

Fernald SEC Petition Review

Status Report and Action Items
Following the Work Group Meeting
Held on April 19, 2011

Presented by John Stiver (SC&A, Inc.)

Meeting of the Advisory Board on Radiation and Worker Health
Held in St. Louis, Missouri
May 24–26, 2011

Historical Overview – November 2006–Present

- **Site Profile Review – 11/10/2006**
- **SEC PER Review – 07/02/2007**
 - Six Principal SEC Issues Identified
 - Issue #1: Coworker Model for Uranium Internal Exposures
 - Issue #2: Validation of the HIS-20 database
 - Issue #3: Recycled Uranium (RU)
 - Issue #4: Use of radon breath data for reconstructing doses from inhalation of Ra-226 and Th-230
 - Issue #5: Review of radon emissions from the K-65 silos and associated exposures
 - Issue #6: Reconstruction of internal exposures from inhalation of Th-232 [DWE (6A) and chest counts (6B)]
- **Ten Work Group Meetings (August 2007 – April 2011)**
 - Numerous white paper exchanges and work group discussions
 - SC&A work products and summary can be found at:
 - [O:\AB Document Review\Fernald\SC&A Work Products for SEC Issues Resolution](#)
- **After April 19, 2011, Work Group meeting, 2 SEC Issues Remain:**
 - RU (Issue #3)
 - Thorium chest count data (Issue #6B)

Issue #1: Coworker Model for Uranium Internal Exposures

■ Description of Issue:

- Completeness and adequacy of uranium bioassay data for dose reconstruction and to support ORAUT-OTIB-0078, Fernald internal dosimetry coworker model (August 13, 2009)

■ Status of Issue (April 2011):

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

■ Action Item (from November 2010):

- NIOSH to perform an analysis of construction worker (CW) vs. non-CW uranium bioassay data for ORAUT-OTIB-0078 and deliver a report to the Board
 - Report not delivered as of April 19, 2011

Issue #2: Validation of the HIS-20 Database (Issue #2 has 2 parts - #2A and #2B)

■ Description of Issue #2A:

- Complete the validation of the accuracy with which hardcopy dosimetry data were converted into electronic data for the HIS-20 database
 - Canberra™ HIS-20 database used in uranium bioassay (coworker) study

■ Status of Issue:

- On December 3, 2010, NIOSH delivered a complete validation study that resolved all of SC&A's concerns
- At the February 8 Work Group meeting, it was recommended that Subpart A of Issue 2 be closed

■ Action Items: None

Issue #2: Validation of the HIS-20 Database (continued)

■ Description of Issue #2B

- Concerns regarding the integrity of the hardcopy bioassay data, as raised by the petitioner

■ Status of Issue: SC&A report describes strategies for investigating data integrity issues that could adversely affect the ability to reconstruct internal doses

- *Draft-Strategies for Analyzing Corrupt Monitoring Allegations*
 - *Compare urinalysis and in-vivo monitoring data*
 - *Investigate consistency and reliability of urinalysis results*
 - *Compare DWE (air sampling data) to urinalysis records of known areas, job types, time periods*
- Work Group agreed that any such investigations would require considerable time and costs and will likely be inconclusive

■ Action Items: None at this time

Issue #3: Recycled Uranium

■ Description of Issue #3:

- **Concern:** Default concentrations (on U mass basis) 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
 - Dosimetric significance: Pu dose 2–5 times U dose (bone surfaces, liver, red marrow) at NIOSH default of 100 ppb U (proportional)
 - Period of Interest:
 - RU first received in 1953; receipts peaked in the mid-1960s and again in the mid-1980s; 18,000 MTU total (DOE Office of Security report on recycled uranium, May 2003, Table A-9)
 - 1986: WMCO replaces NLO as Fernald M&O, institutes comprehensive improvements in HP/IH programs
 - **Prior to 1986: Rad-Safe program probably not adequate to control potential exposures from contaminants in RU**
 - **Thus, period of interest is 1953–1985**

Issue #3: Recycled Uranium (continued)

History - Work Group Discussions of RU

■ 10/28/2008 Work Group Meeting

- SC&A tasked to review NIOSH white paper on RU
 - Are defaults for Pu-239, Np-237, Tc-99 appropriate and bounding for all workers?

■ 1/29/2010 Work Group Meeting

- SC&A white paper discussed – 11 findings, NIOSH prepares response

■ 11/9/2010 Work Group Meeting - NIOSH responses discussed

- NIOSH Action Items
 - Memo - Source data for the dust sample measurements
 - Availability of the raw data used to support the DOE Ohio Field Office Report (2000) subgroup process means
- SC&A Action Items
 - Provide white paper response to NIOSH (second RU report)
 - Basis – Conclusion that DOE Ohio Field Office Report (2000) subgroup means not a firm basis for bounding default TRU and FPs in RU
 - Focused review – Site-specific measurements of TRU and fission products in RU at Fernald

Issue #3: Recycled Uranium (continued)

History - Work Group Discussions of RU (continued)

■ 2/8/2011 Work Group Meeting

- SC&A presents second RU white paper – Key findings
 - Lack of data and limited health physics programs during NLO tenure (pre-1986)
 - Limitations associated with the DOE reports upon which the NIOSH default values are based (variability, uncertainty, data completeness)
 - The magnesium fluoride (dolomite) problem – Plant 5 metal workers and Plant 1 millwrights – most highly exposed subgroups (continuous)
 - High Pu and Np concentrations in some dust collector samples (1985)
 - High Pu concentrations in air particulate samples collected at the site perimeter (1983–1984)
 - High Pu and Np concentrations in onsite air samples (1989)
 - Uncertainties from back-extrapolating from 1980s data
 - “One size fits all” issue
- NIOSH Action Item - white paper response to SC&A’s second RU white paper that addresses new findings – before next meeting

Issue #3: Recycled Uranium (continued)

History - Work Group Discussions of RU (continued)

■ 4/19/2011 Work Group Meeting

- **NIOSH Response:** Delivered just prior to the meeting (preliminary review; no new SC&A RU work authorized after April 19 meeting)
- **Salient Points:** SC&A Preliminary Review of New NIOSH Response
 - Acknowledges that chemical processes resulted in concentration of RU constituents above levels in feed materials (e.g., MgF₂ 'dolomite' problem)
 - Acknowledges the limitations and uncertainties in the data from the DOE reports upon which the NIOSH default values are based
 - Arithmetic mean concentrations for the 19 subgroup processes in DOE Ohio Field Office Report (2000) are not bounding, due to high degree of variability and uncertainty
 - Proposes upper 95th percentile of lognormal distributions for all but highest process subgroup (1973–1989)
 - Results in 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)

Issue #3: Recycled Uranium (continued)

- **Salient Points - SC&A Preliminary Review of New NIOSH Response, concluded**
 - NIOSH Correlates increased worker exposure potential with receipts of Plutonium Out Of Specification (POOS) feed materials beginning in 1973
 - Prior to 1973, NIOSH proposes very low constituent concentrations
 - **Pu-239** (100 ppb U → 7 ppb U), **Np-237** (3,500 ppb U → 2 ppb U), **Tc-99** (9,000 ppb → 19 ppb U)
 - However, POOS feeds down-blended (Plants 1 and 4) on front end, BEFORE being sent to the Refinery (Plants 2 and 3) and subsequent processing steps
 - Chemical concentration of constituents in subsequent processes resulted in the high measurements reported in DOE Ohio Field Office Report (2000)
 - MgF₂ process loop and impact on metal workers in Plant 5 and millwrights in Plant 1 (highest continuous exposure potential)
 - **Therefore, post-down-blending worker exposures appear NOT to be correlated with POOS receipts, and higher defaults may be applicable prior to 1973, based on feed data and process knowledge**

Issue #3: Recycled Uranium (continued)

■ RU Summary

- NIOSH's proposed higher defaults consider variability in DOE Ohio Field Office Report (2000) data and associated uncertainties
- Pu Defaults (most dosimetric significance) based on MgF_2 dataset
 - >400 data points; site-specific, but limited to 1980s timeframe (summary statistics)
 - Highest except for subgroup 10A (tower ash and decontamination residues) (initial POOS feed)
 - Lognormal for MgF_2 over-predicts 95th percentile (histogram)
 - Reflects exposure potential to the highest continuously exposed subset of process workers (Plant 5 metal workers and Plant 1 millwrights)
- Initial POOS feed concentrations (subgroup 10A) may impact handlers and down-blenders; also indirect exposures to nearby workers (bystander effect)
 - Only 39 data points; highly variable and uncertain (Fernald measurements 10 times higher than GPD)
 - NIOSH claims protective measures in place and short-term exposure
 - However, issues with HP practices prior to 1986 cast doubt
 - Impact not yet quantified/estimated
 - **Significant from 1973–1985 (1980–1986 – most contaminated tower ash)**
- NIOSH has also recently acquired 450 boxes of Fernald-specific records from Legacy Management
 - Disposition and potential impact uncertain at this time

Issue #4: Use of Radon Breath Data for Reconstructing Doses from the Inhalation of Ra-226 and Th-230

- **Description of Issue #4:** SC&A agrees - radon breath analysis is a scientifically valid method for reconstructing the intake of Ra-226 and Th-230 when the intake ratios of the two radionuclides are known and the impacted worker population can be identified.
 - Remaining Issue – Identifying impacted workers and reconstructing Th-230 dose when the Th-230 intake is not accompanied by equivalent or known quantities of Ra-226.
- **Status of Issue:** White papers have been exchanged in previous meetings
 - April 15, 2011: NIOSH posted a response (in ORAUT-RPRT-0052) to SC&A's white paper *Review of the NIOSH "White Paper on Fernald Th-230 and Other Associated Radionuclides – Rev. 7," dated May 2010*, that summarizes their position
 - 1958–1962: Cold raffinate processed in 2/3 → Silo 3; low Ra-226, but Th-230 on par with Silos 1 and 2 (Q-11) that have high Ra-226
 - Most exposure in Plant 2 – front end; ore charging
 - High Th-230 in Silo 3 materials – liquid stream contained in a closed piping system and then to a closed calcination system
 - Dispersible dry calcined powder transferred to Silo 3 in enclosed airlift
 - NIOSH – add Th-230 equal to U activity (short term, enclosed system, respiratory protection)
 - **SC&A – suggest adjustment factor - ratio of Th-230 to U in Silo 3; more realistic and claimant favorable**
 - Tractable problem – Site Profile
- **Action Items:** None

Issue #5: Review of Radon Emissions from the K-65 Silos and Associated Exposures

- **Description of Issue #5: SC&A Position**
 - Radon release rate from the K-65 silos as estimated by NIOSH substantially underestimated
 - Method to derive the atmospheric dispersion factors, given the source term, is scientifically flawed, but results in an overestimate of the atmospheric dispersion factors at receptor locations
- **Status of the Issue:**
 - Numerous white papers have been exchanged; Both sides 'agree to disagree'
 - As a practical matter, NIOSH believes that this issue has little significance with respect to the dose reconstruction for actual claimants, and **both parties (i.e., NIOSH and SC&A) agree that this is not an SEC issue**
 - April 19, 2011 – Board agrees to remove from SEC issues → TBD Issues
- **Action Items (2/9/2011):**
 - NIOSH to identify which cases might be impacted by SC&A's findings regarding the applicability of the atmospheric dispersion model and the veracity of the source term
 - NIOSH to consider rescinding its technical guidance regarding the K-65 silos based on what SC&A believes is a flawed source term and atmospheric dispersion model and its conclusions regarding the validity of their model based on the Pinney reports

Issue #6A: Reconstruction of Internal Exposures from the Inhalation of Th-232 (DWE Data)

- **Description of Issue #6A:** Use of BZ and GA sampling data and associated daily weighted exposures (DWEs) to reconstruct Th-232 intakes pre-1969 (see NIOSH white paper dated March 11, 2009)
 - NIOSH posted a response (in ORAUT-RPRT-0052) to SC&A's white paper *Focused Review of "Uncertainty and Variability in Historical Time-Weighted Average Exposure Data" (Davis and Strom 2008) and Its Application in Dose Reconstruction under EEOICPA, Rev. 1,* that summarizes their November 2010 white paper (Revision 3)
 - Assign the DWE for the job description with the highest DWE in the FMPC plant where thorium was handled for a specific year to every worker in that plant, with a GSD of 5
 - Assign a high DWE from an adjacent year when neither DWE data nor air sampling data are available, or when they are judged to be inadequate or incomplete, with a GSD of 5
 - Use the upper 95th percentile of the air sampling data for a facility when time-weighted average data are not available
 - Recommends that the dose reconstructor search the SRDB for DWE data if the reconstructor has reason to believe that exposures may have taken place that are not identified in the existing data set.
- **Status of Issue:** Numerous white papers exchanged. SC&A accepts NIOSH last white paper (November 2010) as being scientifically sound and claimant favorable; however, a few technical questions remain that require attention.

Issue #6A: Reconstruction of Internal Exposures from the Inhalation of Th-232 (DWE Data) (continued)

■ SC&A Perspective

- NIOSH should investigate the issue of “blunders” in the raw data (significant in the Davis and Strom (2008) analysis)
 - Davis and Strom: For those job titles in which significant blunders occurred, average blunders cause a two-fold underestimate of exposure; worst case was a factor of 10 underestimate
 - DWE data used for DR should be verified against original measured data to evaluate the impact of blunders
- The 95th percentile of unweighted air concentration data introduces a chronic exposure to dust that may not be physiologically realistic in all scenarios
 - Davis and Strom: Average of un-weighted air sample data is a biased estimator of exposure but can be used in making compensation decisions when it is required to be favorable to a claimant
- The Fernald TBD should make available the necessary DWE data to the dose reconstructor and not require the dose reconstructor to search for that material

■ Action Items: None at this time

Issue #6B: Reconstruction of Internal Exposures from the Inhalation of Th-232 (Chest Count Data)

- **Description of Issue #6B:** Use of chest counts to reconstruct Th-232 exposures (1968–1988)
- **Status of issue:** White papers exchanged; this issue was discussed in detail at the April 19, 2011, Work Group meeting
 - No DWE data after MIVRML introduced in 1968 – completely dependent on integrity of chest count data thereafter
 - Data Adequacy
 - Reported in milligrams thorium (1968–1978)
 - No Information on calibration
 - No information if measured quantity was gamma emission from Ac-228 or Pb-212 or both
 - Highly variable and uncertain (SC&A Memo to NIOSH; April 6, 2011) (Ac-228, Pb-212 basis)
 - MDL of 6 mg not supported by reference or data (> 84th %)
 - Subgroups readily distinguishable in portion of curve below stated MDA: uncertainty on significance of positive results
 - May be able to bound with high values
 - Reported in nCi Thorium (based on Pb-212) (1979–1988)
 - MDL of 0.25 nCi > 84th percentile: uncertainty on significance of positive results
 - Equilibrium factor (EF) of 0.72 for Pb-212 measurements is a midpoint value based on a closed system (no progeny migrate out of lung)
 - Experimental data indicate EF could be a factor of 10 lower or less

Issue #6B: Reconstruction of Internal Exposures from the Inhalation of Th-232 (Chest Count Data) (continued)

□ Data Completeness

■ NIOSH Position

- Distribution for all workers sufficiently broad that 95th percentile will bound intakes for thorium workers
- 2/9/2011 Work Group meeting – NIOSH believes that chemical workers are a reasonably bounding surrogate for thorium workers

■ SC&A Position

- Need sufficient number of thorium workers to show they are not under-represented
- Require evidence that chemical workers are a reasonable surrogate for thorium workers
- Worst exposures from re-drumming, metal production, and casting, not chemical processing
- Highest results not thorium or former thorium workers (veracity of identification)

■ SC&A Preliminary Analysis presented at 4/19/2011 Work Group meeting (CDF charts)

- Only about 60 thorium workers identified (1968); Th work not clear beyond 1968
- Thorium workers clearly have higher lung burdens than chemical workers (Figure 1)
- Chemical workers indistinguishable from all workers (not bounding) (Figure 2)

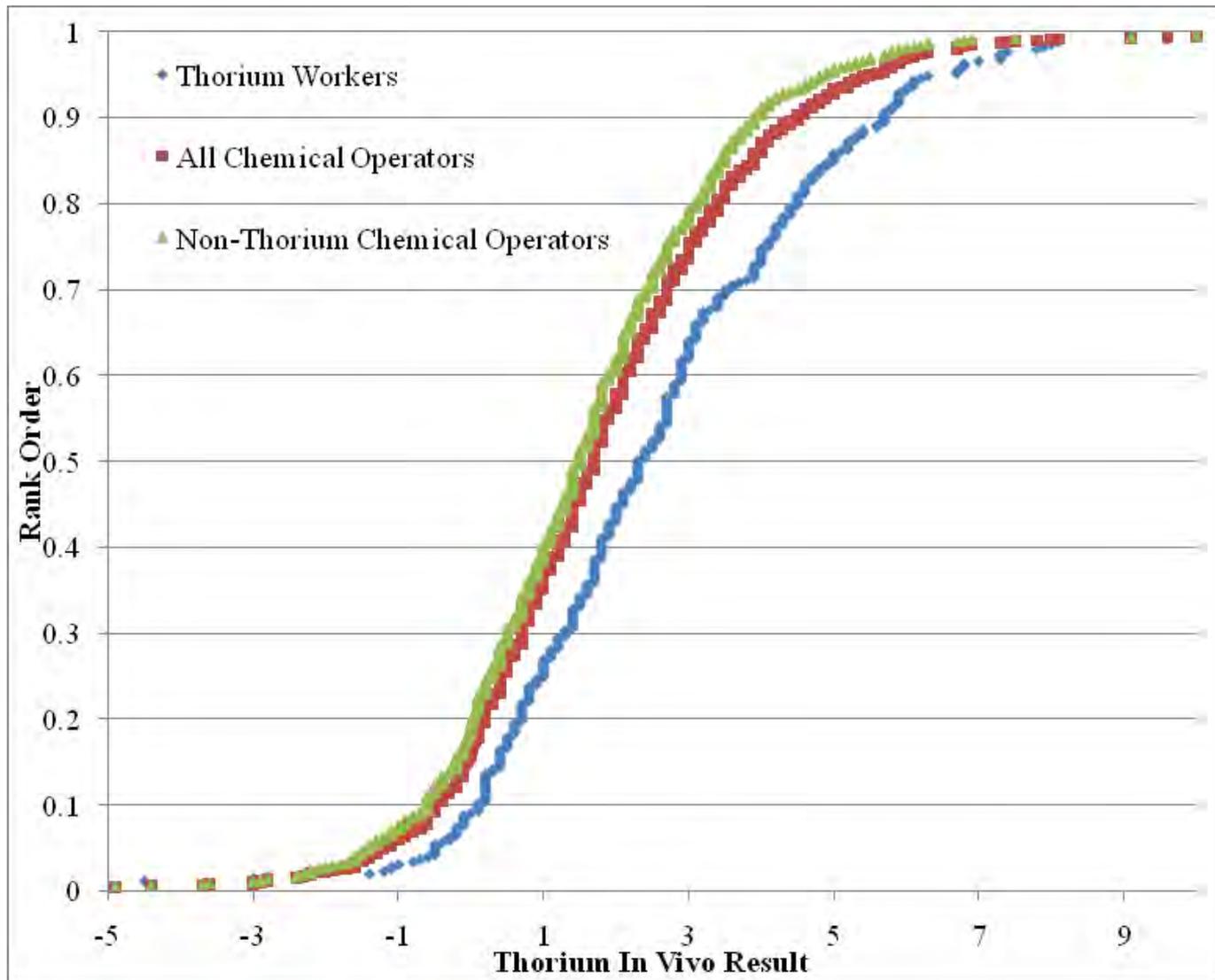


Figure 1. Rank Ordered Comparison of In Vivo Results (mg Th) for Thorium Workers and Chemical Operators

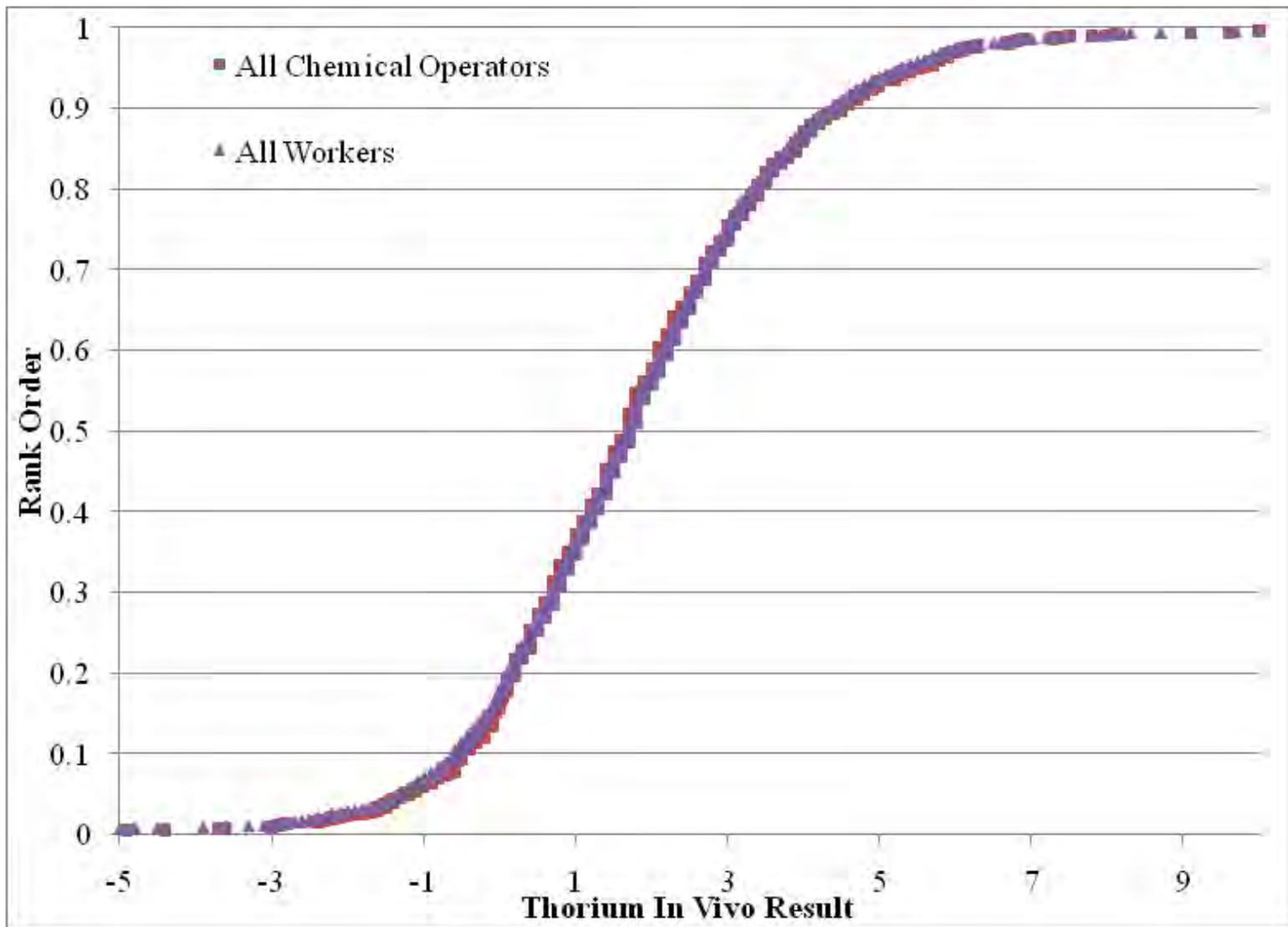


Figure 2. Rank Ordered Comparison of In Vivo Results (mg Th) for Chemical Operators and All Monitored Workers

Issue #6B: Reconstruction of Internal Exposures from the Inhalation of Th-232 (Chest Count Data) (continued)

■ Action items (4/19/2011)

- NIOSH: Post the recently acquired Y-12 MIVRML calibration information for review (about 300 pages)
- SC&A: Prepare a formal white paper on the thorium worker subgroup data completeness issue and deliver to the Advisory Board

Summary

■ Remaining Issues

- Issue #1 (TBD): Coworker model for U – need report on Construction Worker subgroup
- Issue #3 (SEC): Recycled uranium – preliminary observations
 - 1953 –1972: Proposed higher NIOSH defaults appear to be adequate to bound doses for all classes of Fernald workers (process knowledge)
 - 1973–1985: ‘Front-end workers’ intakes from subgroup 10A feed materials (tower ash and decontamination residues) not quantified/estimated
 - Applies to handlers, down-blenders, bystanders
 - Particularly important after receipt of most highly contaminated Paducah tower ash in 1980 (1980–1985)
 - 1986–1989: WMCO HP/IH improvements, monitoring sufficient for dose reconstruction
- Issue 6B (SEC/TBD): Thorium intakes from chest count data
 - High variability in mg thorium data not compatible with biokinetics (1968–1978)
 - Calibration, detection limits questionable – open issue
 - Thorium worker intakes not bounded by coworker model for all workers or chemical workers – open issue