

# Basis for SEC Consideration for M&C

Meeting of the Advisory Board on Radiation and Worker  
Health

April 17, 2024

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# Chronology

- **September 1, 2016:** SEC-00236 Petition submitted for Metals and Controls Corporation (M&C) residual period.
- **April 5, 2017:** NIOSH evaluation report (ER) completed.
- **August 24, 2017:** SC&A review tasked by Board. ER review issued by SC&A in February 2018.
  - Subsequent reviews included NIOSH exposure pathway models and airborne dust loading. Tacit agreement reached on models, but Work Group did not concur.
- **March 3, 2022:** M&C Work Group tasked SC&A to focus on any remaining lines of inquiry or outstanding issues relevant to Work Group's review of SEC-00236 evaluation report.
- **August 22, 2022:** SC&A issued supplemental review (SC&A, 2022) with two findings:
  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 period.
  2. The application of surrogate data from the Mound project to provide a dust-loading factor for M&C activities does not satisfy the Board's surrogate data policy.
- **January–December 2023:** NIOSH and SC&A exchanged a series of issue papers and responses, with M&C Work Group meetings held May, July, and December 2023.
- **December 6, 2023:** Work Group referred M&C to full Board for SEC consideration.

# Work Group review: SC&A Finding 1

For Finding 1 of SC&A's supplemental review (SC&A, 2022), the Work Group concurs with SC&A's conclusions from its 2024 memo (SC&A, 2024) that:

“plausible circumstances exist for radiation exposures different from and potentially in excess of those addressed by NIOSH's Inside Subsurface bounding values for M&C maintenance workers”

# Work Group review: SC&A Finding 2

- For Finding 2 of SC&A's supplemental review (SC&A, 2022), the Work Group concurs with the SC&A and NIOSH agreement that the surrogate data concern regarding M&C dust loading factor is a site profile issue, i.e., not bearing on dose reconstruction with sufficient accuracy.
- NIOSH committed to review “recent suggestions to upgrade its dust loading models, including enhancement factors and confined spaces, and will consider incorporating methods suggested by SC&A in their supplemental review” (NIOSH, 2023a).

# Work Group review of exposure models

- Given worker interviews indicated intrusive activities during the residual period, NIOSH developed six exposure models to bound potential dose: (1) inside subsurface, (2) outside subsurface, (3) roof and overhead, (4) welding operations, (5) HVAC maintenance, and (6) remaining exposures.
- SC&A recommended alterations to one model, to which NIOSH agreed. With suggested modifications, SC&A found internal and external doses from each maintenance exposure pathway can be bounded (SC&A, 2021). Tacit agreement between NIOSH and SC&A was reached.
- However, the Work Group did not concur. Supplemental review was requested in 2022, and additional potential exposure pathways and conditions were identified that the Inside Subsurface model needed to address.

# Additional exposure pathways and conditions

- **Contaminated scale:** M&C maintenance workers were potentially exposed to contaminated aerosols and particulates during mechanized cutting and cleanout of drain pipes containing internal surface contamination.
- **Presence of coagulants:** The concentration of contaminated scale and sediments may have been elevated due to the effects of regular releases of a coagulant oil into the Building 10 drain pipe system during operations in the early M&C residual period.
- **Internally contaminated AWE-era machinery and equipment:** Repurposed M&C machinery and equipment likely contained radiological contamination inside and under the units, potentially exposing maintenance workers during routine maintenance and relocation that occurred during the residual period.

**While the Work Group considers them plausible, these exposure pathways and conditions have not been adequately addressed by NIOSH in its bounding model.**

# Unaddressed M&C exposure pathway: Release of contaminated scale

- NIOSH identifies contaminated sediment and scale as source terms but only bounds sediment in its Inside Subsurface model.
- Accumulation of contaminated scale on inside of piping is confirmed, with one survey of interior surface contamination up to 1,000,000 dpm/100 cm<sup>2</sup> for a 4-inch vitreous clay mainline drain being cut and removed.
- During M&C residual period, drain pipes were frequently cut, repaired, replaced, and cleaned out, using power tools such as saws, drills, grinders, and powered snakes as well as cutting torches.
- As noted by DOE in its hazard assessment of Bridgeport Brass AWE, “the residual uranium could eventually be released . . . through intrusive work activities such as pipe cutting and removal,” and that “it is possible that under certain conditions (such as cutting through a steel pipe with a cutting torch) surface activity attached to the steel could be released with the steel particles” (DOE, 1996).
- Such pipe cutting may have released particulates and fine aerosols that would have been concentrated by the confined space (trenches, pits) atmospheres where such work was performed.

# Aerosolization of contaminated scale: SC&A response to NIOSH counterpoints

- M&C workers used a wide array of powered tools; these mechanized tools would have volatilized and suspended fine particles and fumes. The torch-cutting example from Bridgeport Brass AWE was highlighted by SC&A to substantiate the exposure pathway involved with cutting pipes with in-pipe scale.
- Use of Bridgeport Brass parameters to compare and model M&C exposure is problematic: M&C had different or uncertain conditions, processes, source terms, and surface contamination thickness.
- NIOSH's conclusion on scale only being associated with cast iron pipes is not corroborated: 1,000,000 dpm/100 cm<sup>2</sup> in-pipe surface contamination was found in vitreous clay mainline pipe.
- **NIOSH lacks sufficient and representative survey data for in-pipe contaminant scale (or interior pipe surface contamination) to provide an adequate basis for an upper bound source term.**

# Survey data inadequate to be representative of contaminated scale in M&C drain pipes

NIOSH data	SC&A response
<p><b>Two</b> measurements: Caged Area (Areas 1 and 4) – typically less than 3,000 dpm/100 cm<sup>2</sup> (NIOSH, 2023a)</p>	<p>Survey data from “near-surface recirculation piping,” <i>not</i> drain pipes (Weston, 1996)</p>
<p><b>Two</b> measurements: Locations 4 and 5, supporting assay laboratories – concentration of 500 pCi/g total uranium (NIOSH, 2023a)</p>	<p>Specific to only one Building 10 activity</p>
<p><b>Two</b> measurements: Areas 3 and 4 – total uranium concentration of 1,864 pCi/g (NIOSH, 2023a)</p>	<p>Represents total loose pipe sediment and debris, <i>not</i> just scale</p>
<p>Reliance on “beta scintillator data” to represent scale activity (NIOSH, 2023a)</p>	<p>Beta scintillator used to identify, <i>not</i> quantify, scale activity; Weston emphasized limitations of any direct measurements given pipe surface irregularities, geometry, blockages and liquids</p>
<p>Reliance on Weston (1996) method for hypothetical dose and exposure rate (NIOSH, 2023a)</p>	<p>May not be sufficiently accurate for bounding source term for scale</p>

# Work Group conclusion for scale

- Referenced survey sampling data are very few in number (6), most are not applicable (4), and, overall, not sufficiently representative of drain pipes at M&C to establish even a “biased high” value (NIOSH, 2023b).
- Reliance on direct measurements (beta scans) or hypothetical exposure models as backup methods is not sufficient and reliable.
- NIOSH has not demonstrated that the as-high-as 1,000,000 dpm/100 cm<sup>2</sup> value is bounding for in-pipe surface contamination or scale value at M&C during the entirety of the residual period prior to 1995.

# Unaddressed M&C exposure condition: Presence of coagulants

- A vegetable-based mineral oil that was used in Building 10 for drawing wire reportedly had the properties of a coagulant. Upon discharge to the drainage system, M&C workers found it would frequently “plug up the drains” (NIOSH, 2017a).
- The discharged oil may have consolidated and concentrated drainpipe sediments and scale, including existing AWE uranium and thorium.
- **Question:** During active Building 10 operations (through 1981), would regular releases of coagulants have led to more frequent and substantial blockages, involving elevated uranium and thorium, as a function of the consolidation properties of the coagulant oil on sediments and scale?

# Presence of coagulants: NIOSH response and Work Group conclusion

- **NIOSH** determined it can bound exposures associated with unclogging pipes while accounting for the effects of nonradioactive coagulant on the drain line source term.
- **Work Group disagrees:** NIOSH has not provided any supporting information to characterize potential effects of coagulant oil on sediment and scale source term in the early residual timeframe of Building 10 drain pipe discharge.
- **What is clear:** During M&C residual period, drain pipes contained both in-solution suspended sediments and fixed sediment contamination of varying degrees, for which regular introduction of oil-based coagulant was known by M&C workers to cause the blockage of drain pipes, requiring cleanout.
- **Work Group concludes** that presence of coagulant oils within the M&C drainage system may have led to increased concentrations of uranium- and thorium-contaminated sediments and scale for which a maximum dose estimate may not be feasible.

# Unaddressed M&C exposure pathway: Internally contaminated AWE-era machinery and equipment

- Involves “repurposing M&C equipment (e.g., removing and replacing mill units)”; NIOSH found it not addressed by ER resuspension models based on OTIB-0070 (NIOSH, 2017b).
- Issue is the presence of residual contamination underneath and in interior of AWE-era (pre-1968) M&C machinery and equipment repurposed for later use during the residual period. Significance of this particular exposure source was highlighted during Linde SEC deliberation (ABRWH, 2011).
- Routine maintenance on machinery and equipment cited by former M&C workers; also, regular relocation of equipment in Building 10 (NIOSH, 2017c; NIOSH, 2017d; NIOSH, 2017e).
- NIOSH position is that decontamination and decommissioning (D&D) of site in 1955–1968 would have removed any remaining contamination.
- Work group disagrees that D&D would have removed contamination within and under machinery and equipment. Repurposing would have led to potential exposure of M&C maintenance workers employing intrusive measures to clean and move these items during the residual period. Represents unaddressed, plausible exposure pathway.

# Work Group summary of NIOSH basis for sufficient accuracy of dose reconstruction for M&C

## General

- Finds intrusive activity comparable to other AWEs and back applies available survey data to cover residual period. Observes that Board has accepted this approach for other AWEs in the past (NIOSH, 2023b).
- Extreme conservatism applied to address unknowns and uncertainties. Interpreted to mean “appropriate” for bounding scenario, not as cited by SC&A from earlier NIOSH definition and scope of application (NIOSH, 2023b).

## Specific

- Survey measurements for scale not intended to be representative but meant to be biased high to identify maximum concentrations, not range (NIOSH, 2023b).
- Oil-based “coagulant” cited as “green lube” by NIOSH; finds no evidence of coagulant effects described by SC&A (NIOSH, 2023b).

# Work Group concerns with NIOSH basis: General

- NIOSH itself acknowledged the pronounced level of intrusive activities by M&C maintenance workers based on 2017 worker interviews; led to addition of six bounding models to address identified exposure pathways.
- M&C maintenance activities were unique in terms of their level of intrusiveness (excavations, pipe cleaning, pipe cutting), work environments (confined spaces), and uncertain or unknown source terms (contaminated pipe sediments and scale, presence of coagulants, repurposed equipment).
- Work Group finds that unknowns and uncertainties exist regarding pre-1995 residual period source terms and exposure circumstances for which sufficient and reliable information is lacking to support NIOSH's Inside Subsurface bounding approach; "extreme conservatism" should not compensate for lack of this information.

# Work Group concerns with NIOSH basis: Specific

- NIOSH has not demonstrated that the as-high-as 1,000,000 dpm/100 cm<sup>2</sup> value is bounding for contaminated scale at M&C during the residual period. Survey data are few in number, and most are not applicable and, overall, not sufficiently representative of drain pipes at M&C to establish even a “biased high” value.
- NIOSH acknowledges worker-described “coagulant” discharges to Building 10 drain lines but disputes that these would have had any impact on consolidation or concentration of sediments and scale. NIOSH has not addressed potential impact to uranium and thorium source terms of potential physical and chemical interactions of a potential coagulant known to “plug up the drains” (NIOSH, 2017a).
- NIOSH has not addressed the identified exposure pathway for internally contaminated, repurposed pre-AWE era machinery and equipment, and whether potential worker exposures can be bounded.

# SEC threshold issues for M&C residual period

1. What potential exposure pathways may have existed and whether they represent “plausible circumstances” under 42 CFR Part 83
2. Whether available information for those exposures is sufficient and reliable to support a maximum dose estimate

# M&C potential exposure pathways: Work Group findings

- **Residual contamination (without intrusive activities):**
  - ***Plausible:*** adequate information, dose reconstruction via ORAUT-OTIB-0070 and Battelle-TBD-6000
- **Intrusive worker maintenance activities (outside subsurface, roof and overhead, welding operations, HVAC maintenance, and remaining exposures):**
  - ***Plausible:*** adequate information, maximum dose estimate feasible with bounding scenarios
- **Intrusive worker maintenance activities (*inside subsurface:* contaminated sediment and scale in cleanout of drain pipes, compounded by potential coagulant effects; and internally contaminated machinery):**
  - ***Plausible:*** BUT *inadequate information, so maximum dose estimate may not be feasible*

# “Plausible circumstances”

*“Radiation doses can be estimated with sufficient accuracy if NIOSH has established that it has access to sufficient information to estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class.” [42 CFR 83.13(c)(1)(i)]*

The Work Group concludes that NIOSH does not have sufficient information to estimate the maximum dose for the following plausible exposure pathways at M&C:

- Cutting and cleaning of drain pipes containing contaminated scale (i.e., in-pipe surface contamination) – too few applicable survey measurements for bounding purposes
- Maintenance and movement of internally contaminated pre-AWE era repurposed machinery and equipment – identified but not addressed
- Potential for increased source term values for sediment and scale in early residual period due to the effects of reported regular discharge of coagulant oils to drain pipes

# “Similarity of conditions and processes”

*“NIOSH must also determine that it has information regarding monitoring, source, source term, or process from the site where the employees worked to serve as the basis for a dose reconstruction.” [42 CFR 83.13(c)(1)(i)]*

*“In order for radiological data from one time period to be considered informative about exposures during another time period, there should be some similarity of conditions and processes between the two periods.” [HHS, 2011]*

The Work Group concludes that the proposed Inside Subsurface bounding scenario, based on 1995 pre-D&D survey measurements, may not account for all exposure scenarios and conditions during the entirety of the 27-year prior residual period. This uncertainty, coupled with a lack of sufficient and reliable information regarding these earlier exposure pathways, makes the back-application of 1995 information insufficiently accurate for this purpose.

# Work Group recommendation

That SEC status be accorded to:

All atomic weapons employees who worked at Metals and Controls Corp. in Attleboro, Massachusetts, during the period from January 1, 1968, through September 21, 1995

- The proposed end date marked the completion of the pre-D&D radiological survey of the M&C drain pipe system

# Questions?

# References (1 of 3)

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Weston [Roy F. Weston, Inc.]. (1996). *Texas Instruments Incorporated Attleboro Facility: Building interiors remediation drainage system characterization*. SRDB Ref. ID 165965, PDF pp. 6–31.