

# **SC&A Evaluation of Residual Dose Reconstruction Methods at Simonds Saw and Steel**

**Bob Barton**

**Health Physicist**

**S. Cohen and Associates**

**Contractor to:**

**Advisory Board on Radiation Worker Health/ABRWH  
Centers For Disease Control and Prevention**

**July 29, 2014**

**Idaho Falls, Idaho**

# SC&A Review of Proposed Methods of Assigning Residual External Dose

## Original Concerns:

1. What measurement data are available during this period?
2. How do the proposed dose assignments compare with the available measurements?
3. How long is the worker assumed to be exposed at the chosen external dose levels?

# Available External Measurements

- **Gamma/Penetrating Radiation Measurements Taken During Six Survey Activities Spanning 1957–2007**
  - 79 measurements available from the 1957, 1976, 1980, 1984 and 1999 survey reports (ranging from “Not Detected” to a maximum of 300  $\mu\text{R/hr}$ ).
  - Over 2,000 measurements taken during the 2007 USACE survey (maximum value of 63  $\mu\text{R/hr}$ )

# Available External Measurements (cont).

- Beta/Non-Penetrating Measurements at 3 feet only available from the 1957 survey report (results shown below):

<b>Survey Location (Approx. Volume of Contamination)</b>	<b>Beta @ 3 Feet (mreps/hr)</b>
10" Bar Mill Bed (75 ft <sup>2</sup> – ½ in. thick)	1.0–1.7
Front of Shear (10 ft <sup>2</sup> – 1 in. thick)	0.4
Between Plates on Mill Floor (not given)	0.05
Forge Area (not given)	0.2

# Evaluation of Chosen Dose Assignments

- Proposed Gamma/Penetrating Value:  $80 \mu\text{R/hr}$ 
  - Represents the maximum observed measurement during the 1957 survey
  - Of the 79 measurements observed during the 1957–1999 surveys only 4 exceeded  $80 \mu\text{R/hr}$
  - Highest values were associated with a localized hot spot which decreased to levels below  $80 \mu\text{R/hr}$  within  $\sim 10$  feet of the area
  - The 95<sup>th</sup> percentile of the 1957–1999 data is  $\sim 66.5 \mu\text{R/hr}$
  - None of the 2,000+ measurements from 2007 exceeded  $80 \mu\text{R/hr}$ ; the 95<sup>th</sup> percentile of measurements taken in AEC work areas is  $\sim 11.3 \mu\text{R/hr}$  (within the range of background for the Lockport area).

# Evaluation of Chosen Dose Assignments (cont).

- **Proposed Beta/Non-Penetrating Value: 1.35 mreps/hr**
  - Represents the midpoint of the 1957 measurements in the 10" Bar Mill Bed area
  - Measurements in other plant areas ranged from 0.05 to 0.4 mreps/hr
- **Beta/Gamma Dose Ratios:**
  - Table 3.10 of TBD-6000 prescribes a beta/gamma dose ratio of ~100
  - 2013 SC&A study using MCNP calculated a beta/gamma dose ratio of ~45
  - Both values assume an infinitely thin layer of contamination (i.e., no self attenuation) → actual beta/gamma dose ratios are likely much lower
  - Proposed Beta/Gamma ratio ( $1.35/.08 = 16.9$ ) is within range of the calculated bounding values and so represents a realistic dose ratio

# Worker Exposure Duration

- TBD assumes a work-day exposure duration of 10 hours during the operational period and 8 hours during residual period
- Insufficient evidence exists to warrant a shorter work day during the residual period
- NIOSH agrees that the exposure duration utilized during the residual period should be consistent with the operational period
- New dose reconstruction method assumes proposed external exposure assignments ( $80 \mu\text{R/hr}$  penetrating and  $1.35 \text{ mreps/hr}$  non-penetrating) are assigned as a constant for 10 hours per work day (2,500 hours per year).

# Summary of External Dose Evaluation

- Proposed dose reconstruction method assigns dose by selecting measured values in the upper end of observed survey results
- Beta/gamma dose ratio of chosen values is comparable with theoretical ratios assuming an infinitely thin layer of contamination
- Doses are assigned as a constant assuming a 10-hour work day, which is consistent with the operational period
- SC&A/Work Group recommend acceptance of the proposed method as plausible, scientifically defensible and claimant favorable

# SC&A Review of Proposed Methods of Assigning Residual Internal Dose

- **Original Concerns**
  1. **Assignment of exposure duration (8 hours versus 10).**
  2. **How is the dust loading established for the beginning of the residual period?**
  3. **How is the dust loading established at the end of the residual period?**

# **Selection of Dust Loading at the Beginning of Residual Period**

- **Ideally, the source term available for inhalation can be characterized immediately following operations**
- **Air sampling data at the site are available from 1948–1954, but not from 1955–1957**
- **NIOSH evaluated 21 general air samples available from 2 rolling days in 1954 (as close to the end of operations as feasible)**
  - **Chosen samples represent an actual uranium rolling operation → likely a significant overestimate of actual residual airborne levels**
  - **Samples taken during a period where industrial dust control measures had been removed or were rendered ineffective**

# **Selection of Dust Loading at the End of the Residual Period**

- **2007 USACE Survey contained an extensive evaluation of all areas of the site including former AEC operational areas (Buildings 3, 6/8, and 24)**
- **Proposed dust loading calculated based on the highest observed 95<sup>th</sup> percentile contamination measurement in these operational areas (67,000 dpm/100 cm<sup>2</sup> in the southern portion of Building 24)**
- **Calculated dust loading assumes a resuspension factor of  $10^{-6}$ , breathing rate of 1.2 m<sup>3</sup>/hr, and 10 hours per day**

# Selection of Dust Loading at the End of the Residual Period (cont.)

- 95<sup>th</sup> percentile surface contamination in Building 24 was a factor of 1.2 higher than the observed 95<sup>th</sup> percentile contamination during the 1999 survey of the same location
- Proposed intake rate is a factor of 4.5 higher than the previous intake rate derived from USACE's Exposure Point Concentrations (EPC)
- ORAUT-OTIB-0070 recommends a source depletion factor of 0.00067 d<sup>-1</sup>; the proposed methodology results in a calculated depletion factor that is roughly 25% of this value (i.e., more claimant favorable)

# Selection of Dust Loading at the End of the Residual Period (cont.)

- 2007 USACE survey performed breathing zone analyses for work activities likely to generate airborne contamination including:
  - Brush clearing activities using the hydro-axe
  - Boring activities in Buildings 6 and 8
  - Radiological survey work conducted on the Building 24 roof trusses
- Survey concluded: *“Breathing zone sample results demonstrated that airborne contamination during site activities was minimal. The maximum value for the breathing zone samples equated to 0.2 DAC-hrs [~ factor of 10 lower than proposed value], with the majority below detection limits.”*

# Summary of Internal Dose Evaluation

- **10-hour work day has been adopted for consistency with the operational period**
- **Airborne dust loading at the beginning of the residual period based on general air samples taken during a uranium rolling operation as close to the end of operations as feasible**
- **Airborne dust loading at the end of the residual period is based on the highest 95<sup>th</sup> percentile surface contamination value among buildings utilized in AEC work**

# Summary of Internal Dose Evaluation (cont.)

- Calculated source depletion factor of the proposed method compares favorably with the recommended value in ORAUT-OTIB-0070
- Breathing zone analyses conducted during the 2007 survey are bounded by the proposed intake rate
- SC&A/Work Group recommend acceptance of the proposed method as plausible, scientifically defensible, and claimant favorable

# Questions?