OSHA FATALFacts

No. 18 – 2023

Hydrogen Sulfide Release

U.S. Department of Labor | Occupational Safety and Health Administration | www.osha.gov • (800) 321-OSHA (6742)

BRIEF DESCRIPTION OF INCIDENT*

A worker died of acute hydrogen sulfide (H_2S) poisoning while responding to an alarming water pump involved in the process of extracting crude oil and natural gas. The worker was alone in the pump house attempting to close process valves to isolate the pump. Either before the worker's arrival or during his work, the pump unexpectedly energized, releasing water containing H_2S gas into the pump house. H_2S monitors in and around the building were not functioning, and the worker was not wearing a personal H_2S gas detector. The H_2S concentration reached fatal levels killing the worker. A few hours later, out of concern that she had not heard from her husband in a while, the worker's spouse entered the facility and died from H_2S poisoning. Emergency responders noted they could smell H_2S as soon as they entered the facility. As they approached the pump house, the smell of H_2S was overwhelming even though the pump houses' bay doors were partially open and there were no H_2S alarms.

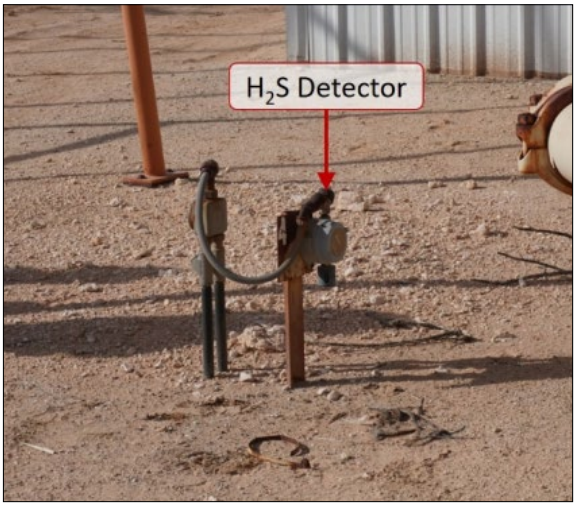

Photo: U.S. Chemical Safety and Hazard Investigation Board

LIKELY CAUSES

The employer knew about the potential H_2S exposure hazard, but did not establish and enforce a formal policy requiring employees to wear personal H_2S detectors while in the pump house or adhere to OSHA's standard on *air contaminants,* 29 CFR 1910.1000.

Although the facility had been equipped with multiple H_2S detection and alarm systems, none of the detectors communicated with the system's control panel. Some detectors had been set to a testing mode, preventing any alarm signals from being sent by any of those detectors to the alarm control panel. Other detectors that were correctly set up were also unable to send a signal to the control room. The employer supplied personal H_2S gas detectors, which would have notified the worker of the potential exposure with an audible alarm, but they did not have formal written policies requiring their use.

The following contributed to the deaths. The employer:

- Failed to maintain and properly configure the H_2S detection and alarm system.
- Failed to enforce operator use of personal H_2S detectors when in the vicinity of equipment or facilities with the potential for an H_2S release.
- Failed to develop, train, and enforce lockout/tagout procedures.
- Failed to evaluate the ventilation systems of the building to ensure it was adequately ventilated and in working condition.
- Lacked a robust safety management program.
- Did not establish procedures prohibiting untrained visitors from entering processing buildings; which allowed the employee's spouse to access the facility and her subsequent toxic H_2S exposure and death.

H2S is a colorless, flammable, and corrosive gas with an odor similar to rotten eggs. People can lose their ability to smell H2S, even at low concentrations, a condition called olfactory fatigue. Because of olfactory fatigue, OSHA warns that the sense of smell should not be used as a detection method. According to the National Institute for Occupational Safety and Health (NIOSH), H2S environmental concentrations of 100 ppm are immediately dangerous to life or health, concentrations greater than 500 ppm can cause a person to collapse within five minutes, and concentrations exceeding 700 ppm can cause immediate collapse, and death, within just one or two breaths. The OSHA permissible exposure limit (PEL) for H2S is 20 ppm (29 CFR 1910.1000 Table Z-2) and is not to be exceeded at any time during an 8-hour shift, except if the exposure is 50 ppm for no more than 10 minutes in an 8-hour shift so long as no other measurable exposure occurs.

* Some of the information in this FatalFacts was obtained from the US Chemical Safety and Hazard Investigation Board Final Investigation Report on Aghorn Operating Waterflood Station Hydrogen Sulfide Release: www.csb.gov/file.aspx?DocumentId=6155.

INCIDENT PREVENTION

H_2S hazards during oil and gas production activities are generally well known. In this instance, H_2S is a known hazard for oil and gas activities in the Permian Basin where this facility was located. Employers must implement appropriate safeguards against H_2S exposure hazards.

Employers must have engineering and administrative controls for air contaminants whenever feasible in compliance with 29 CFR 1910.1000(e). When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures must be used to keep the exposure of employees to air contaminants within the limits of OSHA's *air contaminants* standard, 29 CFR 1910.1000. Respirators must comply with NIOSH guidelines for respiratory protection and OSHA's standard on *respiratory protection,* 29 CFR 1910.134. Whenever respirators are used, employers shall ensure that the selected respirators are certified and used in compliance with their certification conditions in accordance with 29 CFR 1910.134(d)(1)(ii). The NIOSH division of National Personal Protective Technology Laboratory (NPPTL) provides a certified equipment list that is regularly updated as respirators are approved, made obsolete, or the status changes in any way.

Additionally, if the pump had been properly isolated under a lockout/tagout program, it is less likely the worker would have been exposed to such high concentrations of H2S. Employers must have a formalized lockout/tagout program to isolate equipment from energy sources. This program should emphasize energy control procedures, training, and periodic inspections in compliance with OSHA's *control of hazardous energy* standard 29 CFR 1910.147.

The US Chemical Safety and Hazard Investigation Board (CSB), an independent federal agency charged with investigating industrial chemical accidents, recommend the following to the employer:

- Mandate the use of personal H_2S detection devices as an integral part of every employee or visitor personal protective equipment (PPE) kit prior to entering the vicinity of the facility. Ensure detector use is in accordance with manufacturer specifications. (2020-01-I-TX-1, abbreviated)
- Commission an independent and comprehensive analysis of each facility ventilation design and mitigation systems to ensure that workers are protected from exposure to toxic gas (2020-01-I-TX-3, abbreviated)
- Ensure the H_2S detection and alarm systems are properly maintained and configured and develop site-specific detection and alarm programs and associated procedures based on manufacturer specifications, current codes, standards, and industry good practice guidance (2020-01-I-TX-5, abbreviated).

Employers in the oil and gas production industries should develop and implement a written formal site-specific security program to prevent unknown and unplanned entrance of non-employees to the facility. Site security for petroleum and petrochemical facilities should follow industry standards and guidance such as ANSI/API Standard 780, *Security Risk Assessment Methodology for the Petroleum and Petrochemical Industries,* and API RP 781, *Facility Security Plan Methodology for the Oil and Natural Gas Industries*.

YOU HAVE A VOICE IN THE WORKPLACE

The Occupational Safety and Health Act of 1970 (OSH Act) affords workers the right to a safe workplace and the right to speak up about hazards without fear of retaliation (see OSHA's Worker Rights page, www.osha.gov/workers). Workers also have the right to file a safety & health complaint with OSHA if they believe that there are either violations of OSHA standards or serious workplace hazards. In addition, if workers are retaliated against for exercising their rights under the OSH Act, they may file a whistleblower complaint with OSHA within 30 days of the alleged retaliation.

HOW OSHA CAN HELP

For questions or to get information or advice, to report an emergency, fatality, hospitalization, amputation, or loss of an eye, or to file a confidential complaint, contact your nearest OSHA office, visit http://www.osha.gov or call our toll-free number at 1-800-321-OSHA (6742), TTY 1-877-889-5627. It's confidential

MORE INFORMATION

- OSHA standards and regulations: www.osha.gov/law-regs
- OSHA publications: www.osha.gov/publications
- OSHA-approved state plans: www.osha.gov/stateplans
- OSHA's free On-site Consultation services: www.osha.gov/consultation
- Training resources: www.osha.gov/training
- Help for Employers: www.osha.gov/employers

ADDITIONAL RESOURCES

The following CSB report provides a detailed incident report: Aghorn Investigation Report

The following resources provide additional information on chemical hazards, respiratory protection, H_2S, and the control of hazardous energy:

- OSHA Chemical Hazards and Toxic Substances Safety and Health Topics
- OSHA Respiratory Protection Safety and Health Topics
- OSHA Lockout/Tagout Safety & Health Topics, Fact Sheet, Guidance Booklet, eTool
- For the oil and gas extraction industry specifically:
  - OSHA Safety & Health Topics and eTool
  - Harwood Grant Training Materials PowerPoint
  - LOTO OSHA Harwood Grant Training Materials PowerPoint
- OSHA Hydrogen Sulfide Safety & Health Topics, Fact Sheet, eTool, and Quick Card
- NIOSH H2S Safety and Health Topics
- NIOSH National Personal Protective Technology Laboratory (NPPTL)
- Oil & Gas Well Drilling Common Incidents Asphyxiation
- OSHA-NIOSH Hazard Alert: Health and Safety Risks for Workers Involved in Manual Tank Gauging and Sampling at Oil and Gas Extraction Sites

Note: *The described case was selected to increase awareness of the risk discussed and prevent similar fatalities. The incident prevention recommendations do not necessarily reflect the outcome of any legal aspects of this case. OSHA encourages your company or organization to duplicate and share this information.*

For assistance, contact us. We can help. It's confidential.

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