HAZARD INFORMATION BULLETIN:

H2S Exposure

Following are excerpts from a Hazard Bulletin issued by OSHA after a fatality due to H2S exposure.

Fundamentally, employers and employees must be alert to the fact that working with a "closed system" does not always ensure safety. Operations involving the opening of valves or pumps on otherwise closed systems or working on such equipment that is not isolated or locked out are particular sources of danger. When a normally closed system is opened, the potential exists for releasing hazardous chemicals to the workers' breathing zones in unknown concentrations.

Examples of accidents

OSHA reviewed previous fatality inspections involving valves or industrial piping systems and found the following incidents where one or more workers had died. Some examples of these types of accidents included:

* In 1988, two workers were operating a sodium purification system. One worker attempted to pump a sodium sulfhydrate solution into a tank and accidentally opened the valve to another tank which contained an acidic solution. The mixture of the two compounds generated and released hydrogen sulfide gas to which the victim was exposed.

* In 1988, a refinery employee received a fatal exposure to hydrogen sulfide gas while draining the contents of a knockout drum to an oily water sewer, rather than activating a closed system to pump out the drum. The worker failed to observe procedures calling for the use of a closed system, and the valve to the sewer was not locked out.

* In 1993, employees were working in a coker unit that thermally cracks heavy residual feed through a process called delayed coking. The workers were preparing to switch the feed to the core drum, which necessitated opening and closing a number of valves. Three workers were involved with opening and closing the valve, each working at a different location. As the operation was proceeding, a loud noise was heard and a vapor cloud was observed in the vicinity of the pumps feeding the process. The vapor cloud ignited, fatally burning two of the workers.

* In 1994, an employee was killed when disconnecting a line from an ammonia valve causing liquid ammonia to be released, striking the worker on his face and body.

* In 1994, a tragic fatality caused by exposure to hydrogen sulfide was reported by the Billings, Mont. OSHA Area Office. The accident was associated with opening a valve to a sewer cup during the draining of a fuel gas knockout drum in a hydro treating unit of a petroleum refinery. Normal work procedures included periodically opening a valve that carried a water-gas mixture to a separator which removed and vented hydrocarbon gases to a flare.

During the preceding winter, the piping to the separator froze, and the drum was temporarily drained to the sewer. OSHA believes that, due to unclear procedures, the temporary practice of draining some of the water-gas mixture to the sewer in some instances may have been continued, or was incorporated by some workers into the normal draining procedures.

The worker who was killed is thought to have opened the valve to the sewer believing it to be part of the draining procedure, resulting in the release of toxic and fatal amounts of hydrogen sulfide.

Common factors and problems

A common theme running through many industrial fatalities is that they involve situations where a closed industrial system is opened through a valve or pump either to perform maintenance work, vent by-products, or remove condensate. The hazards inherent in these operations should be addressed by one or more of the following measures:

1. Perform a process hazard analysis to address the hazards of the process and engineering and other control measures to ensure worker safety, including a complete evaluation and assessment of process systems handling waste products, by-products, and/or unreacted process components. Recommendations made by the PHA team, including recommended engineering changes, should be promptly implemented.

2. Assure that the system is locked out, including draining and purging of lines and equipment, prior to working on the system.

3. Assure that written procedures are clear and that they provide complete instructions for the safe performance of work activities.

4. Assure that employees, including contract employees, are trained in applicable procedures and safe work practices, and that the employees understand and adhere to the current operating procedures of the process.

While the risk of accidents cannot be entirely eliminated, these procedures and practices will reduce the potential for accidental exposure to hazardous chemicals.

Applicable control measures

Engineering controls -- Plant systems containing hazardous chemicals must be completely assessed to assure that valves capable of releasing the toxic agent to the atmosphere are permitted to be opened only when absolutely necessary and are then vented to a safe location. The valves must also be capable of being locked out.
Sewer systems for draining tanks or drums which present potential exposure to hazardous chemicals should be constructed so that they are closed, vented to a safe location, or not open to the atmosphere. Alternatively, appropriate respiratory protection should be worn before these systems are used.
A valve configuration on an industrial process should be such that only the valves used for

routine use as part of the normal process are readily capable of being opened. If the valves are required to be opened for occasional shutdown operations, they must be locked and tagged in the closed position to preclude erroneous opening during routine plant operations.
Valves that must remain available for immediate use in emergency operations should be clearly labeled as such so that they are not accidentally opened during routine operations.

Monitoring and detection equipment -- Operators working on units where there is potential exposure to hazardous chemicals may need to be supplied with personal monitoring equipment. Alternatively, stationary monitors could be installed. Personal or stationary monitors must be capable of sounding an audible alarm or warning.

Training -- All current and new employees should receive training in standard operating procedures covering all aspects of the job, with emphasis on safe work practices. Where appropriate, training should also include field observations (on-the-job training) by qualified supervisory personnel, including verification that workers have satisfied the training requirements.
Training must include proper procedures for working around areas of potential exposure to hazardous chemicals and include the hazards of exposure. While labeling of pipes cannot be required, the hazard communication standard does require that the employer address the hazards of unlabeled piping systems in a written hazard communication program and that the information be provided through training to workers.

Respiratory protection -- Respirators must be provided by the employer when effective engineering controls are not feasible, or while they are being instituted, when such equipment is necessary to protect the health of the worker. The employer must provide respirators that are applicable for the purpose intended.
Written procedures must be developed for the safe use of respirators during the performance of operations presenting a potential exposure to hazardous chemicals.

Under circumstances where individuals may be exposed to an unknown concentration of hydrogen sulfide or some other hazardous chemical, back-up personnel with appropriate respirators and emergency equipment must be present.

Sources:
Proctor and Hughes' *Chemical Hazards of the Workplace, Third Edition.* Van Nostrand Reinhold, New York, 1991.
Neurobehavioral Impairment from H2S. Kaye H. Kilburn, M.D. and Raphael H. Warshaw, B. A., University of Southern California School of Medicine, Environmental Sciences Laboratory: Los Angeles, CA, 1991.
ILO Encyclopaedia of Occupational Health and Safety Third Edition. International Labor Office, Geneva, 1983.

Published by the Oil, Chemical and Atomic Workers International Union
AUGUST 1996