M&C Work Group Review of NIOSH Response and SEC Issues under Consideration

Meeting of the Advisory Board on Radiation and Worker Health

December 7, 2023

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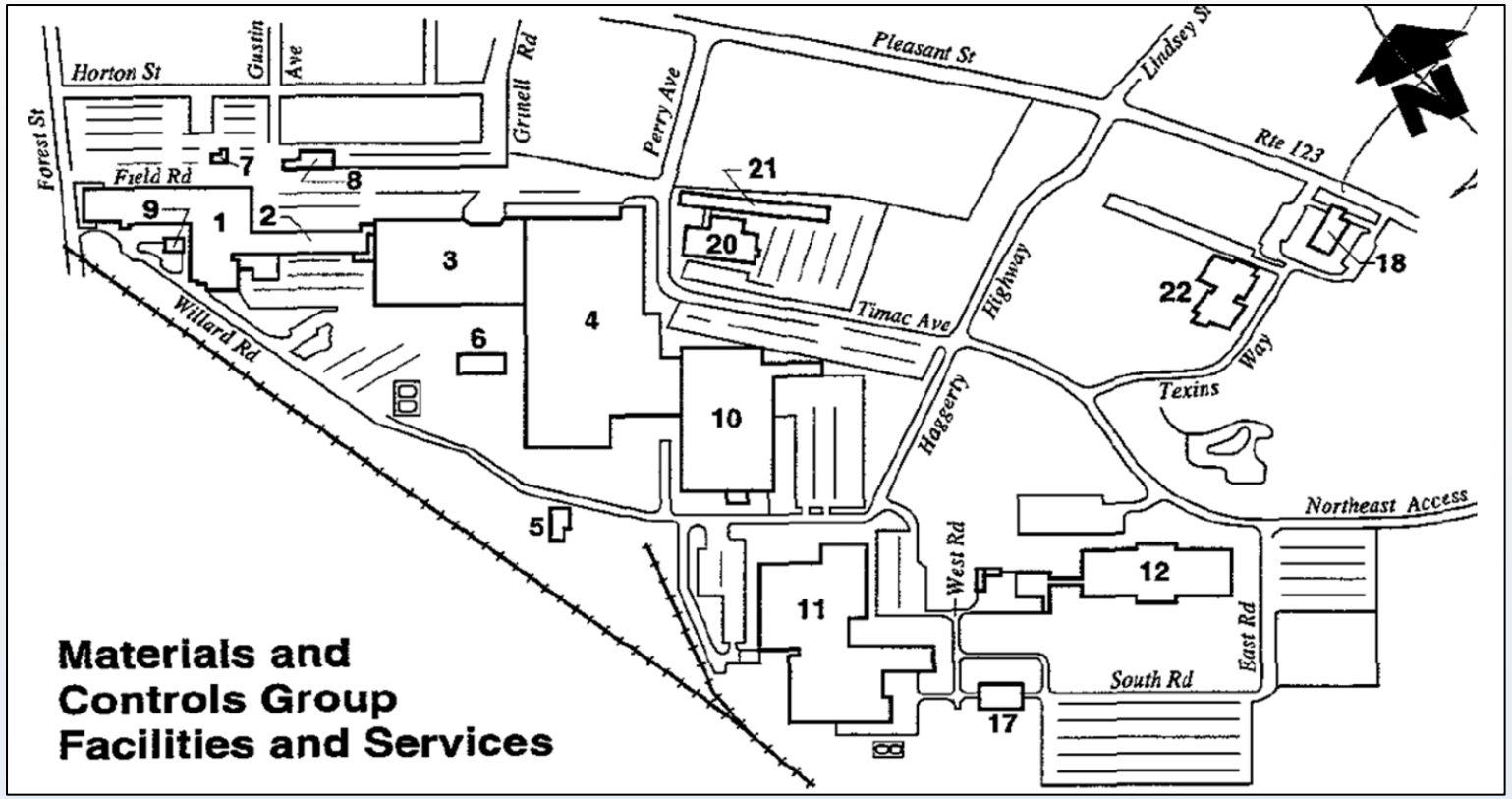
SEC Petition 00236

- Received: Sept 1, 2016
- Petition class evaluated by NIOSH:
  - All atomic weapons employees who worked as facilities construction and maintenance workers, including lubricators/oilers, industrial pipefitters, engineering technicians (mechanical, electrical, structural), maintenance supervisors, electricians, plumbers, millwrights, carpenters, instrumentation technicians, chemical handlers, waste treatment operators, and all production workers, including machine operators/helpers, and repair & maintenance (commonly called R&M) workers, who worked in Buildings 4, 5, 10 interior areas, and Buildings 5, 10, 11, 12, 17 exterior areas at Metals and Controls Corp. in Attleboro, MA, from January 1, 1968, through March 21, 1997.

Site history and background: Overview

- Located on 100 acres in Attleboro, MA
- 30 miles south of Boston
- Covered time periods:
  - Atomic Weapons Employer (AWE) operations from January 1, 1952, through December 31, 1967
  - Residual radiation from January 1, 1968, through March 21, 1997
  - AWE operations period previously added to SEC under petition SEC-00149 (2009) under an 83.14 petition

Site history and background: Site map



Source: Extracted from NIOSH (2017a), slide 8

AWE operations (1952–1967)

Operations during the AWE period included:

- Fabrication of enriched uranium fuel elements and foils for the Navy, Air Force, Government-funded research, and commercial customers
- Processing depleted and natural uranium
- Limited R&D and fabrication of thorium fuel, alloys, and foils for Brookhaven and others
- Production of electrical breakers containing radium

Residual period (1968–1997)

- AWE areas cleaned at end of operations – no covered radiological work after AWE operations period
- Operations during the residual period included:
  - Fuel fabrication for High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory and other Government-owned research reactors
  - HFIR operations exposures not covered under EEOICPA during the residual period
- Formal decontamination and decommissioning (D&D) began in 1981; site characterization surveys in 1984 and 1992–1995; site released for uncontrolled use in 1997 (except Building 1)

Residual period exposure potential

- Maintenance workers supported M&C facilities and had potential exposure to residual contamination from previous AWE operations involving uranium and thorium
- Maintenance workers were unaware of radioactive contamination and operated without radiological controls and health physics oversight

What is status of M&C Work Group review?

- Review commenced in 2017, focusing on NIOSH evaluation report for M&C
  - Original exposure matrix predicated on standard OTIB-0070 and TBD-6000 uranium process models for AWEs
  - NIOSH has since added six bounding models to address worker-identified intrusive activities during residual period
- NIOSH and SC&A reached tacit agreement on bounding models, but Work Group did not concur; in 2021 requested further SC&A review
- SC&A issued "Supplemental Review of M&C Work Group Issues" in August 2022, with NIOSH response in January 2023 and SC&A response in April 2023
- M&C Work Group met on May 12 and July 13, 2023; next meeting will be September 19, 2023
- NIOSH is currently working on a response to SC&A's April 2023 report, including updated table comparing M&C with other AWEs for intrusive activities

How does M&C compare with other AWEs?

- NIOSH finds M&C to be comparable to other AWEs in level of intrusive activity by workers during residual periods.
- SC&A finds M&C to be comparable to facilities with more intrusive activities, e.g., those related to renovation as defined by NRC and found at Linde Ceramics (SEC class designee).
- Why is this important?
  - Standard models from OTIB-0070 and TBD-6000 assume more passive worker activities related to occupancy, like other non-SEC AWEs.
  - To address unknowns and uncertainties with intrusive activities, NIOSH developed six additional bounding models with extremely conservative assumptions.

What were typical intrusive activities and exposure pathways during M&C residual period?

- Drilling, sawing, and jackhammering concrete slab flooring to enable subsurface access
- Subsurface cutting, cleaning out, and repair of frequently clogged drain pipes with radioactive sediments and scale
- Routine maintenance of utility lines, often in pits, trenches, and manholes
- Excavating contaminated soils, including those near or within radioactive waste burial sites
- Maintenance, movement, and replacement of repurposed AWE equipment

What is a plausible bounding dose or method?

- The SEC regulations permit NIOSH to estimate the maximum (or bounding) dose "for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances" (42 CFR 83.13(c)(1)(i)).
- NIOSH must also determine that it has information regarding "monitoring, source, source term, or process from the site" (M&C maintenance workers were not monitored) (42 CFR 83.13(c)(1)(i)).
- "In many circumstances, to establish [dose reconstruction feasibility] under paragraph (c)(1)(i) of this section would require, at a minimum, that NIOSH have access to reliable information on the identity or set of possible identities and maximum quantity of each radionuclide (the radioactive source material) to which members of the class were potentially exposed without adequate protection" (42 CFR 83.13(c)(1)(ii)).
- The Board is responsible for judging whether a proposed bounding scenario is plausible based on the above information, and whether such information is available to NIOSH and can be considered sufficiently accurate under EEOICPA.

What are the Work Group's concerns?

- Is the bounding approach plausible for "Inside Subsurface" work?
  - Pre-D&D survey measurements (1995) of pipe sediments may not reflect exposures during the entire residual period (1968–1997)
  - Additional uncertainties identified bearing on source term and exposure information: contaminated scale and presence of coagulants in drain pipes
  - NIOSH use of "extreme conservatism" to account for M&C's "intrusive activities, high exposure conditions, uncertain facility activities, or unknown contamination sources" (NIOSH, 2023a) results in a high bounding value – but is it plausible?
- Use of surrogate air monitoring data from a Mound excavation project for M&C dust loading does not account for confined space effects

Unresolved source term question: Scale

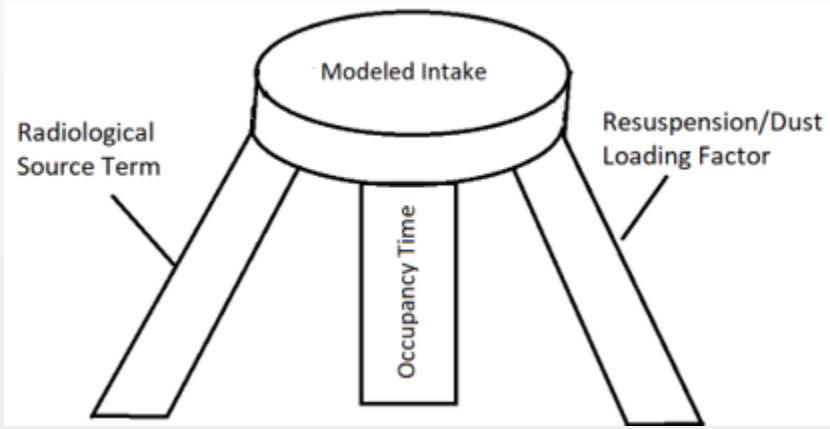
- M&C drainage pipes contained radioactive sediments and scale
- Pre-D&D surveys in 1995 found sediments up to 53,000 pCi/g and scale up to 1,000,000 dpm/cm^2
- DOE in its Bridgeport Brass hazard assessment identified potential of airborne releases when cutting pipes containing scale
- M&C maintenance workers potentially exposed to both sediments and scale when cutting and cleaning out clogged pipes
- NIOSH inside subsurface bounding model only addresses sediments; claims scale at this surveyed level was isolated “hot spot,” not systemic in drainage system at M&C (NIOSH, 2023a)
- NIOSH has not provided evidence that similar or higher levels may not have existed elsewhere in drainage system

Unresolved source term question: Coagulants

- Vegetable-based and/or mineral oils were used in drawing wire in Building 10 at M&C (during operations up to 1981).
  - Had properties of coagulant; workers found it would frequently “plug up the drains” (NIOSH, 2017b)
  - Unknown physical/chemical concentration effects
- Frequent discharge of coagulant may have consolidated and concentrated drain pipe sediments, including existing AWE uranium and thorium.
- Potentially elevated sediment concentration in early years of residual period due to active coagulant discharge has not been addressed.

“Three legs of the stool”: NIOSH’s DR approach

- NIOSH modeled intake for indoor subsurface work is a function of (NIOSH, 2023b):
  - Radiological source term
  - Resuspension factor/dust loading
  - Occupancy time
- Two “legs” remain lacking:
  - **Source term** is uncertain, may be higher
  - **Dust loading** does not reflect confined space effects



Linde Ceramics precedent

- For Linde Ceramics, NIOSH proposed bounding approach that back-applied high D&D airborne activity from jackhammering to renovation period.
- The Board disagreed because of "uncertainty . . . concerning what activities actually took place during renovation and the impact such activities might have had on the resulting dose levels suggests that the dose reconstruction methods may not account for all exposure scenarios during building renovation" (HHS, 2011).
- The Board also noted that D&D activities were conducted with rad controls, whereas no rad control measures were adopted for renovation: "therefore, the Board was not convinced that radiological data from the decontamination efforts . . . were sufficiently informative about exposures in the renovation period" (HHS, 2011).
- The U.S. Department of Health and Human Services (HHS) concluded that "it is not feasible to reconstruct radiation doses with sufficient accuracy for the renovation period" (HHS, 2011).

Linde considerations

- NIOSH finds it has more relevant source term information for M&C than for Linde
- NIOSH notes that maximum annual dose levels for Linde (>5 rem/yr committed effective dose (CED), jackhammering) were much higher than those modeled for M&C (71 mrem/yr CED, sediments) (NIOSH, 2023a)
- Two relevant remarks by the Board Chair at the time:
  - “If the absolute value of the exposure is relatively low, then we’re willing to accept more variability in the dose if it’s being calculated for an individual” (ABRWH, 2013).
  - “We may have a bounding dose, but is it a plausible bounding dose, given how little information we have and the fact that most of these people probably weren’t engaged in the activity that we have done the dose reconstruction for?” (ABRWH, 2011).

Interpretations of Linde lessons

- SC&A:
  - “The use of a high exposure or concentration values based on these [D&D] 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 if there is lack of information upon which to make those judgments” (SC&A, 2022).
- NIOSH:
  - Disagrees. Notes that M&C dose estimates are relatively low, and NIOSH has “a more complete data set to characterize M&C and a better understanding of M&C maintenance work than we had with Linde” (NIOSH, 2023a).

Summary concerns for inside subsurface bounding model

- Intrusive work activities by maintenance workers at M&C during the residual period led to potential exposures for which there are no available monitoring data.
- NIOSH applies 1995 D&D survey data as basis for an upper bound for residual period exposure. For radiological data from one time period to be considered informative about exposures during another time period, there should be sufficient similarity of conditions and processes between the two periods.
- Although NIOSH has proposed a claimant-favorable “inside subsurface” bounding concentration (6,887 pCi/g), there remains uncertainty about source terms and exposure pathways during the residual period, 1968–1997.
- There is insufficient information available to account for the exposure contribution of confined spaces, pipe scale releases, and released coagulants in a workplace not controlled as a radiation environment, unlike that of the later D&D era at M&C from which NIOSH draws its data.
- The application of “extreme conservatism” in formulating the proposed upper bound concentration to account for “intrusive activities, high exposure conditions, uncertain facility activities, or unknown contamination sources” may not be a plausible approach to compensate for inadequate or insufficient information.

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