

OFFICE MEMORANDUM

Nuclear Metals, Inc.

To: DISTRIBUTION

Date: February 29, 1996

From: George Shinopoulos *G. Shinopoulos*Subject: REPORT OF FINDING: SONODYNE VENT
FIRE, February 21, 1996

1. EVENTS LEADING UP TO VENT FIRE

The Sonodyne thermocouple system was found to be reading room temperature erroneously (-3°F) on Thursday, February 15, 1996. The Electrical Group (Richall) was called to replace the thermocouple which he did. The problem persisted. Chemical Engineer (Schlier) suggested that the thermocouple lead wire may be defective. It was temporarily bypassed and the room temperature reading read correctly. New permanent lead wire was then installed. For a point of information, the HEPA filters were changed this same day having lasted a normal useful life before reaching the differential pressure limit of 8 inches of water. The Sonodyne was next started for a test run on Tuesday February 20. It was quickly seen that the indicated temperature was going down rather than up. It was shut down and Richall called. He reversed the lead wires at the controller which appeared to correct the problem. The Sonodyne system was then started and run for about 10 minutes to check out its operation. Shut down was accomplished by shutting off the feed water and allowing the high temperature limit to automatically shut down the system. All appeared normal during that 10 minute test. Full normal operation was approved for the next day, February 21, 1996.

2. VENT FIRE

The following is a chronology of the events that took place during the Sonodyne vent fire of February 21, 1996. The sources of the information are the Guard's Log Sheet, Sonodyne Log Sheet for that run, Ed Cantino as the Sonodyne operator, Mark Nelson as Leadman of the area and assisting the Emergency Response Team, Paul Roberts as a responding member of the Emergency Response Team, Larry Hafer who reported the vent fire and a participant in extinguishing the fire, and myself as an observer.

- 5:35 AM Sonodyne started, good start
- 5:37 AM Overtemp shutdown at 266°F
- 5:50 AM Running normal
- 6:05 AM Running normal with 20% water flow
- 6:20 AM Running normal with 18% water flow
- 6:25 AM Running normal with 20% water flow
- 6:25 to 6:55 AM Temperature fluctuating and dropping to about 250°F, compensating by reducing water flow to 10%
- 6:50 AM Hafer smelled smoke when entering building
- 6:58 AM Operator entered Sonodyne room to check fullness of waste drum; no off condition evident
- 6:59 AM Guards log smell in court yard

A-8

- 7:00 AM Sonodyne auto shut down upon loss of the exhaust fan operation. Operator logged an indicated temperature of 258°F. Operator could smell smoke then
- 7:01 - 7:10 AM Nelson went to roof and saw smoke coming from Sonodyne vent exhaust stack. Hafer also went to roof and saw smoke coming from Sonodyne Room exhaust stack. Both reported fire to Cantino. Room supply air was turned off and room exhaust fan shut down about 15 minutes later.
- 7:07 AM Guard log indicates Nelson requested Emergency Response Team for fire in Sonodyne
- 7:13 AM Code 2 (fire) for Sonodyne announced shortly after 7:07 but logged in at 7:13.
- 7:35 AM Building E evacuated
- 7:42 AM Schlier and Shinopulos arrive and met by Nelson to inform both of the fire
- 8:00 AM approx.: Emergency Response Team (Cormier, Roberts, Hedin, Alvarez, assisted by Nelson) and others assemble at entrance to Building E to develop action plan
- 8:30 AM approx.; Emergency Response Team members enter Sonodyne room to find smoke, hot Torit hopper. Removed back hatch of Torit and only saw smoke; no flame. High temperature limit on Sonodyne control panel was seen to be reading 21°F.
- 9:00 - 11:15 AM approx.; Four CO₂ bottles brought to roof and four to Torit collector. Fire was seen then through rear Torit hatch coming out of filter cartridges. Sprayed down fire with water hose and closed hatch. Monitoring thermocouple inserted into Torit through rear hatch. A temperature of about 750°F was indicated. The four CO₂ bottles discharged down duct from roof through flex connection. Temperature of monitoring thermocouple indicated 578°F and was dropping about 1 1/2°F per minute. Four bottles that had been on floor were also brought to roof and discharged down duct. Temperature indicated by thermocouple showed 497°F then crept up to 500°F before resuming drop of about 1°F per minute. When temperature fell to 400°F, prefilter and HEPA filter housing covers were removed for inspection. Cardboard framed prefilters had been completely burned; however, high temperature HEPA filters were found to be substantially in tact and were removed from housing and dropped to floor below. At that time Roberts reported that the fire had restarted as seen through the Torit rear hatch. Said to be more of a glow with a lazy type flame coming out of one cartridge. Nelson then sees smoke coming from HEPA housing filter ports. Cartridges sprayed with water and front access was made to the Torit by removing six cartridge hatch covers. Cartridges were said to be glowing. They were water sprayed and six cartridges were removed to provide room to spray all from the front to completely kill the low intensity filter fire.
- 12:30 PM Building E re-opened.

3. INVESTIGATORY FINDINGS

Later inspection of the HEPA filters found three of the four to be in good condition with the fourth having suffered some heat damaged which seemed to blind the media rather than opening voids. The media had been pulled away from one side of the frame on the fourth filter. Roberts states he did not see this upon removal of the filter from the housing and believes that it occurred from the drop to the floor. All four filters show mechanical damage obviously from the drop.

As said above, the HEPA filters were in fairly good condition and remained effective throughout the entire fire event. Depending on the exact time the fire started during the 6:25 to 6:55 period of high temperature/erratic temperature control, the vent blowers were on somewhere between 5 and 35 minutes during the fire. Based on the condition of the HEPA filters, the comparatively short period of time that the blowers were on during the fire and, most importantly, that the uranium content measured by the discharge vent sampling filter reported to show no increase, it is concluded that the fire did not cause an increase of uranium to be discharged from the vent to the environment. Also, the integrity of the 12 gasketed round metal cover plates for the Torit Cartridges was apparently sufficient to keep any dust from entering the closed front compartment of the Torit housing. The Torit cartridges themselves function as a solids separation device and are not part of the containment structure. Therefore, it is concluded that there was no loss in integrity of the containment structure of the Torit filter housing, duct work, HEPA filters and housing nor any other component of the complete Sonodyne Pulse Combustion drier structure. Smoke from the fire however, with a potential for airborne uranium, entered the Sonodyne room either during opening inspection ports for evaluation, during periods of fighting the fire or from down drafts. This was drawn into the interior space of Building E and exhausted through the three HEPA filtered general building and other process vents. Total filtered building vents provide about 38,000 cfm of filtered exhaust air. The removal of the filters during the final periods of the fire fighting process did present another pathway for uranium to enter the work area.

There were no injuries resulting from the fire. Damage or loss to equipment was minor and limited to the Torit cartridge filters, prefilters, HEPA filters (mostly from handling), gaskets and caulking. The estimated cost to repair the damage is \$8,000 for materials and 150 man hours of NMI labor.

The root cause of the vent fire was found to have been the purchased thermocouple supplied with reversed wires (polarity). Secondary to the root cause was the reversal of the lead wire polarity at the instrument. It was an incorrect fix of the root cause. In fact, what this did was to introduce a secondary thermocouple that caused the instrument to read an artificially low temperature and the Sonodyne vent system to overheat.

Testing and information was gathered to identify the material that first ignited; the fuel. No oil could be found in the waste water. There was some inconsistent evidence that the dried Sonodyne solids could burn under red heat from a propane flame; much higher than would have been experienced in the Sonodyne at the time of ignition. Visolite powder which is used to check the integrity of the Torit filters did ignite with the propane torch and sustained a flame. This material had been used for a number of years without a problem and again the propane flame was hotter than the Sonodyne overheat condition. The possibility of a hot spark being carried over to the filters from the combustion chamber was discussed. Sparks had been seen some years ago in the primary collector but cleaning procedures were instituted to keep this from happening. The other material investigated was the Torit filter media itself. Both Nelson and Roberts independently observed the media burning during fighting the fire. Mr. Mirvan Wright of the Donalson Company (the cartridge supplier) stated that their experience indicated that the media would have to exceed 600°F, say 650°F, before it would combust. He did say however that they have observed that if carbon and rich diesel fuel are present, the media could ignite as low as 550°F. Although this is at the upper limit to which one could expect the Sonodyne

as 550°F. Although this is at the upper limit to which one could expect the Sonodyne vent gas to have reached, it could have occurred. It can be said with some certainty that the Torit filter media is what started burning and provided the fuel to the fire. In summary, the defective thermocouple caused the Sonodyne vent system to exceed the maximum operating temperature of 285°F and ultimately burn the Torit Filter media.

4. CORRECTIVE ACTION

The following was done to prevent a similar situation from occurring again.

- A properly functioning thermocouple and leadwire were installed with the correct polarity
- An independent over temperature thermocouple, leadwire and controller were installed to limit the maximum temperature excursion should the primary high temperature limit system fail again

The following was done to assist in fighting a Torit fire should one occur again.

- A water deluge system was installed directly into the Torit housing

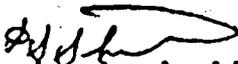
The following is being evaluated as an additional layer of fire control.

- Installation of a CO₂ system to be actuated automatically before there would be a need to use water.

Distribution: BEZ, FJV, DSS, RTF, MAN, EBA, FGO'K, LEH, MPJ

Facilities/vents/Sonodyne vent fire

TO: Eric Andersen

FROM: David Schlier 

Subject: Potential Uranium involved in Vent Fire, 2/21/96

1. Sample: took sample from feed tank bottom, 1/21, attempting to maintain normal (2 gpm) flow.
2. Measured 3 mls sulfuric acid into 50 ml volumetric flask. Added about 40 ml. mixed sample and mixed. Filled to volume with more mixed sample. Mixed well
3. Analyzed using colorimeter at 400 nm.
 1. Aliquoted 20 ml. acidified sample (from 2 above) into 50 ml. volumetric flask.
 2. Added 5 ml. 20% Ammonium Tartrate solution.
 3. Added 15 ml. NH_4OH (conc.)
 5. Added 0.1 ml. H_2O_2 , 50%.
 6. Brought to volume, mixed well.
 7. Read on Milton-Roy Spec 20D Colorimeter at 400 nm per instrument instructions.
 8. Reading was 0.144 AU, factor is 10.6 mg U/AU
4. Total solids in sample is approximately 0.33 lb/gallon (from Resorce Recovery Monthly Report).
5. Approximate weight of contaminated solids in Collector: 2 lb/filterx24 filters: 50 lb.
6. Calculations:
 1. Determine U in Sample

$$U = 0.144\text{AU} \times 10.6 \frac{\text{mgU}}{\text{AU}}$$

$$U = 1.53\text{mgU}$$
 where U is the total amount of Uranium found in the volume analyzed.
 2. Determine sample size.

$$V = (20\text{ml}) \cdot \left(\frac{50 - 3\text{ml}}{50\text{ml}} \right)$$

$$V = 18.8\text{ml}$$
 where V is corrected sample volume.
 3. Uranium concentration.

$$[U] = \frac{1.53\text{mgU}}{18.8\text{ml}} \cdot \frac{1000 \frac{\mu\text{l}}{\text{ml}}}{1000 \frac{\mu\text{l}}{\text{l}}}$$

$$[U] = 0.0814\text{gU/l}$$
 where [U] is the uranium concentration.
 4. Total uranium in Collector

$$W_U = \frac{0.0814\text{gU/l} \cdot 3.785\text{l/gal} \cdot 50\text{lb.}}{0.33\text{lb/gal}}$$

$$W_U = 47\text{gU}$$
 where W_U is the weight of Uranium in the collector.
7. Conclusion: less than 50 grams U could have been potentially involved in the vent fire on 2/21/96.

REGION I
NRS LICENSEE EVENT REPORT

License No. SMB-179

Docket No. 040-00672

Insulation ALER-AI 96-23

LICENSEE Nuclear Metals

EVENT DESCRIPTION Fire in liquid radioactive waste process system

EVENT DATE Feb 21, 1996

REPORT DATE 4/22/96

3/23/96 *ms*

Date rec'd

1. REPORTING REQUIREMENT

- 10 CFR 20.2201 Theft or Loss
- 10 CFR 20.2203 30 Day Report
- 10 CFR 30.50 Report

- 10 CFR 35.33 Misadministration by OPA
- License Condition

Other 10 CFR 40.60(c)

2. REGION I RESPONSE

Immediate Site Inspection

Inspector/Date Miller 2/27-28/96

Special Inspection

Inspector/Date Miller 2/27-28/96

Telephone Inquiry

Inspector/Date _____

Preliminary Notification

Daily Report

Information Entered on the Region I Log

Review at Next Routine Inspection

Report Referred to _____

3. REPORT EVALUATION

- Description of Event
- Levels of RAM Involved
- Cause of Event

- Corrective Actions
- Calculation Adequate
- Letter to Licensee Requesting Additional Information

4. SPECIAL INSTRUCTIONS OR COMMENTS

Completed by *[Signature]*

Date 5/7/96

Reviewed by *[Signature]*

Date 5/8/96

RETURN ORIGINAL TO
REGION I

g:\las\mlerform
(Revised 1/6/95)

100066