ODH Assessment

Date: 7 November 2007
Division:
Location: FEL Gun Test Stand (Room 109)

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Approval

Accelerator Division Engineering Department Head: Will Oren 12/14/07


Introduction

The following assessment addresses the risk of oxygen deficiency hazard (ODH) for the FEL (bldg. 18) room 109. The assessment is conducted according to the requirements of Appendix 6500-T3, “ODH Risk Assessment”. Two general categories of ODH hazards are identified in the facility. These include sources of nitrogen and sulfur hexafluoride gas which can dilute the normal oxygen content with health effects as outlined in Appendix 6500-T3, but according to the MSDS, the maximum exposure of sulfur hexafluoride is 1000 ppm. Therefore, sulfur hexafluoride should not be considered as an asphyxiant. It is recommended that a separate assessment address sulfur hexafluoride as a toxic hazard other than what is covered here as an ODH hazard.

The following sections cover the modeling scope and methodology for cryogen dispersion release, a description of the work space, risk assessment, failure rates of components, and requirements.

Model for Cryogen Dispersion Release

The Model for Cryogen Dispersion Release is based on a ½ inch GN2 supply line at 80 PISG supply pressure with a ¼ inch solenoid valve. Because of the large capacity of the nitrogen dewar, the nitrogen source will be treated as an infinite supply.

Because the nitrogen is considered to be an infinite source, the rooms have been modeled to limit the nitrogen flow and never let the oxygen levels go below the 18%. This means that there has to be a limiting device in the nitrogen supply line located outside the room. This also means that there must be an interlock outside the room that will shut off the nitrogen source if fresh air supply is not on.

The model for an oxygen deficiency hazard is based on the largest quantity of gaseous nitrogen available for use. Failure rate estimates \( P_i \) are based on JLAB listed equipment rates under EH&S Section 6500. Fatality Factors \( F_i \) are derived from Figure 3, from EH&S Appendix 6500-T3. The sum of the failure product of the \( F_i \) and \( P_i \) determined the area classification in accordance with table 6 of Section 6500 of the EH&S manual.

Description of Work Space

The room floor area was measured as 606.5 cubic feet with a 10 foot ceiling. At one end of the room is an intake duct to the air handling unit that supplies heated or cooled air mixed with fresh air to the FEL accelerator room. At the other end of the room is a hole in the wall that is open to the accelerator room and is covered with steel screen. Therefore, the room is considered a plenum. There is one roll up door, normally closed,
and a concrete door, normally open. The concrete doorway has plastic panels to eliminate air flow through the doorway.

Gaseous Nitrogen Sources

The gaseous nitrogen ODH source is a 20,000 gallon dewar. Liquid nitrogen is piped from the dewar to an ambient vaporizer. The gas that leaves the vaporizer is then piped to a header. The FEL has a connection to that header that supplies different locations at the FEL, including room 109. This dewar represents approximately 1,900,000 standard cubic feet (SCF) of nitrogen gas at 300 Kelvin. If the nitrogen was accidentally released into an unventilated room, the oxygen level would become dangerously low.

Type of Ventilation

In accordance with Appendix 6500-T3, reliable ventilation may be considered a relevant factor in this ODH assessment if the volume of air in the room is replaced with fresh air at a minimum of once an hour. The ventilation for this room comes from an air handing unit. This unit operates 24 hours a day and 7 days a week. Because this room is a plenum (see Description of Work Space), the air changes are larger than 50 air changes an hour.

ODH Risk Assessment

The following are a set of events of associated probability and fatality factors that are true only after the engineering controls have been implemented.

<table>
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<tr>
<th>Event</th>
<th>Spill Rate</th>
<th>Spill cf</th>
<th>%O2</th>
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</table>

Pi Note: The probability factor Pi is assumed to be 0 ≤ Pi ≤ 1 for this ODH analysis. It does not depend on the value of Pi. For all values of probability, engineering ventilation interlock controls will maintain O2 levels >19.5% where the fatality factor Fi will always be equal to zero. Therefore \( \phi = \sum P_i F_i = 0 \) for all values of Pi.

ODH Classification

Because \( \phi < 10^{-7} \), the **ODH classification is 0.**
### Engineering Controls

The following engineering controls are necessary to provide a safe working environment while retaining an ODH 0 posting.

This analysis requires an interlock between the nitrogen source and the air handling unit. The interlock is to be a fail-closed solenoid valve up-stream and outside of the room that closes when the air handling unit is not working. Normally an orifice plate is installed, as shown in the diagram, but is not required for this analysis because there is already an orifice of 1/8 inch at the gas nitrogen header behind CHL. This will limit the N2 flow rates which allow the ventilation air to maintain O2 levels > 18%.