigate if occupational medical X-rays for the PSF workers were performed offsite. The Occupational Medical Dose Section of the DR Template will be updated based on the outcome of this investigation and guidance in ORAUT-OTIB-0006, *Dose Reconstruction from Occupational Medical X-Ray Procedures* [ORAUT 2019] and ORAUT-OTIB-0079, *Guidance on Assigning Occupational X-ray Dose Under EEOICPA for X-rays Administered Off Site* [ORAUT 2017].

FINDING 7

"The fission product information in the DR Template is not consistent with current guidance in ORAUT-OTIB-0054, Revision 04."

NIOSH Response:

NIOSH agrees that guidance associated with the current version of ORAUT-OTIB-0054, *Fission and Activation Product Assignment for Internal Dose-related Gross Beta and Gross Gamma Analyses* [ORAUT 2015], needs to be incorporated into the DR Template. This will be done as part of the next revision to the DR Template.

FINDING 8

"No basis or reference is cited for the recycled uranium activity fractions in Table 5 of the DR Template."

NIOSH Response:

NIOSH agrees that the section on the recycled uranium activity fractions should be updated. NIOSH will revise the DR Template based on guidance in Battelle-TBD-6000, *Site Profiles for Atomic Weapons Employers that Worked Uranium Metals* [NIOSH 2011].

OBSERVATION 1

"SC&A did not locate a PSF-specific tool containing the preprogrammed plutonium DCFs."

NIOSH Response:

Given the limited number of claims for PSF, no site-specific tool has been created for PSF. For sites without a site-specific tool, the complex-wide generic "SM Calculation Workbook" is used.

OBSERVATION 2

"The natural uranium PSL in the DR Template is not consistent with information in ORAUT 1997 and is not referenced."

NIOSH Response:

The color coding in the DR Template indicates that claim-specific PSL values are a placeholder value to be updated during the dose reconstruction process. This is why they do not match what is in "ORAUT 1997" [GE 1997]. Additionally, "ORAUT 1997" is not the primary reference for the PSL values that are used in the PSF dose reconstructions, as the claim-specific information takes precedence over generic programmatic information.

The "5 µg uranium/day" in the template is actually based on the PSLs for natural uranium in urine that were reported in Claims [identifying information redacted]. Those [redacted] claims were the only known PSF claims with natural uranium urine bioassay data at the time that the DR Template was created. Therefore, NIOSH believes that there is value in maintaining the "5 µg uranium/day" in the DR Template.

OBSERVATION 3

"The plutonium composition information is correct. However, the reference cited is outdated and needs updating."

NIOSH Response:

NIOSH agrees that the reference for the plutonium composition information is outdated and needs updating. NIOSH will update the reference as part of the next revision to the DR Template.

REFERENCES

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