BLUE - Nitrogen Dewar Over-Pressurization and Rupture

Lesson ID: B-2007-LPPORTS-0401 *(Source: User Submitted)*

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Statement: Being aware of changing conditions, stopping work and proactively evaluating those changes before proceeding can avoid major problems.

Discussion: On February 15, 2007, a subcontractor was preparing a gamma spectroscopy unit for assay of uranium-bearing waste drums. Part of the preparation process involved filling the instrument dewar (reservoir that provides cooling to the attached High Purity Germanium Detector) with liquid nitrogen. About 5 minutes into the nitrogen filling cycle, the instrument dewar (believed to already be holding several liters of liquid nitrogen) over-pressurized and subsequently ruptured. The escaping nitrogen tore the fill line loose from both the larger nitrogen supply dewar and the instrument dewar. The pressure release propelled the instrument dewar and coupled detector about fifty feet across the room. The assembly struck a wooden sign post and broke apart. The detector came to rest approximately 10 feet from the sign post and the instrument dewar came to rest about 20 feet from the sign post.

Analysis: This subcontractor had been working for LPP for several months with no significant problems. As additional tasks were added to the subcontractors work load, the subcontractor determined they needed to add a third NDA instrument to complete their assigned tasks on schedule. This third instrument had been in use by the subcontractor at another site. Prior to arriving at the PORTS site, the instrument was modified by the subcontractor for ease of maintenance, but the subcontractor's engineering organization had not followed appropriate configuration management controls. This modification added an elbow to the vent line which may have permitted an ice plug to form allowing a pressure buildup. The pressure buildup may have been aggravated because the larger supply dewar was nearly empty.

The technician operating the instrument unit failed to recognize indications that the liquid nitrogen transfer was not progressing as intended. The flexible transfer line between the supply

dewar and the instrument dewar was not completely covered with frost. Frost over the entire length is typical when liquid nitrogen is being transferred. The pressure relief valve on the supply dewar had emitted some large and loud “burps” earlier in the day, indicating a low liquid nitrogen level. Secondly, there were only intermittent puffs of vapor from the instrument dewar vent relief valve rather than the normal steady stream of vapor that is characteristically emitted when filling.

A review of the subcontractor’s operating procedures revealed that they lacked adequate detail for conducting the fill. There needed to be more discussion regarding; the type of equipment the procedure pertained to, the preparation steps for filling, method for checking connections, what to look for during the filling operation and any cautionary notes for things that could go wrong.

Once the pressure built up high enough, the aluminum shell of the instrument dewar ruptured causing the pieces to fly in several directions. If the instrument dewar had not been modified, there would not be potential for developing an ice plug in the vent line and the nitrogen gas might have vented successfully as it was being filled. If the supply dewar would have been full, liquid nitrogen could have flowed continuously from the supply to the instrument dewar. This would have reduced the probability for over-pressurization.

More rigorous management oversight of procedures and changes made by the subcontractor may have helped to prevent an incident like this from occurring.

Actions: As a result of the over-pressurization incident, the following corrective actions were established:

• Verified that the subcontractor implemented the following corrective actions:
--Use only one single approved NDA Instrument Design at this site;
--Revised configuration management and QA Procedures;
--Revised operating procedures for filling dewars;
--Training of Operators and Engineers on revisions to procedures.
• Verified no similarly designed small dewars were in use at PORTS.
• Modified the Activity Hazards Analysis (AHA) to incorporate the changes made to the subcontractor’s operating procedures and trained employees on the modifications
• Conducted Supervisory training on subcontractor oversight expectations.

Keywords: DEWAR, OVER-PRESSURIZATION, RUPTURE, LIQUID NITROGEN, MODIFICATION

Hazard(s): Pressurized Systems

ISM Code(s): Analyze Hazards, Develop / Implement Controls

Work Function(s): Conduct of Operations - Work Control

References: Occurrence Report EM--PPPO-LPP-PORTENVRES-2007-0003 -- Rupture of Non-Destructive Assay (NDA) Unit Liquid Nitrogen Tank

Priority Descriptor: Blue / Information