Reassessment of Internal Radiation Dose at the Rocky Flats Plant Critical Mass Laboratory SEC – 0192

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Purpose

- Reevaluates prior assumptions used to assess upper bounds on personnel dose from mixed fission products and activation products (MFAP) at the Rocky Flats Plant (RFP) Critical Mass Laboratory (CML)
- The report was reassessed because of concerns identified by the RFP CML Lead Physicist and a former Radiological Control Supervisor

Background

- NIOSH issued original white paper on CML exposures June 9, 2015
  - *Assessment of Sealed Radioactive Sources, and Fission and Activation Products as Radiological Exposure Sources in the RFP CML*
- During the work group meeting on July 15, 2015 SC&A responded in general agreement with NIOSH's findings.

Background

- The former CML Associate Research Scientist spoke during the work group meeting indicating:
  - That the neutron flux for a CML experiment could not be bounded, and
  - That the best one could say is that power level was probably less than 50 kW
- Based on this statement NIOSH committed to do further evaluation to ensure the assumptions made in the white paper were appropriate.

Background

- Additional interviews were conducted with the former CML Associate Research Scientist and with a former Radiological Control Supervisor who was identified by the petitioner as a person who may have information on the CML.
- The interviews were conducted with work group members, SC&A, and the petitioners online as much as possible.
- The former CML Associate Research Scientist reiterated his concerns and indicated that he sent 50 boxes of documents concerning CML to LANL
- Additional concern identified by the Radiological Control Supervisor was a lack of air sampling for Bldg. 886 (CML).

Background

- In Feb. 2016, NIOSH and SC&A were able to review the documents at LANL. A number of documents were identified for capture. The documents were not released until late summer 2016
- Additional data captures were conducted in search of air sampling data and surface contamination surveys. NIOSH did not receive all of these documents until fall 2016
- Late November 2016 NIOSH issues a new white paper titled *Reassessment of Internal Radiation Dose from Sources at the RFP CML*

Power Levels

- In NIOSH's initial calculations NIOSH used 10 mW for 1 hour (US DOE public document)
- From the CML documents captured at LANL NIOSH found a more accurate estimate of thermal power of 3.6 mW averaged over 70.5 minutes
- CML staff however, reported to ERDA an average thermal power of 6.7 mW over 70.5 min based on the same experiment.
- NIOSH concluded they would use the value reported to ERDA for the revised calculation

CML Surface Contamination

- In NIOSH's original assessment an estimate of surface contamination was used to develop air concentrations for the dose model
  - DOE Surface Contamination Limit (1000 dpm/100cm^2)
- NIOSH captured surface contamination and Airborne radioactivity surveys for Bldg. 886 from Jan. 1981 – December 1990
  - Surveys were conducted regularly
  - Values in uncontrolled areas were rarely above the limit
  - Evidence indicates spills were promptly cleaned up
- Use of the Contamination limit is bounding

CML Air Monitoring

- The original dose model airborne concentrations were based on applying a resuspension factor to the surface contamination limit
- Since then NIOSH captured:
  - Plant-wide procedures describing air monitoring program for alpha particulate emissions
  - Air sample locations for Bldg. 875 and 886 (Fig. 8)
  - Air sample results (Table 6)

CML Air Monitoring cont.

- NIOSH concludes a well defined air monitoring program was required by RFP procedures
- Air samples for bldg. 886 and 875 appear to have been routinely collected and analyzed
- Sample results were evaluated against the RCG of 70 dpm/m^3
- Sample results were reviewed and initialed

CML Air Monitoring cont.

- Based on the air sample data NIOSH determined a bounding air concentration can be calculated as a weighted average concentration by
  - Using the three recorded values in excess of the RCG
  - Assuming samples between 10%-100% of RCG were 100% (70 dpm/m^3)
  - Samples less than 10% of RCG were 10% (7 dpm/m^3)
  - No respiratory protection
- This results in a weighted average concentration of 19.2 % of RCG or 13.5 dpm/m^3

Unmonitored Exposure to MFAP

- Concern with potential internal exposure from MFAP associated with numerous spills of enriched uranyl nitrate
- No indication of confirmatory bioassay being performed for persons involved in cleanup of spills
- No indication of routine bioassay for MFAP

Bounding Estimate MFAP Dose

- The approach used for Bounding MFAP dose is the same approach used in the previous white paper
- Maximum MFAP internal dose modeled by
  - Using a representative UNH experiment
  - Average thermal power and duration
  - Average air concentration from CML air monitoring results
  - ICRP 68 dose conversion factors
  - ORAUT-OTIB-0054 (Dosimetrically significant nuclides)
  - ORIGEN-S code

Bounding Estimate MFAP Dose

- The bounding values are significantly reduced from the previous calculation.
  - Soluble (Type F) 2.5 x 10^{-9} Sv or 2.5 10^{-4} mrem Bone Surface (BS)
  - Moderately Soluble (Type M) 2.3 x 10^{-9} Sv or 2.3 10^{-4} mrem (BS)
  - Insoluble (Type S) 2.4 x 10^{-9} Sv or 2.4 10^{-4} mrem Lung
- The orders of magnitude difference is driven by a calculation error in the previous calculation
- The other factors in the lower dose are reduced power level and airborne activity

Questions?