Review of ORAUT-TKBS-0020, Revision 00

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ORAUT-TKBS-0020 overview

- The National Institute for Occupational Safety and Health (NIOSH) issued ORAUT-TKBS-0020, revision 00 ("TKBS-0020"), on March 30, 2004
- Provides information for assigning internal and external doses to Tennessee Valley Authority (TVA) workers
- SPR tasked SC&A to review this document in July 2025
- SC&A issued review of TKBS-0020 on January 23, 2026

TVA background

- TVA researched uranium recovery as part of fertilizer production from phosphate ore
  - Took place from 1951 to 1955 within some buildings on TVA site
  - Process initially developed by Dow Chemical Company
- Uranium dried and shipped to Atomic Energy Commission for further processing
  - Estimated 5.5 pounds (lb) of uranium produced in total
  - Averaged 2% uranium by weight
- No monitoring records for TVA
  - NIOSH used Blockson Chemical Company (Blockson) exposures and scaled accordingly

Internal exposure

- NIOSH compared the production rate of Blockson (50,000 lb/year) to estimated production rate at TVA (5.5 lb over 5 years)
  - Inhalation potential at TVA factor of 45,300 lower than at Blockson
- NIOSH used this factor and the median intake rate from Blockson to calculate intake rate and air concentration for TVA
  - Intake rate of 5.3E-04 picocuries per day (pCi/d)
  - Air concentration of 5.5E-05 picocuries per cubic meter (pCi/m^3)
    - Continuous exposure at this concentration for all 5 years would give total inhalation intake of 1 picocurie
      - Therefore, NIOSH does not include inhalation intakes in dose reconstructions
  - Ingestion intake would be 1.1E-05 pCi/d
    - Also insignificant and not included in dose reconstructions

SC&A comments on internal exposure

- Agrees that work done at Blockson is similar to TVA
- Agrees that scaling the intakes is appropriate, given only a small amount of uranium was produced at TVA
  - For Blockson, “production” workers were assumed to be exposed to the 95th percentile air concentration
  - SC&A agrees with NIOSH’s reasoning that, since the TVA work was of limited scale, using the median concentration for TVA is appropriate
- Agrees that inhalation and ingestion intakes are very low and do not need to be included in dose reconstructions

Observation 1

Updates to Blockson Chemical Company technical basis document (TBD) may affect TVA estimates

- For Blockson, SC&A reviewed OCAS-PER-020 (2009), the petition evaluation report for Special Exposure Cohort (SEC)-00225 (2016), and DCAS-PER-036 (2024)
- If the resolution of any findings or observations from these reviews affects the estimates for TVA, TKBS-0020 should be revised accordingly

Radon exposure

- This section was noted as being “reserved” in TKBS-0020, revision 00
- SC&A notes that this section was also “reserved” in revision 00 of the Blockson TBD

Observation 2

Update radon exposure potential

- Most recent version of Blockson TBD states that, as a result of the SEC determination, doses from radon exposure could not be reconstructed for Blockson during the operational period
- SC&A requests additional information on whether radon exposure for TVA workers can be reconstructed

External dose – submersion

- NIOSH used estimated uranium air concentration (5.5E-05 pCi/m^3) and dose coefficients for uranium (U)-238, thorium (Th)-234, and protactinium (Pa)-234m from Federal Guidance Report No. 12 (FGR 12) assuming 2,000-hour work year
  - Annual organ dose estimate of less than 1 millirem (mrem)
    - Not included in dose reconstructions
- SC&A was able to closely match NIOSH's calculated annual organ doses
  - Assumption of 2,000 hours per work year does not include overtime, but increasing dose estimates by 20 percent would still be insignificant for dose reconstructions

External dose – surface contamination

- NIOSH used assumed air concentration, deposition velocity of 0.00075 meters per second (m/s), deposition time of 1 year, and dose coefficients from FGR 12 for contaminated ground surface
  - Doses less than 1 mrem and are therefore not included in dose reconstructions
- SC&A was able to closely match NIOSH's calculated doses
  - Agrees that they are insignificant for inclusion in dose reconstruction

Observation 3

Update methodology to Battelle-TBD-6000, revision 1 ("TBD-6000")

- TKBS-0020 was written prior to TBD-6000, revision 1
- If TKBS-0020 is revised in the future, applicable dose estimate methodologies should be updated to use TBD-6000 as applicable for consistency across sites
  - An update to TKBS-0020 may require a program evaluation report

External dose – skin contamination

- NIOSH used a deposition velocity to skin of 0.012 m/s; deposition time of 8 hours; and electron dose rate conversion factors for U-238, Th-234, and Pa-234m
  - Assumed that contamination accumulated at the beginning of the shift and the employee then showered at the end of shift
  - 1.9E-07 rem annual dose
    - A small dose and therefore not included in dose reconstructions

SC&A comments on external dose – skin contamination

SC&A reviewed NIOSH's calculations

- Questions NIOSH's assumption that all workers showered and removed work clothing at the end of shift
  - Modifying this assumption may not have a significant impact on the doses from skin contamination
- Located the reference used by NIOSH for the dose conversion factors
  - Calculated an annual dose of 4.25E-05 rem
    - Still would not be included in dose reconstructions, less than 1 mrem

Observation 4

SC&A could not match skin contamination dose calculated by NIOSH

- SC&A's calculated dose was two orders of magnitude higher than NIOSH's dose
- Although SC&A's dose is still small, the discrepancy should be identified

External dose – drummed uranium

- NIOSH assumed all 5.5 lb of uranium stored in one container
- NIOSH compared dose rates of a half-full drum (1,500 lb) of uranium from Fernald to modeled dose rates using Microshield and Monte Carlo N-Particle (MCNP) transport code from Blockson TBD
  - Dose rates from Fernald drum most claimant-favorable
  - Assumed worker was 1 meter from the container for 1 hour each workday, 5 days per week, 50 weeks per year
    - 0.017 rem per year
- SC&A agrees that the Fernald dose rates are most claimant-favorable
  - SC&A able to closely match NIOSH's calculated doses

Observation 5

Justification needed for assumed time and distance spent near drum

- Blockson TBD also used the Fernald dose rate measurements
  - Workers assumed to be 1 foot from drummed uranium for 8 hours per day, 1 day per week, 50 weeks per year
- SC&A requests additional information on how NIOSH determined TVA workers would be further away from the uranium and the assumptions for the amount of time used in the calculations

Occupational medical dose

- NIOSH assumes each worker received a posterior-anterior x-ray annually
- NIOSH uses ORAUT-OTIB-0006 to assign occupational medical dose
- SC&A agrees with the guidance of using ORAUT-OTIB-0006

Residual contamination

- Very little potential for contamination beyond operational period
  - Doses from residual contamination not included
- SC&A agrees with NIOSH's determination

Questions?