

# Fernald SEC Petition Review

Status Report and Action Items  
Following the Work Group Meeting  
Held on August 11, 2011

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Presented to the Advisory Board on Radiation and Worker Health

Full Board Meeting Held in Richland, Washington,

August 23-25, 2011

# Work Group Review: Overview

- April 19, 2006: SEC Petition qualified
  - “All employees who worked in all facilities at the Feed Materials Production Center (FMPC) in Fernald, Ohio, from Jan 1, 1951 through Dec 31, 1989”
- Nov 3, 2006: NIOSH Evaluation Report issued
  - “NIOSH found no part of the class under evaluation for which it cannot estimate radiation doses with sufficient accuracy.”
- Nov 10, 2006: SC&A Site Profile Review
- July 2, 2007: SC&A SEC PER Review
- August 2007 → August 2011: Eleven Work Group meetings
- May 24, 2011, ABRWH Meeting: SC&A presents detailed summary of SEC issues (as of April 2011)

# Work Group SEC Issues

1. Coworker Model for Uranium Internal Exposures – **open**
2. Validation of the HIS-20 database – **closed\***
3. Recycled Uranium (RU) – **open**
4. Use of radon breath data for reconstructing doses from inhalation of Ra-226 and Th-230 – **closed\***
5. Review of radon emissions from the K-65 silos and associated exposures - moved to site profile discussions
6. Reconstruction of internal exposures from inhalation of Th-232
  - 6A: DWE Data (1953 – 1967) – **closed\***
  - 6B: Chest Counts (1968 – 1989) - **open**

(\* recommended by SC&A)

# Open Issue (#1): Co-worker Model for Uranium Internal Exposures

## Description of Issue –

Concerns regarding the completeness and adequacy of the uranium bioassay data available for dose reconstruction and supporting the Fernald internal dosimetry co-worker model (OTIB -0078, dated November 6, 2007)

## Status of Issue –

Resolved except for matters related to the applicability of the co-worker model to Fernald construction workers

## Open action Items:

NIOSH to perform an analysis of construction worker (CW) vs. non-CW uranium bioassay data for TIB-0078 and deliver a report

August 11, 2011 WG meeting - NIOSH indicated analysis complete and report in internal review

SC&A to review the report when it becomes available

# Open Issue (#3): Recycled Uranium (RU)

Description of Issue: Concern that default concentrations of Pu-239, Np-237, and other isotopes associated with RU at Fernald may not be bounding for some classes of worker activities, buildings, and time periods.

Status of issue: Numerous white papers have been exchanged where NIOSH provides its technical basis in support of its default values and SC&A provides the reasons it believes that the default values may not be bounding for all workers and time periods.

August 2011 Work Group Meeting: SC&A response to NIOSH review of second SC&A white paper (March 31, 2011) and NIOSH position paper on RU defaults (August 5, 2011)

## SC&A Observations – NIOSH review of second SC&A RU white paper

- NIOSH acknowledges processes that resulted in concentration of RU constituents above levels in feed materials (e.g., MgF<sub>2</sub> 'dolomite' problem)
- NIOSH acknowledges limitations and uncertainties in the data from the DOE mass balance reports (basis for NIOSH default values)
  - Arithmetic mean concentrations for the 19 subgroup processes in DOE Ohio Field Office Report (DOE 2000) are not bounding; data highly variable and uncertain
  - Propose upper 95th percentile of lognormal distributions for all but highest process subgroup (1973–1989)

# Issue #3: Recycled Uranium - continued

## August 11, 2011 Work Group Meeting

### New NIOSH Position on Default Values (August 5, 2011):

1953 -1960: Proposes no RU constituent intakes

1961-1972: Proposes 'original' defaults

Pu-239 (100 ppb U)

Np-237 (3500 ppb U)

Tc-99 (9000 ppb U)

1973-1989: Proposes increased default values (value, basis)

Factor of 4 for Pu-239 (100 ppb U → **400 ppb U**) (Subgroup 8; MgF2)

Factor of 3 for Np-237 (3500 ppb U → **11,000 ppb U**) (Subgroup 11; Waste Residues)

Factor of 2 for Tc-99 (9000 ppb U → **20,000 ppb U**) (Subgroup 6B; LEU products)

Based principally on MgF2 concentration in metal reduction (Plant 5) → highest continuous worker exposures

# Issue #3: Recycled Uranium - continued

## SC&A observations - NIOSH position on RU defaults

- NIOSH correlates increased worker exposure potential with receipts of Plutonium Out Of Specification (POOS) feed materials beginning in 1973 (worst was in 1980 – Paducah tower ash)
  - Prior to 1973, NIOSH proposes original (lower) defaults
  - However, POOS feeds down-blended (Plants 1, 4, 8) before being sent to the Refinery (Plants 2 and 3) and subsequent processing steps
  - Therefore, concentrated constituents in MgF2 (metals production step) were mostly from down-blended materials
  - Because MgF2 data in DOE 2000 report were from 1982-1987; cannot assess extent of MgF2 concentration prior to POOS receipts
    - If MgF2 constituent concentrations are not correlated with POOS receipts, higher defaults could be applicable prior to 1973 (bounding one-size-fits-all approach)

# Issue #3: Recycled Uranium - concluded

## SC&A position on new proposed NIOSH default values

### 1953-1960:

- This period can be bounded (site profile); However, SC&A believes that a default of zero is neither appropriate nor claimant favorable

### 1961-1972:

- This period can be bounded (site profile); questions remain as to what the default should be (original vs. new higher values)
  - Impact of MgF2 concentration with low feed levels

### 1973-1989:

- Proposed higher defaults; probably bounding for the highest continuously exposed subgroup of workers (Plant 5 metal workers and associated millwrights)
- Initial POOS feed concentrations (subgroup 10A) could have impacted handlers and down-blenders; also indirect exposures (bystander effect) (SEC issue 1973-1985; 1986-1989 – good HP/IH program)
  - Small subset but cannot identify based on work records
  - Likely intermittent exposure but not yet quantified

NIOSH Action Item: quantify down-blending intervals; assess impact

SC&A action item: review NIOSH assessment

# Open Issue (#6B) Reconstruction of internal exposures from the inhalation of Th-232

Description of issue 6B: Use of chest counts to reconstruct Th-232 exposures (1968 -1989)

- No DWE data after MIVRML introduced in 1968 – therefore completely dependent on integrity of chest count data thereafter
- SC&A believes that uncertainties in data sets are not adequately quantified

Status of issue: White papers exchanged; issue first discussed in detail at the April 19, 2011, Work Group meeting

April 19, 2011, Work Group meeting:

- NIOSH action item: post for review newly acquired documents on MIVRML calibration
  - Documents posted and new white paper provided (May 6, 2011)
- SC&A action items:
  - Review the new calibration documents in the context of our June 2010 white paper review (data adequacy)
  - Provide a formal response to NIOSH concerning the issue of whether thorium workers may be underrepresented in the coworker model (data completeness)
  - New responses provided ( August 2011: data adequacy; data completeness)

# Issue #6B: Use of chest counts to reconstruct Th-232 exposures (1968-1989), continued

August 11, 2011, Work Group meeting: Discussions of new NIOSH white paper and SC&A responses on data adequacy and completeness

## SC&A Concerns - Data Adequacy

1968–1978: Reported in milligrams (mg) thorium (period of thorium processing)

- Questionable calibration method (screening vs. quantitative)
- Questionable calibration source used to derive MDL- contaminated with Ra-228
- Questionable method to evaluate age of source and transform Ac-228/Pb-212 activity into mg Th-232 – No raw data, just mg thorium reported
  - Examples indicate Ac-228 used – very sensitive to age of source
- Uncertainty in age of source(s) at time(s) of intake (factor of about 2 for a closed system using Pb-212; orders of magnitude if Ac-228 used)
- Uncertainties in the resident time in the lung (progeny in-growth and translocation; factor of 2.5 or more)
- MDL of 6 mg not supported by reference or data (only 3 % of results > 6 mg); uncertainties in MDL and from 'noise' in values < MDL
- Inconsistencies between mg Th-232 and nCi Pb-212 for period of overlap (1978) Highest mg Th-232 correspond to negative Pb-212 results (SC&A white paper – June, 2010, Table 1)
- Data for individual workers inconsistent with biokinetic processes (SC&A Memo to NIOSH; April 6, 2011)
- Large variability and uncertainty in mg Th-232 data and lack of knowledge on derivation may preclude ability to bound intakes 1968 - 1978 (SEC issue)

# Issue #6B: Use of chest counts to reconstruct Th-232 exposures (1968-1989), continued

## SC&A concerns - Data Adequacy, concluded

1979–1988: Reported in nCi Thorium (based on Pb-212 and Ac-228) (period of stewardship)

- Large impact of measurement variability (nCi Pb-212 and nCi Ac-228) on derived result (cited example - factor of about 2)
- Uncertainties in the resident time in the lung (progeny in-growth/translocation)
- Uncertainties in the REMAB phantom (up to a factor of 3, pre-1983)
- MDL of 0.25 nCi > 84th percentile; uncertainties from 'noise' in values less than the MDL
- Equilibrium factor (EF) of 0.42 for Pb-212 measurements based on a closed system (no translocation out of lung)
  - Experimental data indicate EF could be lower
- Raw data are available - nCi thorium data may be adequate to bound intakes (site profile)
  - NIOSH coworker model uses a GSD of 3 (based on biokinetic modeling)
    - Does not appear to address measurement uncertainties
    - Possibly adequate when applied to a distribution of results for multiple workers over a year, but not quantified

# Issue #6B Use of chest counts to reconstruct Th-232 exposures post-1968, continued

SC&A Concerns - Data Completeness (assuming data adequate for coworker model)

SC&A tasking – formal response (February and April 2011 Work Group meetings):

- Are thorium workers adequately represented in the data set?
  - Only one reference identifies thorium workers with a specific production year (1968)
- If not, do chemical operators provide a reasonable surrogate for thorium workers for use in a coworker model?
- Is sampling frequency correlated with lung burden? (sampling directed at most highly exposed workers)

SC&A response (thorium operational period – mg thorium data)

Finding #1

- Thorium worker results generally higher than chemical operators at most percentiles
- Thorium worker 95th percentiles are higher in all but 4 years when compared with either the all workers or chemical operator 95th percentiles
- Non-parametric 95% confidence intervals for the 95th percentiles: only 1971 showed significant differences between the thorium subgroup, the chemical operators, and all workers
- No evidence that chemical operator group provides definitive upper bound for thorium worker exposure

# Issue #6B Use of chest counts to reconstruct Th-232 exposures post-1968, concluded

## Finding #2

- Less than 3% of the in-vivo records for mg Th are at or above the assumed MDL of 6 mg
  - This, combined with uncertainties regarding the accuracy and veracity of the MDL, call the utility of the model into question
- Nonetheless, thorium workers appear to be well represented among the in-vivo results at or above the MDL
  - Workers comprise 7% of the total but over 20% of those with positive results
  - Samples comprise 13% of the total but nearly 33% of the positive results

## Finding #3

- No positive linear correlation between thorium monitoring frequency and magnitude of results
- Uranium monitoring results showed much better linear correlation between monitoring frequency and the relative magnitude of results
- Suggests that the in-vivo program may have been targeting higher risk workers based on uranium activities

NIOSH action item: Formal response to SC&A responses before next meeting

SC&A to review NIOSH response

# Summary

## Issues remain to be dispositioned with NIOSH and SC&A

- Work Group deferring action on recycled uranium for 1973 through 1985 pending further assessment
  - NIOSH to locate historical information regarding the time required for down-blending
  - From this it may be possible to estimate periods during which down-blenders (and bystanders) may have been exposed to subgroup 10A concentrations and determine whether the new higher defaults are bounding
  - SC&A to review NIOSH's quantitative analysis when it becomes available
- Work Group deferring action on thorium chest count data (1968-1978) pending further assessment
  - NIOSH to provide formal responses to SC&A on the August 2011 data adequacy and completeness reports
  - SC&A to review NIOSH's response when it becomes available

Questions?