Supplemental M&C Data Sufficiency, Adequacy, and Precedent Discussion

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May 12, 2023

Background

- M&C work group (WG) tasked SC&A (March 3, 2022) to focus on any remaining lines of inquiry or outstanding issues relevant to WG's review of SEC-00236 evaluation report (ER)
- SC&A's issued supplemental review on August 22, 2002. Based on:
  - Record of WG discussions
  - Former worker input
  - Supporting NIOSH and SC&A reports, responses, white papers, and presentations
- **Purpose:** Support M&C WG in its assessment and interpretation of proposed exposure modeling and bounding assumptions
- Three lines of inquiry applied

Line of inquiry 1

Are conditions and work activities associated with the M&C residual period unusual or different such that (a) standard modeling procedures do not apply and (b) exposure potentials higher than those addressed by OTIB-0070 and TBD-6000, and supporting bounding analyses may have resulted?

Line of inquiry 1: Background

- **Concern:** M&C maintenance activities during residual period may have been unique and dissimilar to activities at other Atomic Weapons Employer (AWE) facilities
  - Intrusiveness (excavations, pipe cutting, and cleaning)
  - Work environments (confined spaces)
  - Uncertain or unknown source terms (contaminated pipe sediments/scale, effect of coagulants, potential dilution over time)
- **NIOSH:** "M&C operations were similar to operations at [other AWE sites]" and the "methods proposed for M&C by NIOSH and SC&A are similar and consistent with those previously approved by the Board" (NIOSH, 2020a, slide 12)

SC&A review for line of inquiry 1

- Salient discussion point is the unknowns and uncertainties associated with exposure pathways
  - Regular releases of coagulant oil into drainage system
  - Cutting of pipes containing contaminated scale
  - Maintenance work activities performed in confined spaces (elevated dust loading/resuspension of contamination)
- Unlike decontamination and decommissioning (D&D) workers, M&C maintenance workers were unaware of radiological contamination and were essentially unprotected

Discussion for line of inquiry 1

- Standard exposure model, as founded in OTIB-0070 and TBD-6000, and complemented by six exposure pathway models, may not be sufficiently accurate or appropriate for one or more pathways because:
  - Higher exposure potentials than can be appropriately bounded might have existed
  - Is there sufficient information to rule out the possibility?
- NIOSH response: “incorporated extreme conservatism in its modeling to account for intrusive activities, high exposure conditions, uncertain facility activities, or unknown contamination sources” (NIOSH, 2023, p. 17)
- Work group will need to judge whether this approach is plausible, given:
  - Level of uncertainty involving bounding exposure models
  - Lack of information for direct M&C worker exposures during the residual period

Line of inquiry 2

Are the exposure pathway bounding methods prescribed by the ER and subsequent NIOSH reviews appropriate and consistent with how other AWE sites have been addressed?

SC&A review for line of inquiry 2

- Examined whether:
  - NIOSH bounding approach for exposure pathways for M&C consistent with past practice and precedent for AWE residual periods
  - Dose reconstruction methods for M&C pathways are plausible and sufficiently accurate
- Like other AWEs:
  - Residual uranium and thorium contamination, and many work activities were similar
  - However, nature of some M&C activities likely differed by degree of intrusiveness: Placed workers close to elevated contamination sources in normally inaccessible locations (e.g., subsurface maintenance activities)

Board policy decision on back extrapolating survey data

- Are such bounding formulations sufficiently accurate?
- Is it plausible to back apply them for a 27-year period when actual information about M&C work activities or conditions is lacking?

WG considerations for inside subsurface (line of inquiry 2)

- Each AWE had its own unique operations, equipment, and facility engineering; radiological, chemical, and mechanical processes; drain pipe composition and layout; and effluent handling practices.
- For M&C, regular releases of coagulant oil may have influenced consolidation and concentration of contaminated sediments.
- To unclog drainage pipes, M&C workers cut and cleaned out pipes, with potential exposure to contaminated sediments and internal scale.
- Presence and effect of extensive confined spaces at M&C not reflected in exposure modeling. Leads to increased dust loading and resuspension of contaminant particulates and aerosols.
- Remedial work on drain pipes differed from M&C maintenance and clean out activities: The remedial work removed and disposed of the piping, while maintenance activities would have included cleaning and repairing pipe sections.

Supplemental finding 1, inside subsurface (line of inquiry 2)

- **Finding 1:** The back application of a high 1995 sediment survey result to bound inside subsurface activities is not adequately supported by information for M&C worker activities from the earlier residual time period
- **NIOSH (2023) response:**
  - Disputes the effects of coagulant oil and cutting of pipe containing contaminant scale but does not appear to address the effects of confined spaces
  - Disagrees that there is any difference in how D&D and M&C workers handled pipe cutting
- **SC&A:** WG issue remains the sufficient accuracy of applying pre-D&D data and the plausibility of the inside subsurface bounding model

WG considerations for outside subsurface areas (line of inquiry 2)

- Appropriateness of NIOSH bounding assumption can be judged on whether:
  - Outside maintenance excavations prior to 1984 substantially spread, diluted, or altered the levels/contours of elevated subsurface contamination
  - Is the 95th percentile sufficiently conservative and plausible to back apply these measurements?
- Burial site and Metals Recovery Area:
  - Uranium soil concentrations in excess of 5,000 pCi/g and 17,000 pCi/g, respectively
  - CPS found “presence of contaminants, at nonuniform distributed concentrations, at varying depths” (CPS, 1992, p. 3)
- **Key question:** Can “blended” bounding model accommodate significantly varying uranium concentrations (hot spots) at varying locations and depths?

Conclusions for outside subsurface areas (observation 1, line of inquiry 2)

- **Observation 1:** The use of blended D&D characterization survey data from 1984 and 1992 to support a bounding dose from outside subsurface activities may not be necessarily bounding for work in nonuniform soil contamination, given the presence of hot spots that existed during the residual period at M&C (SC&A, 2022, p. 27).
- **NIOSH response:** 95th percentile distribution is applied as opposed to maximum value for hot spots, given that they are limited exposures and not normally expected condition (NIOSH, 2023, p. 20).
- **SC&A:** SC&A accepts NIOSH's clarification of this issue given the availability of soil measurements.

Line of inquiry 3

Are the available source term, survey data, and other information applied by NIOSH to support its dose bounding methods sufficiently accurate and plausibly applied?

SC&A review for line of inquiry 3

- NIOSH guiding principle for addressing the "uncertainty [or understanding] around the work performed" is that it is "NOT an issue when the bounding doses are very low, and specifically, during AWE residual periods such as at M&C" (NIOSH, 2020a, slide 14).
- Question of deriving bounding dose in absence of monitoring data by applying sufficient conservatism is not without precedent and carries with it the question of plausibility.
- Board Chair noted during Linde review: "carried to an extreme, we could take any site . . . and we could come up with what we think is the highest possible exposure at that site that would occur, and that would be bounding, and apply that to everybody that ever worked at the site." However, "is that a plausible bound? And then, who are we trying to characterize?" (ABRWH, 2011, p. 129).
- NIOSH's position that it has "incorporated extreme conservatism in its modeling to account for intrusive activities, high exposure conditions, uncertain facility activities, or unknown contamination sources" (NIOSH, 2023, p. 17) raises the very question cited by the former Board Chair.

Considerations for confined spaces (line of inquiry 3)

- Not apparent how Mound project data being applied for M&C outdoor dust loading factor addressed increased resuspension or dust loading in a confined space (e.g., various manholes, trenches, pits, and vault spaces at M&C)
- Lack of natural ventilation in a confined space is demonstrable and has a direct impact on resuspension and dust loading
- M&C maintenance workers entered confined spaces to perform various activities:
  - Excavations
  - Operate saws, grinders, and drills
  - Pull, cut, clean out, and repair drain and air lines
- Potential for exposure to fine aerosols and particulates generated from sawing, grinding, drilling, and welding activities

Key question for confined space dust loading assumption

Were the dust loading concentrations within the trenches of the Mound excavation adequately similar that these data can be applied to corresponding confined work spaces at M&C?

Finding 2 on confined spaces (line of inquiry 3)

- Not apparent how Mound project addressed confined space considerations that existed at M&C.
- It appears that Mound project air samplers were positioned near to excavation activities but were not sampling air at (or within) the trenches.
- **Finding 2:** The application of surrogate data from the Mound project to provide a dust-loading factor for M&C subsurface activities does not satisfy the Board's surrogate data policy.
- **NIOSH response:** SC&A seeks clarification on the finding. The response has provided an account of past NIOSH and SC&A exchanges where it is acknowledged that dust loading factors in OTIB-0070 will need to be "uniquely evaluated at each site" and that "one size will not fit all" (NIOSH. 2023, pp. 21–22).
- **SC&A:** Reaffirms its position on Board judgment concerning surrogate data.

Conservatism of 95th percentile (line of inquiry 3)

- **NIOSH original position:** "M&C's area monitoring assures that the 95th percentile soil-contamination value is conservative based on routine surveys of Building 10 during the first 14 years of the residual period (1968-1981)," with obtained surveys for 1968–1969 (NIOSH, 2020b, pp. 7–9).
- Cites contamination survey requirements and procedures from the health and safety manual, NRC inspections during the residual period for the regulated HFIR facility, and "typical" alpha contamination surveys for HFIR.
- **SC&A observation 2:** References to the M&C safety and health manual, NRC inspection results, operator training, and other programmatic considerations do not necessarily substantiate the conservatism of the 95th percentile soil contamination value being applied.
- **NIOSH response:** Is not using the M&C safety manual, NRC inspection results, operator training, and other programmatic considerations to "justify" using the 95th percentile (NIOSH, 2023, p. 23).
- **SC&A comment:** Reaffirms its observation and seeks clarification of how such programmatic considerations assure the conservatism of NIOSH's bounding values.

Overall policy considerations for the WG and Board

- Precedent suggests that while less precision or technical accuracy can be tolerated if the exposure of a worker cohort is relatively low, the use of a high exposure or concentration values based on these data to bound or represent that of other workers in a facility or on a site for long time periods would not be appropriate if:
  - their exposure potential could be higher,
  - conditions were different, or
  - there is lack of information upon which to make those judgments.
- As noted in the Board's deliberations on the Linde residual period, the question of where to draw the line for applying such bounding constructs is a subjective one, weighing the precision (or accuracy) of the bounding assumption and data, as well as the plausibility of their application to the target worker population.

NIOSH response to general conclusions

NIOSH 2023

- NIOSH response cites SC&A's general conclusion but appears to parse it:
  - Cites low exposure precept and attributes it to M&C. NIOSH finds that it has a "more complete data set" for M&C and a better understanding of M&C work processes than it did with Linde
  - Cites application of "high exposure" for bounding purposes and attributes it to Linde. NIOSH finds Linde case does not apply to M&C because potential exposure level is much higher (5,479 mrem/yr CED)

SC&A 2023

- SC&A is not referring to a specific bounding value (i.e., Linde), but rather to site monitoring data not related to actual operations being back applied over a long period of time with a formulation made extremely conservative to (1) compensate for the lack of data, and (2) address the inherent uncertainties and unknowns in the proposed approach
- Original question remains about plausibility: **Where does the Board decide the appropriate application of bounding values?**

SC&A general comments on NIOSH response to supplemental review

- NIOSH response to SC&A supplemental review issued on January 13, 2023
- SC&A issued review of NIOSH response on April 25, 2023
- SC&A general comments:
  - NIOSH response contains the recurring comment that it does not find any “new technical information or technical justifications”
  - NIOSH response notes in several places that NIOSH and SC&A “have done extensive work” on each issue and have “previously agreed” on them
  - **Purpose and intent of the WG’s most recent tasking:** SC&A was to provide a supplemental means to inform final WG deliberations, considering various (and additional) interpretations of the plausibility and sufficient accuracy of proposed exposure models and bounding assumptions

Overarching WG question

Are the data sufficiently accurate, appropriate, and representative of a set of plausible exposure models to support dose reconstruction for M&C workers during the entirety of the residual period (1968–1997)?

Ultimately, this is a work group and Advisory Board judgment.

References

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