

# **Nuclear Metals, Inc.**

## **Special Exposure Cohort Petition**

### **Evaluation Report Addendum**

**Dr. Samuel Glover**  
**NIOSH**  
**Division of Compensation Analysis and Support**

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**Augusta, GA**

# Site Overview

- Emerged from Massachusetts Institute of Technology's (MIT) special metallurgical operations for the Manhattan Engineer District (later merged into Hood Building on MIT campus)
- Assumed operations control at Hood Building as private company (transferred operations in 1958 to Concord, MA)
- Provided Atomic Energy Commission fabrication capabilities and metallurgical consulting services (uranium, thorium, many alloys of these elements)
- Started large-scale depleted uranium (DU) munitions for U.S. military
- Covered period – AWE facility October 29, 1958-1990; Residual period from 1991-March 1, 2011

# Petition Overview

- Petition received October 20, 2011 (83.13)
- Petitioner-proposed class definition

All employees who worked in Buildings A, B, C, D, E, the Butler Building, external storage containers, and outside areas immediate to plant grounds at the Nuclear Metals, Inc. facility in West Concord, Massachusetts, during the period from January 1, 1970 through December 31, 1983

# Petition Overview - continued

**NIOSH**  
proposed class  
addition of all  
workers at  
covered  
facility  
Oct. 29, 1958  
through  
Dec. 31, 1979

Based on  
inability to  
reconstruct  
internal dose  
for Thorium  
and enriched  
Uranium

Board agreed,  
recommended  
class addition.  
Class added  
on Jan. 6,  
2013

NIOSH  
reserved  
1980 - 1983  
time period  
to review  
several  
thousand air  
monitoring  
and bioassay  
records from  
that time  
period

NIOSH  
reviewed  
Jan. 1, 1980  
through  
Dec. 31, 1990  
time period

# Sources of Available Information

- ORAU Team Site Profiles and Technical Information Bulletins (TIBs) and Procedures
- NIOSH Site Research Database
- Existing claimant files
- Information from petitioner which included 9 affidavits with 23 supporting documents
- Worker interviews (21) as well as information from claimant telephone interview files (CATIs)
- ATL/ORAUT/NIOSH conducted three outreach meetings in Concord attended by approximately 50 former workers and company management (some of whom were present from the beginning (at MIT))

# Data Capture Efforts

- Standard database searches
- Internet
- Department of Energy (DOE) locations –
  - Office of Scientific and Technical Information, Hanford, DOE Germantown, Legacy Management, Grand Junction, Morgantown, Sandia, Savannah River, Health and Safety Laboratory-Environmental Measurements Laboratory (HASL-EML)
- Hagley Museum & Library
- Nuclear Regulatory Commission (NRC)
- Documents from U.S. Environmental Protection Agency, Massachusetts Department of Environmental Protection

# Status of Claims

(as of March 27, 2014)

Total submitted

26

Claims for those who worked during proposed  
SEC time period

19

Dose reconstruction  
at Department of Labor (DOL)

18

With dosimetry records

External 19 / Internal 19

# Background

Operated at the Hood Building (DOE) near MIT until October 28, 1958

NMI at Concord, MA (evaluated site) was located at 2229 Main St. on 30 acres, 1990 it expanded to 46.4 acres

Began moving operations to Concord after March 1958 and fully transferred operations on October 29, 1958, DOL date for Atomic Weapons Employer (AWE) facility status



**Employed 60 to more than 650 workers during the time period under review (peaked in early 1980s)**

# Background – continued

## Original facility consisted of three buildings

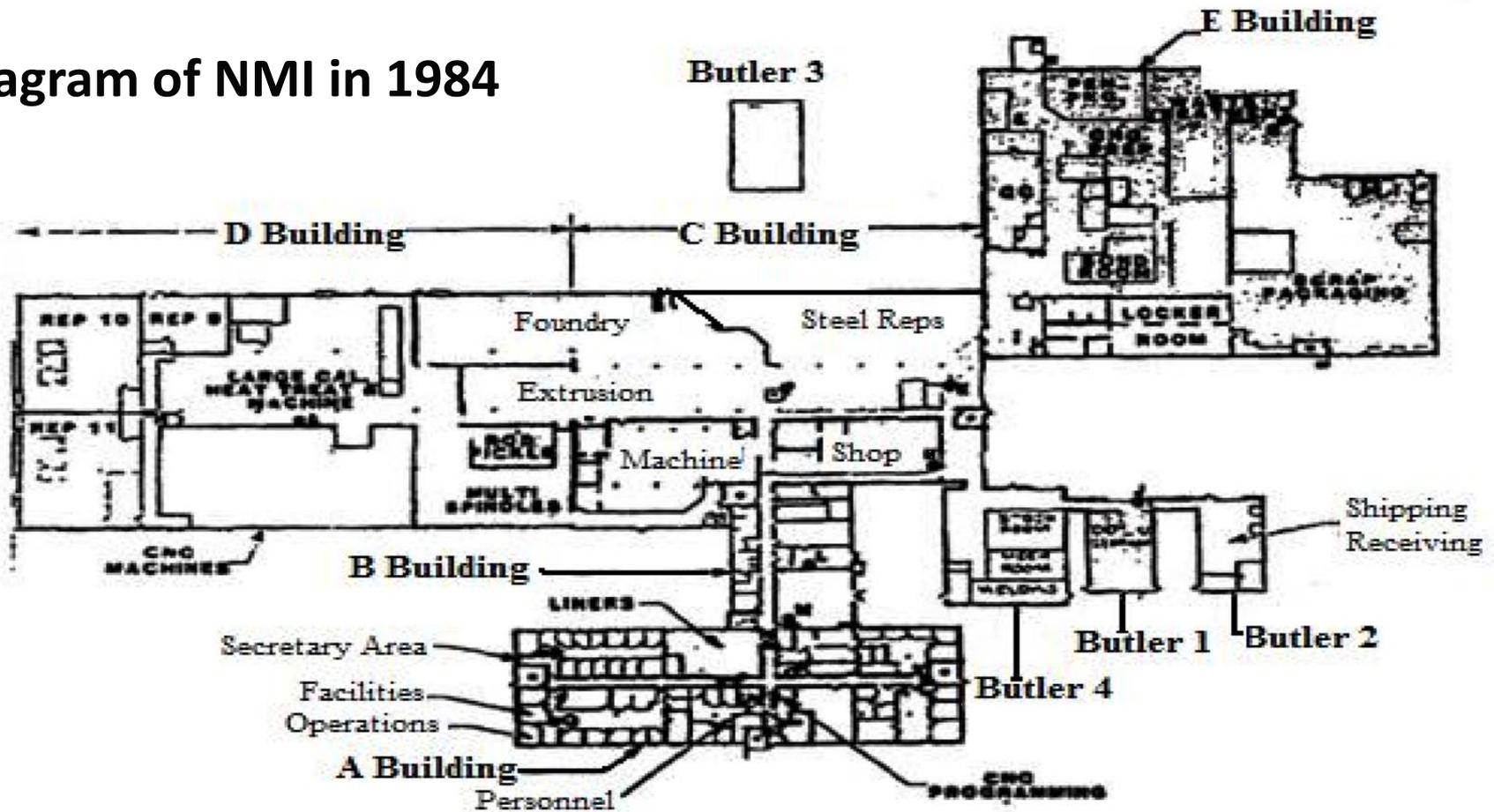
<b>A</b>	Office space and research laboratories (analytical, x-ray equipment, vacuum furnaces)
<b>B</b>	Services (cafeteria, electrical switch room, lockers) and sometimes used as needed to hold radioactive materials
<b>C</b>	Main production facility and included equipment for melting metals, extrusion, metal working, pickling and etching, and electroplating

## Additional building added over time

<b>D</b>	1978 - to expand the production space
<b>E</b>	1983 - production area for wet processes (pickling, coolant recovery, waste treatment)
<b>BB</b>	Butler Buildings (BB) - added over time and used for storage and sometimes pressed into service as needed

# Background – continued

Diagram of NMI in 1984



# Background – continued

- **Partial listing of operations conducted pre-1972**
  - Fundamental, physical, and chemical metallurgy
  - Production element and fuel element development and manufacture
  - Manufacture of high-temperature materials
- **Operations 1972 - 1979**
  - Shifted to large-scale production (manufacture of depleted uranium shields, counter weights, armor penetrators, metal powders, beryllium and beryllium alloys, and specialty titanium parts)
  - Enriched uranium operations discontinued in 1974

# Post 1979 operations

- **Similar as described for 1972-1979**
  - Shifted to large-scale production including the manufacture of DU shields, counter weights, armor penetrators, metal powders, beryllium and beryllium alloys, and specialty titanium parts
- **Melting and casting of DU and UF<sub>4</sub>**
  - In 1983 UF<sub>4</sub> processing ceased and was transferred to Carolina Metals, SC
- **Billet operations**
  - Assembly, extrusion, copper, removal/pickling/straightening

# Post 1979 operations - continued

- Provided depleted uranium and natural uranium for AVLIS project at Lawrence Livermore National Laboratory
- Metal powders and materials programs included thorium
- Maintained license for millions of pounds of DU and up to 25,000 kg of thorium into the 1990s

# Health Physics Program

- No trained health physics staff until 1981
- Program transferred from Hood Building in 1958
- The programs were research in nature and thus the staff often unaware of new hazards which may be encountered
- Program evolved over many years, may have periods of lapses into poor practices
  - Mid-1960s reports describe significant U spills and contamination which were left unreported
  - Inspection reports from the mid-1970s emphasize lack of contamination controls and monitoring

# Health Physics Program

- Improvements in the radiation protection program coincided with the growth of the company in the late 1970s and 1980s and emphasis to becoming a production program
- Reported improvements were described as
  - Access controls enforced
  - Increased air monitoring program
  - Air and swipe sample analysis brought in-house to reduce delays
  - Employee radiation safety training provided by full time training specialists as part of orientation
  - Increased health physics coverage for all three work shifts
  - Large increase in the amount of uranium bioassay samples collected
  - Still in 1980-84, there were 70 documented fires, smoke and spill incidents.
  - NIOSH has not located any incident document after 1984

# Source of Internal Exposure

- Research and production activities involved numerous radioactive materials
- Amounts changed over time (up and down)
- Some activities and materials still classified
- Internal dose sources included
  - Uranium (depleted, natural) in many physical forms and as the result of fires and explosions
  - Recycled uranium components
  - Enriched uranium was removed in 1974 as source term
  - Uranium and thorium progeny
  - Thorium (oxides, powders, and metal)

# Thorium before 1980

- About 1 ton of thorium transferred from Hood building at the start of operations
- Extruded thorium rods for British and French companies in the 1960s
- Converted thorium rods to powder and also extruded thorium powder to shapes
- Cast thorium to billet size followed by machining, jacketing, extrusion, pickling and machining
- Work with thorium further supported by worker outreach meetings

# Thorium before 1980 - continued

- Given the limitations on records NIOSH identified -
  - A persistent and radiologically significant thorium source term over the operating history of NMI
  - For which no monitoring existed for the period 1958 through 1979
  - Formed part of the basis for the infeasibility to reconstruct internal dose up through 1979

# Thorium

- Available records at NMI are limited and NIOSH is not able to confirm complete access to relevant records
- Others may be lost and are known to have been destroyed because it is a closed facility amidst a radiological cleanup activity

# Thorium - continued

- **NMI maintained several NRC licenses that provide insight**
  - Requested a thorium limit of 20,000 lbs in 1974
  - Requested an increase to 25,000 kg of thorium metal and oxide in 1981
  - Regarding NRC questions about a 1975 license request, NMI responded the material would be 90% thorium minimum and they would operate under the same manner for thorium as depleted uranium
  - NRC stated that NMI/Starmet (subsequent owner of NMI) ceased DU munitions work in 1999, that thorium and thorium oxide as well as some other materials would continue onsite

# Thorium - continued

- NMI did have two thorium-specific bioassay measurements performed in the 1980s
  - A single thorium bioassay in 1983
  - A single thorium specific in vivo lung count in 1982
  - NIOSH found no indications of any routine monitoring program involving air monitoring or any other bioassay program to support thorium operations

# Thorium - continued

- Thorium operations and quantities were never detailed during known operation periods for programs NIOSH knows used thorium
- Perhaps based on compartmentalization of programs from classified operations

# Thorium - continued

- This practice continued through the entire history of NMI
- NIOSH concluded these programs were ongoing and significant
  - Interviews with employees, senior NMI management, and maintenance and
  - Actual increases to the thorium license limits (to 25,000 kg) coupled with the silence in the past on thorium programs
- Given the limitations on records
  - NIOSH identified that a persistent and radiologically significant thorium source term continued during the January 1, 1980 through December 31, 1990 covered period

# External Exposure Sources after 1979

- Primarily processing of depleted/natural uranium and thorium metal
- Submersion in contaminated air and exposure to contaminated surfaces
- Concentration of progeny during metal working and separation processes enhanced radiation
- X-ray sources
  - Two industrial X-ray units (by the mid 1960's there were five units)
  - 40 mCi unencapsulated Ir-192 source and 45 Ci of Ir-192
  - 100 kV medical X-ray machine

# External Exposure Sources after 1979

- Personnel monitoring program in place prior to relocation of operations to Concord
- In the late 1950s, film badges were issued to all uranium processing employees
- In the 1960s, all personnel wore film badges (according to documents)
  - Processed every 6.5 weeks
  - Clerical personnel badges processed annually
  - These programs were maintained and improved through the end of the covered period

# Internal Dose Monitoring Programs and Data Availability

- The bioassay program consisted of urinalysis samples and lung counts
- Air monitoring program for uranium consists of 34,400 results available to NIOSH
  - Included breathing zone samples for 1980-90
  - Not a single sample attributable to thorium operations

# Internal Dose Monitoring Programs and Data Availability - continued

- Bioassay program evolved over time according to the AEC (NRC) inspection reports
  - NIOSH has obtained approximately 44,000 legible urinalysis samples for uranium conducted 1980-90
  - A single thorium urinalysis sample was found (<0.2 dpm/sample) from 1983

# Internal Dose Monitoring Programs and Data Availability - continued

- Lung counts for uranium annually on representative sample of employee population (approximately 100 per year)
  - Approximately 500 lung counts are available for the period 1982 through 1990
  - A single natural thorium specific lung count was identified in 1982

# Internal Dose Monitoring Programs and Data Availability - continued

Table A-2. 50th- and 84th-percentile urinary excretion rates of uranium, 1978 to 2000 (pCi/d).

Effective bioassay date	50th percentile	84th percentile	No. of employees
1/1/1979	0.910	6.194	145
7/1/1980	1.777	5.405	417
7/1/1981	3.454	7.729	656
7/1/1982	2.514	4.763	863
7/1/1983	2.038	4.002	747
7/1/1984	1.413	2.717	679
7/1/1985	0.693	1.660	674
7/1/1986	1.549	3.101	583
7/1/1987	1.125	1.928	627
7/1/1988	1.343	2.278	556
7/1/1989	0.812	2.160	83
7/1/1990	1.028	1.777	473
7/1/1991	0.785	1.492	406
1/1/1993	1.323	2.644	390
7/1/1994	1.072	2.829	167
7/1/1995	0.341	0.935	173
7/1/1996	0.283	0.686	209
1/1/1998	0.244	0.801	97
7/1/1999	0.214	0.630	102
7/1/2000	0.287	0.825	33

# NMI SEC Petition 195 - continued

## Why the class?

- Workers were potentially exposed to thorium and thorium progeny who were not monitored nor does a suitable dose reconstruction method exist.
- Decision was based on lack of adequate biological monitoring data, sufficient air monitoring information, and/or sufficient process and radiological source-term data to reconstruct dose with sufficient accuracy.

# NMI SEC Petition 195 - continued

## Why everyone?

- Based on reports by the AEC and facility layout and worker interviews, the process areas were not isolated from the non-process areas and no barriers to access were in place
- NIOSH was unable to find any records on thorium operations that would allow it to identify specific employees or groups of employees that would limit the class

# NMI SEC Petition 195 - continued

## What about employees not included in the SEC?

- NIOSH will use any internal and external monitoring data that may become available for an individual claim (and that can be interpreted using existing dose reconstruction processes or procedures)
- Therefore, dose reconstructions for individuals employed at Nuclear Metals, Inc. during the period from January 1, 1980 through December 31, 1990, but who do not qualify for inclusion in the SEC, may be performed using these data as appropriate
- NIOSH will estimate doses from medical x-rays using information from employee medical records and claimant favorable medical dose reconstruction assumptions and methods

# Health Endangerment

The evidence reviewed in this evaluation indicates that some workers in the class may have accumulated chronic radiation exposures through intakes of radionuclides and direct exposure to radioactive materials

Consequently, NIOSH is specifying that health may have been endangered for those workers covered by this evaluation who were employed for a number of work days aggregating at least 250 work days within the parameters established for this class or in combination with work days within the parameters established for one or more other classes of employees in the SEC

# Proposed Class

**All Atomic Weapons Employees who worked at the facility owned by Nuclear Metals Inc. (or a subsequent owner) in West Concord, Massachusetts during the period from January 1, 1980 through December 31, 1990, for a number of work days aggregating at least 250 work days, occurring either solely under this employment or in combination with work days within the parameters established for one or more other classes of employees included in the Special Exposure Cohort.**

# Summary

## Feasibility Findings for NMI Petition SEC-195 Addendum January 1, 1980– December 31, 1990

Source of Exposure	Reconstruction Feasible	Reconstruction NOT Feasible
<b>Internal</b>		
- Uranium	All years	N/A
-Thorium	N/A	No
<b>External</b>		
- Gamma/Photon	All years	N/A
- Beta	All years	N/A
- Neutron	N/A	N/A
- Occ. Medical X-ray	All years	N/A