The following cross references are intended to support the NMI SEC Petition application sections E5, F1 and F2, for the years 1970 – 1983. We have been requested to describe specific dates and plant locations for unplanned and unmonitored activities that resulted in exposure of NMI employees to radiation contamination. In an attempt to comply with this request, we do not wish this response to replace the many exposure incidents or poor safety practices described in the various affidavits. The affidavits further provide evidence of general safety practices that were inadequate and management decisions and behavior that introduced additional safety risks.

After more than 40 years it is difficult to be specific as to dates. We have tried to reference published technical reports, internal reports and memos, where available, to bracket time periods.

A number of employees have since passed away. These include 
with whom worked, and 
during the period 1978 to 1980s. was a 
who has passed away.

, co-petitioner, was in the 1978 – 1983 time frame. 
was assigned to support his staff efforts to 
. Many of his activities and exposures can be confirmed by him. Indeed, he was also exposed to many of the same unmonitored exposures.

Incidents for unmonitored exposures can be characterized as both discrete, or chronic and daily. Discrete incidents may be associated with unique experiments and may number from one to a dozen, or more separate exposures. These exposures could be limited to one or several, depending upon the type of work and length of time the experiments were conducted. Chronic and daily exposures may be associated with standard operating procedures, such as drinking from Gatorade stations in process areas.

As for the lost records requirements of Section F2 of the application, NIOSH has a better feel for this deficiency than the petitioners. The petitioners are aware that in many of the claims that have been submitted there are large gaps in the records of exposure. NIOSH should be able to review the limited number of NMI claims to assess the degree to which records are unavailable. For the time period of this petition, there appears to be a significant loss of exposure data.

In cases of general work area monitoring, the petitioners are aware that much of the area monitoring that was performed was done poorly and did not reflect accurate area exposures. We will attempt to specifically identify these situations. In some cases, employees in their effort to increase output to meet production goals and bonuses would by-pass monitoring efforts in order to make their jobs easier.
The list of unmonitored exposures was based primarily upon the affidavit submitted by the
Citations by page, section and paragraph number refer to areas of this affidavit where specific unmonitored exposures are referred to. Other affidavits and their sections are identified specific to the appropriate affidavit.

Additional photos have been uncovered. These photos were from an album that documented the in the mid 1970s.

What is remarkable is the limited use of work uniforms or no protective gear. Workers are shown performing standard process steps in their reusable work clothes along with personal clothing. In many cases even work gloves were not being worn. Personal glasses, but not safety glasses were worn. By the mid-1980s plastic safety glasses were required to be worn over prescription glasses in order to reduce radiation exposure to the eyes.

For some period after work gloves were required in the 1980s, their contamination and overuse was noted to be a problem. This required the more frequent retirement of used work gloves, particularly in . However, in the 1970s work glove use was not required. Workers were free to augment their uniforms with personal clothing. This was found to be a problem as these clothing articles were not cleaned by the outside source used for uniform cleaning. Even this outside source proved to be a problem as uniforms were not totally decontaminated upon cleaning.
E5 (?) or F.2 Unmonitored, unrecorded or inadequately monitored exposure incidents.

The following sections of specific affidavits support this section of our petition.

Affidavit:

**Exposure:**

1. **Salt Water Processing of Uranium Machine Chips Resulting in Unmonitored Fire and Explosion**

   *Type of Exposures:* Fire during testing. No respirators or PAM worn.
   *Page:* 2
   *Paragraph:* 1 – 6
   *Other supporting documents:* Test stand photo, page 2
   *Plant Building:* D
   *Process Area:* Empty area where large caliber CNC machining was later installed.
   *Date:* early 1979
   *Number of Incidents:* One
   *Personnel Exposed:

   *Witnesses:*

2. **Development of a Foam Encapsulation Alternative to Concrete for Machine Turning Packaging for Shipment and Burial Resulting in Unmonitored Fires and Airborne Exposures**

   *Type of Exposures:* Fires involving foam encapsulated DU chips being tested or during processing for test package preparation. No respirators or PAMs worn.
   *Page:* 3 - 5
   *Paragraph:* 4 – 9
   *Other supporting documents:* page 3 and 4 photographs, Appendix D- Foam Encapsulation reports and photos
   *Plant Building:* Building and area
   *Process Area:* Inside and outside
   *Date:* 1979 – 1981
   *Number of Incidents:* 12-15
   *Personnel Exposed:

   *Witnesses:*

Type of Exposures: HF acid treatment of DU machine chips permitting the release of acid fumes and airborne contamination. Para 1 - 5

Hydrated UF₄ precipitate decanting, washing, drying, ball milling and magnesium blending with the use of respirators or PAMs. Para 2, 3

Lab scale reductions in an unvented resistance heating lab furnace. Para 6

Opening and breaking out mini derbies using a hammer without respirator or PAM use. Para 7

Page: 5 - 6
Paragraph: 1 – 7
Other supporting documents: Page 5 photographs, USAARDC Report No. ARLCD-CR-83018, Appendix D

Plant Building: Building
Process Area: motor generators
Date: 1979
Number of Incidents: Chronic, Daily over several years of experiments
Personnel Exposed: witnesses:


Type of Exposures: Contaminated quench water of DU at 850 °C – water spray on clothing, face and hands. Para 1 - 3

Lack of PAM monitoring. Para 4

The use of contaminated work gloves with no monitoring of gloves to determine the appropriate time for replacement. (general observation)

Page: 6 - 7
Paragraph: 2 – 4
Other supporting documents: photograph on page 6
Plant Building: Building C
Process Area: motor generators
Date: 1979
5. Uranium Alloy Development and Unmonitored Exposure to Used Crucibles

Type of Exposures: Crucible mold wash application to previously used furnace crucibles without the use of respirators, safety glasses or ring badges. Para 1, 2

Drinking coffee during melting and casting  Par 3

Crucible lid pacification resulting in flash flame and detonation of vapor deposited DU and daughter products without the use of respirators. Para 4 - 6

Post casting crucible inspection without the use of respirators. Para 7

Failure to rotate used tooling to permit a cooling off period for radioactive daughter product decay. Para 9

Lack of safety glasses used during all activities. Para 8

Drinking from Gatorade stations in area. Page 18

Para 4

Page: 7 – 8, 18
Paragraph: 2 – 9, 4

Other supporting documents: Page 7 Photographs of my foundry work

6. UF4 Reduction Process Development and Unmonitored Airborne Exposures

Type of Exposures: Reduction Vessel burn throughs  para 3, 12, 13

Magnesium fluoride slag removal  para 6

UF4/Magnesium blending station para 3, 4
Reduction vessel transfer spilling of UF₄ para 3, 7

Sweeping spilled UF₄ para 4, 5

Manually packing reduction vessels para 7

Vacuuming spilled UF₄ causing clogged vent systems para 8

Power failures causing vent system shutdown para 8

Power failures causing furnace explosions para 8

Failure to rotate used tooling to permit a cooling off period for radioactive daughter product decay. Para 10, 13, 24

Enriched uranium recycling and associated exposures to radon and fission products. Para 13, 14, 17 – 21

Unmonitored Radon exposures Para 17 – 23

Moist storage impact on unmonitored Radon exposures Para 13 - 16

Page: 8 - 12
Paragraph: 3 – 8, 10, 13 – 14, 17 - 24
Other supporting affidavits: , Page 1, Para 9 , Page 4 - Para 1-2, Page 5 - Para 1-8, Page 6 – Para2 , Page 3 - Para 3-7, Page 4 – Para 1

Plant Building: Building
Process Area: 1979 - 1982
Date: Chronic, daily
Number of Incidents: Personnel Exposed: ,

Witnesses: 7. Patented Carousel Chip Cleaning & Drying System to Prep Machine Chips for Briquetting Resulting in Fires and Unmonitored Airborne Contamination

Exposure: Carousel operation para 1 - 6

Type of Exposures: DU chip handling without ring badges para 4
DU fires without respirators or PAMs para 5 - 6

Page: 12 - 13  
Paragraph: 1 - 6  

Plant Building: Building  
Process Area: near 300 ton extrusion press  
Date: 1980 - 1983  
Number of Incidents: 120 days of processing, 6 fires  
Personnel Exposed:  
Witnesses:

Exposure:

8. Uranium Penetrator Test Range Fragment Recycling and Unmonitored Airborne Exposure to Contaminated Dust

Type of Exposures: Emptying waste drums and screening sand/fragments without respirators, PAMs or ring badges para 1 - 2

Page: 13 - 14  
Paragraph: 1 - 4  
Other supporting documents: Photos and USAF AFATL Report No. AFATL-TR-82-49 Appendix D

Plant Building: Building  
Process Area:  
Date: 1981 - 1982  
Number of Incidents: 6 months of active processing  
Personnel Exposed:  
Witnesses:

Exposure:

9. Developmental Molten Salt Recycling of Uranium Chips and Unmonitored Airborne Exposure

Type of Exposures: Handling very dry DU machine chips para 1 – 4

Manually dropping chips into molted salt pots Para 1 - 2

Page: 14  
Paragraph: 1 - 4  
Other supporting documents: Photos and USAF AFATL Report No. AFATL-TR-82-49 Appendix D

Plant Building: Building  
Process Area: near 300-Ton Press  
Date: 1981 - 1982  
Number of Incidents: 6 months of active processing  
Personnel Exposed:  
Witnesses:
Personnel Exposed:

Witnesses:

Exposure:

10. Off Site Heat Treatment Experiments and Unmonitored Exposures

Type of Exposures: Uranium transport to Cleveland para 1 – 2
Page: 14 - 15
Paragraph: 1 - 4
Other supporting documents: none
Plant Building:
Process Area:
Date: 1981
Number of Incidents: two weeks
Personnel Exposed:
Witnesses:

Exposure:

11. Off Site Ordnance Testing and Unmonitored/Unavailable Exposures

Type of Exposures: DU explosive testing Para 1 - 3
Page: 15 - 16
Paragraph: 1 - 3
Other supporting documents: Photos and Final Technical Reports, Appendix D
Plant Building:
Process Area: Test sites
Date: 1980 - 1987
Number of Incidents: 50
Personnel Exposed:
Witnesses:

Exposure:

12. Unmonitored Exposures - Heat Treatment Furnace Maintenance

Type of Exposures: Airborne exposures during furnace maintenance Para 1 - 3
Page: 16
Paragraph: 1 - 3
Other supporting documents: none
Plant Building: Building
Process Area:
Date: 1978 - 1983
Number of Incidents: numerous
Personnel Exposed:
Witnesses:
13. Unmonitored Exposures – Uranium Liner Forming

Type of Exposures: Airborne exposures during DU part forming Para 1 - 3
Page: 16 - 17
Paragraph: 1 - 3
Other supporting documents: none

Plant Building: Building
Process Area:
Date: 1978 - 1983
Number of Incidents: numerous
Personnel Exposed: ,
Witnesses:


Type of Exposures: Airborne exposures during DU extrusion of bare billets with molten salt Para 1 - 2
Page: 17
Paragraph: 1 - 2
Other supporting documents: none

Plant Building: Building
Process Area:
Date: 1978 - 1983
Number of Incidents: 12
Personnel Exposed: Witnesses:

16. Plant Material Handling, Employee Access and Traffic Pattern Contamination

Type of Exposures: physical spread of contamination to uncontrolled internal and external areas
Page: 18 – 19 Para 1 - 3, Page 21 – Section 17 – Para 12-14 and 17-19, Page 20 – Section 17 – Para 4, Page 22 – Section 17 – Para 21
Paragraph: 1 - 10
Other supporting documents: other affidavits

Plant Building:
Process Area:
Number of Incidents: numerous
Personnel Exposed: Witnesses:

The following are additional unmonitored exposures that are described in various sections of the affidavit submitted by . These exposures were not reviewed separately but were discussed in various sections.
17. Unmonitored Radon Exposure
Type of Exposures: Radon generation and unmonitored exposures as a result of spent fuel rod recycling and the presence of unexpected radionuclides in government furnished DU
Page and Paragraph: Page 19 - Section 17 - Para 2, Page 20 - Section 17 - Para 5, Page 22 - Section 17 - Para 27
Other supporting documents: DoE spent fuel recycling, Utah Dept. of Public Health report on moist versus arid DU storage the impact on radon generation

Plant Building: 
Process Area: 
Date: 1970 - 1983
Number of Incidents: chronic and daily
Personnel Exposed: 
Witnesses: 

18. Unmonitored Exposures - Post enriched uranium use and failure to decontaminate process areas after enriched license expiration
Type of Exposures: airborne and external
Page and Paragraph: Page 20, Section 17, Para 4-6
Page 20, Section 17, Para 10

Plant Building: 
Process Area: 
Date: 1970 - 1983
Number of Incidents: chronic and daily
Personnel Exposed: 
Witnesses: 

Type of Exposures: airborne and external
Page and Paragraph: Page 22, Section 17, Para 26
Page 20, Section 17, Para 10

Plant Building: 
Process Area: 
Date: 1970 - 1983
Number of Incidents: chronic and daily
Personnel Exposed:
Witnesses:

Exposure:

20. Unmonitored Exposures – Gatorade Stations in DU Process Areas

Type of Exposures: internal
Page and Paragraph: Page 18, Section 16, Para 4
, Page 1, Para 4
, Page 2, Para 3
, Page 6, Para last
, Page 7, Para 2


Plant Building:
Process Area:
Date: 1970 - 1983
Number of Incidents: chronic and daily
Personnel Exposed:
Witnesses: