Important Safety Communication

Division of Fire Safety
Kevin R. Klein, Director
690 Kipling Street, Suite 2000
Lakewood, CO 80215
http://dfs.state.co.us
TEL (303) 239-4600

Division of Emergency Management
Hans Kallam, Director
9195 East Mineral Avenue, #200
Centennial, CO 80112
http://dola.colorado.gov/dem/index.html
TEL (720) 852-6600

7 June 2011

Dear Colorado Emergency Responders and Emergency Managers:

As part of the lessons learned from the Cabin Creek tragedy and interest from emergency responders, the Division of Fire Safety is pleased to announce that it has implemented an accredited technical rescue certification program that includes Confined Space Rescue certification. The Division of Fire Safety would like to thank the members of the various technical rescue committees that devoted their time and expertise to develop the technical rescue certification program and validate the tests and Job Performance Requirements Skill Sheets for the various categories of technical rescue. The Division of Fire Safety would also like to thank the leadership and elected officials of the agencies that allowed their personnel to work on the technical committees.

Both the Division of Fire Safety and the Division of Emergency Management would like to remind Colorado's emergency responders and emergency managers of some of the key lessons learned from the Cabin Creek tragedy. While we will cover some of the important lessons learned, we also suggest you review the Chemical Safety Board's (CSB) findings at http://www.csb.gov/investigations/detail.aspx?SID=9. Of particular interest to the emergency response community is the video titled "No Escape: Dangers of Confined Spaces", which can be accessed from above link.

The Cabin Creek Tragedy:[i]

> On October 2, 2007, a work crew of industrial painters employed by RPI Coating, Inc. (RPI) began applying a new epoxy coating to the steel interior section of the penstock [a 4,163 feet long by 12 feet in diameter pipe that delivers water to the turbines]at the Cabin Creek hydroelectric plant operated by Xcel Energy, Inc. (Xcel), located south of Georgetown, Colorado.

Shortly after the epoxy application commenced, the work crew experienced problems with the spraying process, resulting in poor coating quality. Spraying was terminated and the crew began cleaning the sprayer system equipment with a flammable solvent, methyl ethyl ketone (MEK), to remove epoxy residue before taking the equipment out of the penstock. During this cleaning operation, MEK vapors inside one of the two epoxy hoppers ignited and flashed. The resulting fire grew quickly, consuming several other open containers of MEK and numerous buckets of epoxy material positioned around the sprayer.

Four RPI crew members positioned on the side of the fire nearest the exit evacuated the penstock, although three were later treated for injuries: one received minor burns, one fractured his arm, and another suffered breathing difficulties. Five additional crew members trapped opposite the exit were unable to evacuate due to the fire and narrow configuration of the penstock. The five workers later succumbed to smoke inhalation inside the penstock and died.

As a result of their investigation, the CSB developed several recommendations that pertain to Colorado emergency managers and response personnel. These recommendations include:[ii]

1) The need to train and certify emergency response personnel who perform technical, including confined space rescue.
   a) Implement, through the Division of Fire Safety, an accredited firefighter certification program for technical rescue that encompasses appropriate specialty areas including confined space rescue.
2) Communicate the importance of a written confined space rescue plan for each designated permit space that includes:
   a) Methods of rescue and determination of whether a rescue team is required to standby outside the space.
   b) Rescue equipment requirements and plan of action.
3) Communicate the importance of treating confined spaces with the potential for flammable atmospheres above 10 percent of the lower explosive limit (LEL) as a hazard immediately dangerous to life or health that requires rescuers to be stationed directly outside the permit space and available for immediate rescue with appropriate fire-extinguishing and rescue equipment.
4) Communicate the need for confined space rescue procedures to instruct emergency responders to not enter or occupy a confined space containing a flammable atmosphere 10 percent of the LEL or greater. Personal protective equipment (PPE) will not protect rescuers from an explosion in a confined space.

Confined Space Rescue

A confined space is any space: 1) that has limited or restricted means of entry or exit; 2) is large enough for a person to enter to perform tasks; 3) and is not designed or configured for continuous occupancy.

Confined spaces that present special hazards may be classified as permit-required confined spaces depending on the nature and severity of the hazard.[iii] Permit-required confined space (permit space) means a confined space that has one or more of the following characteristics:[iv]

1. Contains or has a potential to contain a *hazardous atmosphere*[1];
2. Contains a material that has the potential for engulfing an entrant;
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
4. Contains any other recognized serious safety or health hazard.

Entry into permit-required confined spaces must be managed through the use of a written entry program that issues entry permits, assigns attendant(s), designates entrants, and ensures a means of rescue. The means of rescue must be evaluated as to whether a potential rescue service or team is adequately trained and equipped to perform permit space rescues of the kind needed at the facility and whether such rescuers can respond in a timely manner prior to commencing entry.[v]

The CSB determined that a contributing cause of the Cabin Creek tragedy was inadequate rescue capability. Xcel and RPI managers did not plan and coordinate the immediate availability of qualified confined space technical rescuers outside the penstock, although the use of flammable solvent in the open atmosphere of the permit space created the need for immediate rescue due to the potential for conditions that were immediately dangerous to life or health.[vi]

- After the penstock fire erupted, firefighting and rescue activities likely would have been successful and prevented the fatalities had qualified personnel and equipment been immediately available; the trapped RPI workers were in radio communication with coworkers and emergency responders for 45 minutes after the initial 9-1-1 emergency call.
- Neither company ensured that emergency response organizations or personnel with confined space technical rescue qualifications were immediately available with the necessary fire-fighting equipment outside the penstock.
- The approximate travel time of the closest identified public emergency response organization with confined space technical rescue qualifications was approximately 1 hour and 15 minutes.

These findings reinforce the importance of developing a written confined space rescue plan for each designated permit space. A permit-required confined space rescue plan should:[vii]

[1] Under 29 CFR 1910.146(b), a "Hazardous atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

(1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
(2) Airborne combustible dust at a concentration that meets or exceeds its LFL;
(3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
(4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;
(5) Any other atmospheric condition that is immediately dangerous to life or health.

1. Be written
2. Whenever feasible, specify rescue methods that do not involve entry by rescuers into the confined space
3. Prevent unauthorized persons from attempting a rescue inside the confined space
4. Ensure necessary rescue equipment to effectively conduct the rescue is provided and is in proper working condition prior to entry into the space
5. Verify that:
    a. Rescuers have been notified
    b. Rescuers are physically located so they can effect a successful and *timely rescue* at any point during the entry
    c. Rescuers have been trained on rescue from the particular space being entered

It is important to note that a timely rescue is required because "atmospheric hazards which deprive authorized entrants from a safe air supply generally pose life-threatening situations after about five minutes, through some hazards incapacitate or kill even faster."[viii]

Hazardous Atmospheres and Confined Spaces

Failure to recognize, monitor, mitigate and avoid an atmosphere that was immediately dangerous to life or health were among the root causes of the Cabin Creek tragedy. The CSB found that:[ix]

- Xcel and RPI management did not ensure effective planning and coordination of the Cabin Creek penstock recoating project to control or eliminate the serious confined space hazards that were present.
    - An effective hazard evaluation of the penstock confined space was not performed;
    - The work required the use of a solvent to clean the epoxy sprayer and associated equipment in the open penstock atmosphere, yet the serious safety hazards of using a flammable solvent inside the confined space were not identified or addressed.
    - Substituting a non-flammable solvent was not considered.
    - Important safety precautions when using a flammable in a confined space, such as continuous monitoring in the work area, providing adequate ventilation, and eliminating or controlling ignition sources, were not implemented.
- Xcel's and RPI's corporate safety policies and permits did not effectively establish safe limits for flammable atmospheres in permit-required confined spaces that would prohibit entry or occupancy when those limits were exceeded.

The Cabin Creek tragedy is also a reminder of the importance of proper atmospheric testing to the emergency response community. Atmospheric testing is required for two distinct purposes: 1) evaluation of the hazards of the confined space, and 2) verification that acceptable entry conditions for entry into that space exist and are maintained throughout the duration of the entry. Procedures for atmospheric testing include:[x]

1. **Evaluation testing**. The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate entry procedures can be developed.
2. **Verification testing.** The atmosphere of a confined space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions.
3. **Duration of testing.** Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument as specified by the manufacturer.
4. **Testing stratified atmospheres**. When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately 4 feet (1.22 m) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response.
5. **Testing large spaces, or spaces connected to a continuous system (such as a sewer)**. Conduct pre-entry testing to the extent feasible from outside the space before entry. Then, if the entry is authorized, continuously monitor for acceptable entry conditions where authorized entrants are working inside the permit space.
6. **Order of testing.** A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere. Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gases and vapors. If tests for toxic gases and vapors are necessary, they are performed last.

If there is a potential for flammable atmospheres above 10 percent of the lower explosive limit, the hazard should be considered *immediately dangerous to life or health*.[2] This requires rescuers to be stationed directly outside the confined space and available for immediate rescue with appropriate training, and fire-extinguishing and rescue equipment.

If emergency response personnel encounter a confined space rescue with a flammable atmosphere 10 percent of the lower explosive limit or greater, entry should not be made without mitigating the hazard, e.g., ventilating the space. Keep in mind that personal protective equipment will not protect rescuers from an explosion in a confined space.

[2] "Under 29 CFR 1910.146(b), “Immediately dangerous to life or health (IDLH)" means any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space. NOTE: Some materials -- hydrogen fluoride gas and cadmium vapor, for example -- may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

End Notes

[i] U. S. Chemical Safety and Hazard Investigation Board, Investigation Report, Xcel Energy Hydroelectric Plant Penstock Fire, Report NO. 2008-01-I-CO, August 2010, pp. 11 & 12.
[ii] U. S. Chemical Safety and Hazard Investigation Board, Investigation Report, Xcel Energy Hydroelectric Plant Penstock Fire, Report NO. 2008-01-I-CO, August 2010, pp. 118 & 119.
[iii] 29 CFR, 1910.146
[iv] *Ibid.*
[v] 29 CFR, 1910.146, Appendix F
[vi] U. S. Chemical Safety and Hazard Investigation Board, Investigation Report, Xcel Energy Hydroelectric Plant Penstock Fire, Report NO. 2008-01-I-CO, August 2010, pg. 115
[vii] Georgia Tech Confined Space Entry Program, http://www.oshainfo.gatech.edu/written/confined-space.pdf.
[viii] Federal Register, Volume 58, page, 4525, column 3.
[ix] U. S. Chemical Safety and Hazard Investigation Board, Investigation Report, Xcel Energy Hydroelectric Plant Penstock Fire, Report NO. 2008-01-I-CO, August 2010, p.113.
[x] 29 CFR, 1910.146, Appendix B and 29 CFR 1910.146(d)(5)