



U. S. Chemical Safety and Hazard Investigation Board RECOMMENDATIONS STATUS CHANGE SUMMARY

Report:	Valero Refinery Asphyxiation Incident
Recommendation Number:	2006-2-I-DE-R7
Date Issued:	November 2, 2006
Recipient:	American Society of Safety Engineers (ASSE)
New Status:	Closed – Exceeds Recommended Action
Date of Status Change:	March 1, 2017

Recommendation Text:

Revise Safety Requirements for Confined Spaces, ANSI/ASSE Z117.1, to emphasize that:

- *An oxygen-deficient atmosphere rapidly overcomes the victim*
- *There is no warning before being overcome*
- *An oxygen-deficient atmosphere might exist outside a confined space opening*
- *Rescuers must strictly follow safe rescue procedures*

Board Status Change Decision:

A. Rationale for Recommendation

On November 5, 2005, two contractors were overcome and killed by nitrogen gas which displaced the oxygen while they were working near a hydrocracker unit reactor at the Valero Energy Corporation (Valero) refinery in Delaware City, Delaware. The workers were assigned to install a pipe assembly connected to a reactor that was purged with nitrogen. As one of the contractors was preparing the area for work, he tried to retrieve a roll of duct tape from inside the reactor and was overcome by the oxygen-deficient atmosphere. His co-worker went in after him, and also succumbed to oxygen deprivation.

As a part of the investigation, the CSB reviewed applicable industry standards and guidelines that applied to this incident. The American Society of Safety Engineers (ASSE) publishes ANSI/ASSE Z117.1, *Safety Requirements for Confined Spaces*. The CSB reviewed the 2003 edition, which was in effect at the time of the incident, and concluded that it did not adequately address three critical elements with respect to inert gas purged confined spaces:

- Hazardous (oxygen-depleted) atmospheres may be present outside the confined space, near openings;
- Acute oxygen deprivation rapidly overwhelms the victim without warning; and
- Unprotected entry into an oxygen depleted atmosphere for any length of time, no matter how brief, can be deadly.

Consequently, the Board issued a recommendation to the ASSE to address these concerns in the next revision of the Z117.1 standard.

B. Response to the Recommendation

On August 4, 2016, the ASSE committee approved the 2016 edition of ANSI/ASSE Z117.1, *Safety Requirements for Entering Confined Spaces*, with an effective date of January 1, 2017. The 2016 edition added explanatory material and/or wording changes to Section 2.21 (Oxygen Deficiency); Section 6.1.2 (Atmospheric Testing); Section 6.3.1.1 (Acceptable limits for oxygen); and Section 14 (Emergency Response, Evacuation and Rescue) which satisfy all the bullet points listed in the CSB Recommendation. In addition, the Foreword to the 2016 edition notes that in 2009 oxygen deficiency was the leading atmospheric hazard that resulted in fatalities inside confined spaces.

Moreover, the 2016 edition added explanatory material and wording changes to Section 2.5 (Types of Confined Spaces); Section 3.2.4. (Biological Hazards); and Section 15.6.1 (Roles of Rescue Personnel) to incorporate important lessons learned from other CSB investigations involving confined spaces; namely the 2007 Xcel Energy Hydroelectric Plant Penstock Fire and the 2008 Packaging Corporation of America Storage Tank Explosion.

C. Board Analysis and Decision

As the 2016 edition of ANSI/ASSE Z117.1, *Safety Requirements for Entering Confined Spaces*, addresses all the bullet points listed in recommendation and also includes valuable lessons learned from other CSB investigations involving confined spaces that were not the subject of this recommendation, the Board voted change the status of CSB Recommendation No. 2006-2-I-DE-R7 to: “**Closed – Exceeds Recommended Action.**”