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From: Meredith Brown <racer@lanl.gov>  
Subject: Green Alert: Pyrophoric Reaction

**TITLE: GREEN ALERT - Pyrophoric Reaction During Glovebox Size Reduction**

IDENTIFIER: CP-98-115.GP  
DATE: November 5, 1998

**LESSONS LEARNED STATEMENT:** Personnel working with processes involving pyrophoric metals must fully understand the potential reactions. Hazards that could cause or contribute to the severity of a combustible metal fire should be identified by a hazard analysis, and measures to minimize the hazards should be implemented. This event illustrates the importance of the Integrated Safety Management Program. The extensive pre-planning by the D&D team prepared the work force for the worst case scenario. All personnel responded appropriately to this incident.

**DESCRIPTION:** On October 12, 1998, three Decontamination and Decommissioning (D&D) workers were size reducing a glovebox in a soft-sided contamination containment tent when a pyrophoric reaction occurred, resulting in sparks being emitted from a furnace vacuum pipe that one worker was cutting.

The worker was cutting a 2" stainless steel pipe that went from a vacuum pump under the glovebox to a filter housing. The worker had cut 4" above an elbow, approximately  $\frac{3}{4}$  of the way through the pipe with a port-a-band saw when the reaction occurred. Personnel in the area believe that the sparking lasted ten seconds before it self-extinguished. The workers immediately stopped the evolution, and moved to an exit area inside the tent. The pyrophoric reaction resulted in an estimated 1.6 million derived air concentration (DAC) inside the tent. Workers were in PremAire supplied air suits. DAC levels were 20-30,000 prior to the cut, at about 1545 hours. The reaction occurred at about 1550 hours. Using a 12-1A, surveys resulted in one million cpm which converts to greater than 231,000 DAC. The instrument was pegged out; a second instrument was used and also pegged out. Use of the best available instrumentation (5% effective) resulted in approximately 1.6 million DAC plus or minus  $\frac{1}{4}$  million. For the purposes of assigning personnel DAC hours, the lapel air sampler was used. The highest reading was 120 DAC inside the PremAire suit, plus the added protection of a respirator which has a protection factor of 1000. Standard nasal smears were taken; results were negative.

**BACKGROUND:** Room 154 of Building 779 was a plutonium hydride facility. It has had a history of the highest fixed air head samples on plant site. Plutonium hydride is a large particle material that is not very mobile. It tends to stay where it is generated. However, it is very pyrophoric. It will oxidize instantaneously in air and at low concentrations of oxygen. Plutonium oxide formed from the plutonium hydride oxidation process is a very small particle size oxide, on the average between 2.0 and 0.2 microns. During production years, plutonium hydride was placed in a vacuum furnace and heated to remove the hydrogen, leaving pure plutonium metal. Facility Management was aware of the potential hazards in Room 154; therefore, in

preparation for the D&D of the room, subject matter experts (SMEs) were brought in to brief the workers on the conditions of the room. The SMEs walked down the project with the work planners, the engineers and the workers. According to the SME, Glovebox 1363 was de-inerted about two years ago. If any oxide remained, it would be in small quantities in the gas purification unit. When the box was de-inerted, a rubber mallet was used to bang on the filter housing and ancillary equipment in an effort to loosen any hold-up material that might remain. A thermocouple was attached to the filter housing to monitor any heat generated. No heat was detected during the process. The possibility of a pyrophoric reaction had been discussed in planning meetings with the SMEs and the workers. The workers were trained to use magnesium oxide in the event of a pyrophoric reaction. However, the SME explained that the reaction would happen so fast that it would burn itself out before anyone could react with the magnesium oxide. As a precaution, magnesium oxide was placed outside the tent. The workers were trained to expect this type of reaction. While the actual reaction surprised the workers, it was not unexpected. The reaction was compared to a small firework. It flared, then died out.

**RECOMMENDED ACTIONS:** Corrective actions necessary prior to restart were determined.

- 1) Establish a recovery plan; include an appropriate RWP, decontamination and proper use of magnesium oxide.
- 2) Obtain combustion specifications on the PPE (Specifications obtained confirm that the PPE used and Lancs tents do not support combustion).
- 3) Place a CO2 fire extinguisher inside the tent. Train D&D workers that it is to be used on personnel only, not a pyrophoric reaction.
- 4) Revise pre-evolution checklist to include a determination per evolution for the need of a fire blanket.
- 5) Reiterate with crews the proper use of a safe area in containment tents during elevated DAC readings.
- 6) Conduct an All Hands Briefing regarding the incident.

The post-start corrective actions were identified as:

- 1) Build a B-Box for future possible high risk hold up areas. Evaluate the use of point source ventilation.
- 2) Evaluate removing similar items from this glovebox and GB1364 without cutting, possibly cleaning pieces.
- 3) Revise the ALARA Job Review to indicate during high DAC, the waiting period should be dependent on the DAC level going down, not a time limit.

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REFERENCES: Letter EPS-054-98

**FOLLOW-UP ACTIONS:** Information in this report is accurate to the best of our knowledge. As a means of measuring the effectiveness of this report, please notify the contact of any action taken as a result of this report or of any technical inaccuracies you find. Your feedback is appreciated.