



MEMORANDUM

TO: INL Work Group
FROM: SC&A, Inc.
DATE: July 14, 2016
SUBJECT: Progress Report: ANL-W SEC-00224 Review, Strategy of Using the 10% Maximum Permissible Concentration Rule for Performing Dose Reconstruction

NIOSH Evaluation Report Approach

As noted in the Special Exposure Cohort (SEC) 00224 evaluation report (ER) for Argonne National Laboratory-West (ANL-W), “*with a few exceptions, the majority of the actinides at the EBR-II Complex were present with mixed fission products.*” The principal exceptions noted were the Zero Power Plutonium Reactor (ZPPR) and the Fuel Cycle Facility (FCF). The potential for uranium exposures at ZPPR can be considered minimal because the fuel sources were coated and encapsulated, and a strong contamination control program was in place. However, at FCF, the ER is clear that “*because of FCF Hot-Line start-up activities, FCF machine shop activities, and Cold-Line fuel production at the FCF, ITF, and FASB, more-than-incidentals intakes of depleted and enriched uranium without fission products present could have occurred from August 1967 to as late as 1994.*” Further, as noted in the ER, no uranium bioassay data has been found for ANL-W workers prior to July 1983 (after which there was a significant increase in uranium bioassays that can be used to estimate intakes).

For its dose reconstruction approach, the National Institute for Occupational Safety and Health (NIOSH) concludes that “*exposures to uranium without mixed fission products can be bound using 10% of MPC [maximum permissible air concentration] from available air monitoring data,*” an approach referenced in ORAUT-OTIB-0018, *Internal Dose Estimates for Facilities with Air Sampling Programs* (hereafter referred to as “OTIB-0018”), ORAUT-OTIB-0033, *Application of Internal Doses Based on Claimant-Favorable Assumptions for Processing as Best Estimates* (hereafter referred to as “OTIB-0033”). These OTIBs provide a basis for assigning bounding doses assuming routine operating conditions where airborne exposures were strictly controlled to ensure airborne particulates did not exceed 10% of the MPC over the course of a worker’s employment. As emphasized during Advisory Board and SC&A reviews of these OTIBs,¹ this approach is sound if: 1) an adequate air sampling program was in place at the time that the worker of interest was employed at a given facility; 2) the worker can be assigned to a specific job category; 3) there is assurance that the air sampling data are representative of the breathing zone (notwithstanding the uncertainty assigned to the airborne concentrations); and 4) appropriate consideration is given to possible exposures to tritium, carbon-14, radon, and noble gases, which are not covered.

NIOSH similarly applies this dose reconstruction approach for thorium without mixed fission products (MFPs) present (FCF Hot-Line, as thoria crucible coatings, August 1963–November 1967) and for plutonium without MFPs present (ZPPR).

¹ See SC&A’s *Review of NIOSH/ORAUT Procedures and Methods Used for Dose Reconstruction (Supplement 1)*, August 3, 2007.

SC&A Review to Date

SC&A considers this ER approach (10% MPC) to be reasonable for ZPPR given the encapsulation of the fuel, but questionable for uranium and for thorium (without MFPs present) at FCF. SC&A has focused on the basis for applying OTIB-0018 and OTIB-0033 to these latter potential exposures at FCF because:

1. Historically, U.S. Department of Energy (DOE) reactor operations had more formality of operations, including contamination control, than did material production or processing operations – this is borne out in past reviews under the Energy Employees Occupational Illness Compensation Program Act.
2. DOE Order 5480.11, governing occupational radiation protection requirements and instilling more uniform and robust health physics programs across DOE, was not issued until 1988.
3. While the ANL-W site profile indicates that alpha emitters as a primary contaminant were limited on a facility basis to the Specific Manufacturing Capability facility, it is clear that for FCF there were specific operational campaigns that handled alpha-specific radionuclides (these included machining of uranium-235 [U-235] and depleted uranium, handling of thoria-coated crucibles, handling of plutonium fuel, etc.).

The SC&A review strategy is principally based on two of the four criteria outlined above:

- To review the relative “robustness” of the FCF health physics program, particularly the adequacy of the prevailing contamination control and air sampling programs at the time
- To evaluate the representativeness of what air sampling results existed during the time period in question to what would be representative of breathing zone for the workers involved in specific radiological operations

For the first review, SC&A searched and reviewed ANL-W references in the Site Research Database (SRDB) pertaining to the FCF health physics (HP) program as it pertained to alpha emitters as the primary contaminant, e.g., air sampling, respiratory protection, contamination control, intakes and uptakes, and smear and air sampling results. Attention was also focused on FCF operational experience during the time periods of interest regarding handling of pure alpha emitters.

SC&A found that FCF relied on respirators (half and full) to control against intakes of airborne particulates when performing work in the cells and on components withdrawn from the cells. No clear evidence has been found that respirators were routinely worn for other work (e.g., machining, decontamination work, maintenance) under the premise that HP surveillance and available ventilation would mitigate against undue potential exposure to airborne particulates. **It is not clear that the first and third premise of OTIB-0018 were satisfied in these cases, i.e., that an adequate air sampling program was in place and that the air sampling data were representative of the breathing zone.** The location of FCF air samplers is key given the nature

of the work. Unlike Experimental Breeder Reactor I (EBR-I), machining and decontamination activities would have entailed close-in, hands-on procedures by workers, and general air sampling would not have likely captured these exposures. A review of this issue – general versus breathing zone air sampling – is provided in SC&A’s *Review of Petition Evaluation Report for SEC-00224, Argonne National Laboratory-West Regarding the Use of General Area Air Sampling for Internal Dose Assessment*, issued July 13, 2016. That review concludes that, “*given the high degree of uncertainty surrounding GA [general area] air sampling data at the FCF (and possibly other locations at ANL-W)...NIOSH’s proposed value of 10% MPC(40) as a bounding value for internal dose assessment lacks credibility.*”

In terms of contamination control, the monthly HP reports for FCF during 1968–1969 are replete with instances where contaminations were experienced when components were removed from the cells, when decontaminations were performed in plastic tents, when components were machined, and when respirators/anti-Cs were not worn properly. Even for actual high-potential exposure work in the cells, stringent respiratory protection requirements were not imposed until 1967, on the heels of an intake incident. **While judgments on the robustness of the HP program at FCF are obviously subjective, it is clear that FCF was at the lower end of the ANL-W spectrum, particularly compared to the reactors.**

Next Steps

SC&A will continue to investigate the following questions as the inquiry proceeds:

- Are there any corroborating data or references that can be produced to support the assumption that general air concentrations at FCF (and ANL-W, at large) closely correspond to operational air concentrations to which workers would have been actually exposed?
- Otherwise, if non-representativeness of air sampling data precludes use of OTIB-0018 and OTIB-0033 and coworker model development remains an option, **how can that be accomplished if no breathing zone air sampling data, smear data, or bioassay data exist for a particular activity** (e.g., machining of U-235, depleted uranium)? Is FCF the only facility for which this is an issue? Are there any source term characterization data for these activities?
- A review of the 1968–1969 monthly HP reports for FCF show incidental contaminations involving MFPs and alpha particulates occur frequently (just about every month) and were typically found by frisking of personnel or contamination surveys following jobs. **How can these incidental exposures be addressed when follow-up smears, air sampling, and bioassays are usually lacking?**
- While the technical basis document (ORAUT-TKBS-0007-5) indicates that, “*If personnel were required to work in an area or building where known air contamination was present, respirators were worn to reduce internal contamination intake to levels below detectable amounts,*” it not clear for FCF that this was rigorously implemented,

particularly before 1967, as shown by the then-newly enacted control policies issued following a serious incident.² Alpha contaminations without MFPs were routinely detected on personnel performing work in the FCF small decontamination room, FCF machine shop, FCF chemical analysis laboratory, and FCF Rooms 20 and 26, without respiratory protection being indicated (see SRDB Ref. IDs 59958 and 59959). **If respirator use was not rigorously enforced for routine work at FCF involving potential intakes of airborne particulates (e.g., outside of cell work), how can these potential intakes be bounded when air sampling and smear data are not available?**

References

NIOSH 2016. *SEC Petition Evaluation Report: Petition SEC-00224*, National Institute for Occupational Safety and Health, Cincinnati, Ohio. February 18, 2016.

ORAUT-OTIB-0018. *Internal Dose Estimates for Facilities with Air Sampling Programs*, Revision 01, Oak Ridge Associated Universities. August 9, 2005.

ORAUT-OTIB-0033. *Application of Internal Doses Based on Claimant-Favorable Assumptions for Processing as Best Estimates*, Revision 00, Oak Ridge Associated Universities. April 20, 2005.

ORAUT-TKBS-0007-5. *Idaho National Laboratory and Argonne National Laboratory – West – Occupational Internal Dose*, Revision 03, Oak Ridge Associated Universities. March 2, 2010.

SC&A 2007. *Review of NIOSH/ORAUT Procedures and Methods Used for Dose Reconstruction (Supplement 1)*, SC&A, Inc., Vienna, Virginia. August 3, 2007.

SC&A 2016. *Review of Petition Evaluation Report for SEC-00224, Argonne National Laboratory-West Regarding the Use of General Area Air Sampling for Internal Dose Assessment*, SC&A, Inc., Vienna, Virginia. July 13, 2016.

² See SRDB Ref. IDs 140297, 145077, 138885, and 138887.