

## **Red Alert- Confined Space Injury and Fatality**

Date: November 13, 2000

Identifier: 2000-RL-HNF-0045

### **Lessons Learned Statement:**

Nitrogen and other inert gases are not normally dangerous but when used in confined spaces they can quickly create oxygen deficient atmospheres that can be deadly. Workers must remain aware of nitrogen purge operations that may affect their work environment and use caution when such purges are in use.

### **Discussion of Activities:**

Two workers at a Union Carbide plant were inspecting a flange surface on a 48" diameter pipe with an ultraviolet (black) light to detect residual organic chemicals. They draped black plastic over the end of the pipe to create shade so the black light would show surface deposits. They were unaware that nitrogen was being injected into the chemical processing system 150 feet away to protect new catalyst in chemical reactors from exposure to moisture. Nitrogen was also flowing through some of the piping systems connected to the chemical reactors, including the pipe being inspected. When the two workers went under the black cover, they quickly lost consciousness from lack of oxygen displaced by the nitrogen purge. One died and the other was seriously injured.

### **Analysis:**

Nitrogen is an odorless, tasteless, and invisible gas that can cause asphyxiation by displacing oxygen. When used in confined spaces, nitrogen is especially hazardous because it cannot be detected by human senses and can cause injury or death within minutes. The employer did not consider that the temporary black plastic cover created an OSHA-defined "confined space" because it was easily removable and therefore did not result in "limited or restricted means of exit" as described in the OSHA definition. OSHA, however, ultimately cited the company for violation of the confined space entry standard, 29 CFR § 1910.146. Regardless of provisions in the confined space standard, OSHA obligates employers to protect workers from harmful workplace conditions. The piping system involved was quite complex so, even though one of the victims helped start the nitrogen purge on the system the day before, the workers may not have realized that the purge was actually connected to the pipe they were inspecting. No warning sign was posted on the pipe to identify it as potentially oxygen deficient or as a confined space. It is not necessary for nitrogen to displace all of the 21% of oxygen normally found in air to become harmful to people. OSHA requires that oxygen levels be maintained at or above 19.5% to prevent injury to workers. Exposure to atmospheres containing 8-10 percent or less oxygen will cause

unconsciousness without warning so quickly that individuals cannot help or protect themselves. Exposure to an atmosphere containing 6-8 percent oxygen can be fatal in as little as 6 minutes. Exposure to an atmosphere containing 4-6 percent oxygen can cause a coma in 40 seconds and subsequent death. See the following table edited from an MSDS for nitrogen for other effects of reduced oxygen concentrations.

### **Inhalation Responses in Oxygen Deficient Atmospheres**

% O<sub>2</sub>   Symptoms or Result

12-16   Breathing and pulse rate increase, muscular coordination slightly disturbed

10-14   Emotional upsets, abnormal fatigue upon exertion, disturbed respiration

6-10   Nausea and vomiting, inability to move freely, possible loss of consciousness, possible collapse, inability to move or cry out even though

          aware of circumstances

< 6    Convulsive movements, gasping respiration; respiration stops and a few minutes later, heart action ceases

### **Recommended Actions:**

Workers and supervisors planning jobs that include inert gas purges should include precautions to prevent personnel injury from oxygen deprivation, especially in confined spaces. If a job includes entry into an OSHA-defined confined space, requirements of 29 CFR § 1910.146 shall be met. Proper hazard assessment should lead job planners to specify hazard controls (SCBA or supplied air) when a nitrogen purge is in progress. Proper hazard analysis should result in implementing other protective measures appropriate for work in confined spaces. Work in enclosed spaces that do not necessarily meet the definition of a "confined space" may present special hazards that need to be evaluated prior to commencing work.

Priority Descriptor: RED/Urgent based on the fatality

Work / Function: Maintenance - Mechanical; Inspection and Testing;

Hazard: Confined Space

ISM Core Function: Analyze Hazards; Develop/Implement Controls

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References: 29 CFR § 1910.146

Chemical Safety Board investigation report number 98-05-I-LA

<[http://www.chemsafety.gov/reports/1998/union\\_carbide/98005lafr.htm](http://www.chemsafety.gov/reports/1998/union_carbide/98005lafr.htm)>

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<<http://www.hanford.gov/lessons/sitell/1196/96e053.txt>>