

Fernald SEC Petition Review

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

Presented by Brad Clawson

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., MgF₂ '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?