# SC&A Status Report for the Metals and Controls Corporation SEC Petition Evaluation of Petition 236

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# Metals and Controls Corporation

- Located in Attleboro, MA
  - Approximately 30 miles south of Boston
- Covered time periods:
  - AWE Operations:

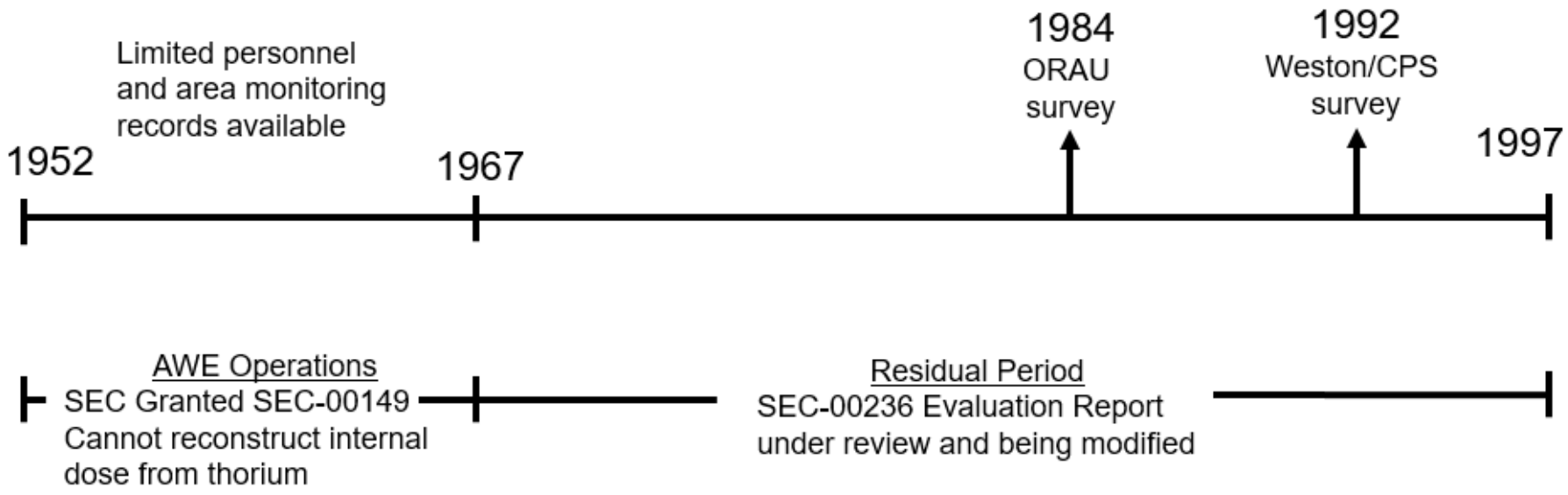
    January 1, 1952–December 31, 1967

    SEC Granted under Petition SEC-00149
  - Residual Period:

    January 1, 1968–March 21, 1997

    SEC Petition 236 currently under evaluation

# M&C Timeline of Key Activities and Events



# Scope of Petition 236

- **Who:** All facilities construction and maintenance workers
- **Work Location:** Metals and Controls Corp. (M&C) in Attleboro, MA, in:
  - Buildings 4, 5, 10 interior areas
  - Buildings 5, 10, 11, 12, 17 exterior areas
- **Time Period:** January 1, 1968, through March 21, 1997 (i.e., the residual period)

# Historical Overview

- April 5, 2017 – SEC Petition Evaluation Report (Petition 236) Issued
- August 24, 2017 – NIOSH/DCAS Presents to Advisory Board
  - Petitioner raises concerns that all not all exposure pathways addressed
  - Board tasks SC&A review
- October 24–26, 2017 – Interviews conducted with petitioners and former employees
- February 12, 2018 – SC&A issues review of SEC Petition
  - Identifies 3 Findings and 5 Observations
  - Includes recommendations for pathways not previously addressed:
    - HVAC Maintenance
    - Subsurface Maintenance in Building 10
    - Burial Area Subsurface exposures
- February 22, 2018 – NIOSH/DCAS memo on SC&A review

# Historical Overview

- April 23, 2018 – NIOSH/ORAUT issues white paper on subsurface exposure models
- May 3, 2018 – Work Group on M&C meets
  - Discusses SC&A review
  - Petitioner raises additional concerns
- September 12, 2018 – Matrix issued
  - Incorporated feedback from SC&A, Work Group Members, NIOSH/ORAUT, and Petitioners
    - 3 SC&A Findings
    - 5 SC&A Observations
    - 10 Petitioner-raised Issues
- September 17, 2018 – SC&A issues white paper response to April 23 NIOSH/ORAUT Subsurface Model
- October 18, 2018 – NIOSH/DCAS memo response to Sept. 17 white paper

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# Historical Overview

- October 24, 2018 – NIOSH/ORAUT issues maintenance exposure model white paper
  - Adds roof/overhead exposure pathway
- November 20, 2018 – Work Group on M&C meets
  - Discusses current NIOSH/ORAUT pathways
  - Preliminary SC&A feedback on models
  - Petitioner raises additional concerns
- November 29, 2018 – SC&A issues response to maintenance exposure model white paper

# Issues Associated with the Specific Approach Used in the ER

- **Observation 1:** SC&A suggests that a more appropriate approach to deriving the chronic airborne concentration of uranium and thorium from resuspension during the residual period would be to use the mean value of the swipe data (i.e., 12.3 dpm/100 $cm^2$, as opposed to the 95th percentile value of 54.8 dpm/100 $cm^2$) and an RF of 1E-5/m, as opposed to 1-E6/m.
- **Observation 2:** The distinction between production and non-production workers should be better defined in the ER.
- **Observation 3:** NIOSH should consider adopting the approach used in the TBD and ER for Carborundum and General Steel Industries for deriving ingestion doses during the residual period.

# Issues Not Explicitly Addressed in the ER

**Finding 1:** Based on interviews with workers held October 24–October 26, 2017, SC&A found that many unique maintenance and repurposing activities were performed during the residual period by many workers who were not aware of any residual radioactivity. These activities could have resulted in external exposures that are not addressed in the ER, including:

1. Recurring subsurface maintenance and repurposing activities in contaminated soil, conduits, and pipelines beneath Building 10
2. Outdoor activities in the vicinity of the low-level radioactive waste burial grounds

# Issues Associated with the Specific Approach Used in the ER

- **Finding 2:** NIOSH incorrectly transcribed some of the Landauer film badge dosimetry reports and incorrectly calculated annual 95th percentile external penetrating doses to workers in the residual period.
- **Finding 3:** NIOSH incorrectly calculated annual 95th percentile beta skin doses to workers in the residual period.
- **Observation 4:** Exposures experienced by High Flux Isotope Reactor workers cannot be used "as supporting evidence to validate the bounding method used in Section 7 of this report" as stated on page 24 of the ER.
- **Observation 5:** SC&A is concerned that it may be inappropriate to use external dosimetry data collected during the last year of AWE operations as the basis for bounding the external doses during the residual period.

# Summarized Petitioner Comments

1. Concerns that the operational period monitoring data are not applicable because to those workers had knowledge of contamination and safety procedures while M&C workers did not
2. 1982 surveys limited in scope and may have missed contamination
3. 1992 surveys limited to burial area
4. Concerns regarding the 1-month duration assumption
5. 1995 drainage system survey only looked at uranium, not thorium
6. Concerns regarding bounding thorium inside drains
7. 1985 surveys limited in scope
8. Concerns that the HVAC model does not allow for residue from operations that may have been in ducts
9. Roof penetrations should have undepleted source term
10. 1982 surveys only covered accessible areas

# Objectives of Work Group

**Primary Objectives – Address Potential SEC Issues**

- Do we have sufficient data and understanding of M&C worker activities to reconstruct doses during the residual period?
- Do we have consensus on what are and are not SEC issues?

**Secondary Objectives – Address Site Profile Issues**

- Can we achieve consensus on scientifically sound and claimant-favorable assumptions regarding scenarios, pathways of exposure, data, models, and parameters?

# Exposure Pathways

## Indoor

**Locations:** Buildings 4, 5, 10 (predominately Building 10)

**Pathways:**

1. Above Ground – Full Time
2. Maintenance and Repurposing

## Outdoor

**Locations:** Buildings 5, 10, 11, 12, 17 exterior areas

**Pathways:**

1. Above Ground – Perhaps Full Time
2. Maintenance and Repurposing

# Major Scenarios

- Building 10 HVAC maintenance
- Building 10 roof and overhead
- Subsurface inside Building 10
- Subsurface areas outside Building 10

# Building 10 HVAC Maintenance

**Internal dose from HVAC filter replacement in Building 10**

- NIOSH has fully adopted SC&A's suggested approach to this exposure scenario as described in SC&A's 2/12/2018 report.
- This scenario was discussed at the 11/20/2018 Work Group meeting. There appeared to be general consensus that the approach makes use of sufficient data representing the time period of interest and that the models and assumption are scientifically sound and claimant favorable.
- The limiting dose is 1.77 mrem/hr effective dose commitment to the extra-thoracic airways (the limiting exposure pathway).

# Building 10 Roof and Overhead

**Internal dose from periodic maintenance work performed by M&C workers in the rafters and upper levels of Building 10 during the residual period**

**NIOSH Analysis**

- Hundreds of alpha, beta, and gamma surveys, including wipe surveys of the upper levels of Building 10 and also the roof in the early 1980s
- NIOSH reconstructed the doses to these workers using these assumptions:
  - Upper 95th percentile of the survey data – 8.99 dpm/100 $cm^2$
  - 10% of the measured contamination levels was removable
  - A resuspension factor of 1E-4/m
  - Occupancy time of 1 month per year (173 hours or 22 work days per year)

**SC&A Analysis**

- SC&A estimated contamination levels on surfaces ~ 20% higher
- We concur with all other NIOSH assumptions
- We derive an annual effective dose commitment of about 0.01 mrem/yr

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# Subsurface Building 10 – Internal Exposures

Internal dose to M&C workers involved in periodic subsurface maintenance and repurposing activities in Building 10 during the residual period.

**INTERNAL EXPOSURES**

| Parameter | SC&A 2018 | 10/24/2018 White Paper |
|---|---|---|
| **Contamination level** | 5,878.1 pCi/g | 6,887.84 pCi/g |
| **Dust loading** | 200 µg/$m^3$ | 220 µg/$m^3$ |
| **Breathing rate** | 2.5 $m^3$/hr | 1.2 $m^3$/hr |
| **Exposure duration** | 184 hr/yr | 173 hr/yr |
| **U Inhalation rate** | 20 Bq/yr | Not provided |
| **Dose** | 15.6 mrem/yr effective dose commitment | Not provided |

# Subsurface Building 10 – External Exposures

**NIOSH**

Used film badge data from the end of the AWE period as the underpinning of the methods used to reconstruct external exposures to M&C workers during the residual period.

**SC&A**

Had reservations on this strategy

- Modeled same worker is exposed to the high-end concentrations of radionuclides in the subsurface environment for all subsurface-related activities in Building 10 (1 month per year )
- External dose conversion factors associated with an effective infinite slab of contaminated soil (e.g., FGR No 12)
- Using these assumption, SC&A obtains effective dose commitment of 12.75 mrem/yr and skin dose of 32.5 mrem/yr
- Comparable doses to NIOSH model

# Subsurface Building 10 – External Exposures

SC&A direct contamination of skin for downhole workers (new exposure pathway in November 29, 2018, white paper response)

- Soil contamination level 5,878.1 pCi/g uranium
- Soil residue on skin of 10 mg/cm$^2$
- DCF of 40 mrem/hr per dpm/cm$^2$ for uranium with short-lived progeny
- 0.67 mrem/hr skin dose

# Substitute Data Considerations for Building 10 Analyses

A number of important points can be made for using the 1990 data:

- Use of 95th percentile data
- High chronic dust loading (220 µg/$m^3$), especially for moist soil
- Same person involved in all subsurface maintenance and repurposing activities
- Notwithstanding these bounding assumptions, the doses are extremely small
- Actual bioassay data collected in the 1990s reveal internal exposures that are well below the modeled doses

# Outside Areas: Internal Exposures

## NIOSH

- Considerable surface and subsurface data were collected in many outdoor areas in 1984 by the NRC and again in the early 1990s
  - 2,391 soil samples were collected prior to remediation
  - 1,629 samples were analyzed for gross alpha
  - 762 samples were collected for uranium and thorium and analyzed using isotopic identification
- 95th percentile gross alpha and uranium concentration of 117.86 pCi/g
- 95th percentile gross alpha and thorium concentration of 87.5 pCi/g
- Occupancy 1 month per year by the same person
- Dust loading of 220 $\mu g/m^3$

# Outside Areas: Internal Exposures

**SC&A Above-ground Exposures –** Use similar assumptions

- **For above-ground internal exposures:** SC&A suggests assuming average soil contamination, 2,000 hours/yr exposure duration and a chronic dust loading of about 200 micrograms/$m^3$.
- **For subsurface exposures:** SC&A suggests that NIOSH derive the upper 95th percentile of the radionuclide concentrations observed in subsurface samples, along with an exposure duration of perhaps 200 hours per year and a dust loading of about 200 µg/$m^3$ as the basis for estimating internal doses associated with outdoor subsurface work.
- Using 95th percentile of all outdoor data, 200 µg/$m^3$, and 2,000 hours/yr, SC&A derives an effective dose commitment of 4.556 mrem/yr.

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# SC&A Conclusions

Doses to M&C workers during the residual period can be reconstructed in a scientifically sound and claimant-favorable manner by using upper end values of the contamination levels measured during the 1980s and 1990s, along with appropriately conservative assumptions regarding airborne dust loadings and exposure durations.

# Additional Petitioner Comments Raised During November 20 Work Group Meeting

1. More explicit consideration of thorium exposures
2. Explicit consideration of internal exposures associated with welding operations