

Weldon Spring Bounding Radon Model

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Approach

- **January 2011 WG meeting: NIOSH presents bounding radon exposure scenario conditions for process workers**
 - All radon released during processing was re-circulated back into the process areas
 - Assume steady state; minimum ventilation
- **Approach establishes a bounding intake to perform dose reconstruction**

History of ABRWH WG Discussions

- **January 2011: NIOSH presented a scenario in which ALL radon released during processing was re-circulated into the facility as bounding**
 - **The maximum concentration of radon, based on release estimate, to be assigned for intake**
- **May 2011: discussion and clarification, but no change in proposed direction**
- **June 2012: WG asked for additional detail to be added to these slides and for presentation of same to full ABRWH**

Bounding Conditions

- **Some sources describe annual uranium-bearing material throughput as 14,500,000 kg per year, while others describe it as 5,000,000 kg per year**
- **Radon release estimated based on amount of uranium processed**
 - 5 million kg uranium/yr processed = 12 Ci radon
 - 14.5 million kg uranium/yr processed = 34 Ci radon
- **Assume 70% of material was uranium**
- **Estimated radium activity as 1% of uranium activity (a conservative, upper end estimate)**

Bounding Conditions—cont.

- **Equilibrium between radium and radon**
- **Radon release estimated between 12 to 34 Curies/year (Meshkov et al. 1986, pp 47-48)**
 - **NIOSH selected the upper bound value of 34 Ci/yr**
- **No surrogate data used**

Scenario Parameters

- **Building 103 volume: $2.6 \times 10^4 \text{ m}^3$**
- **Ventilation rate: 1 air change per hr**
- **$34 \text{ Ci/yr} = 3.9 \times 10^9 \text{ pCi/h}$**
- **1 WL = 100 pCi/L of Ra-222 in full equilib. with short lived alpha emitting progeny**
- **Hours in a WLM = 170**
- **Equilibrium factor = 0.5**
- **Number of occupational work hours = 2,000/yr**

Calculations

- **C_{eq}** is the radon-222 equilibrium conc. (pCi/L) in a ventilated room

$$C_{eq} = \frac{I}{ach * V}$$

- **I** is the influx of radon-222 in pCi/h = 3.9×10^9 pCi/h
- **V** is the volume of the space in L
- **ach** is the number of air changes per hour

$$C_{eq} = \frac{3.9 * 10^9 \frac{pCi}{h}}{1 ach * 2.6 * 10^7 \ell} = 150 pCi/\ell$$

Radon Exposure in WLM/y

$$\frac{WLM}{y} = \frac{C_{eq} \text{ pCi}}{\ell} * \frac{\ell \text{ WL}}{100 \text{ pCi}} * \frac{M}{170 \text{ h}} * \frac{2000 \text{ h}}{y} * \frac{EqF}{1}$$

so

$$\frac{WLM}{y} = \frac{150 \text{ pCi}}{\ell} * \frac{\ell \text{ WL}}{100 \text{ pCi}} * \frac{M}{170 \text{ h}} * \frac{2000 \text{ h}}{y} * \frac{0.5}{1} = 8.8$$