	HYDROGEN SULFIDE PROGRAM	Document No.:	HSE-OP-009
		Department:	Operations
		Revision Date:	31 MAR 2010
Release authorized by:	D. Slattery	Page	Page 1 of 8

Purpose

Hydrogen Sulfide exposure can be fatal, the result of asphyxiation. Hydrogen Sulfide affects primarily the respiratory system. Hydrogen Sulfide is also a highly flammable gas. Hydrogen sulfide presents a potential hazard to workers at the work site. To ensure protection against exposure to hydrogen sulfide, both workers and employers must be aware of its properties, how it affects the body and what to do in emergency situations.

Trinity has established this Hydrogen Sulfide program to ensure the safety of employees who may be potentially exposed to H₂S at or above the ceiling level of 15 ppm.

Administrative Duties

The Training and Compliance Manager is the program coordinator/manager and is responsible for its implementation. Copies of the written program may be obtained in the Operations office.


Occurrence of Hydrogen Sulfide

Hydrogen sulfide exposures usually occur during the drilling for or production of natural gas, crude oil and petroleum products. Hydrogen sulfide is also produced by the putrefaction of organic matter and may accumulate in sewers, sewage treatment plants or hide storage pits in the tanning industry. Well drillers and tunnel workers, as well as miners, may be exposed when underground pockets of hydrogen sulfide are encountered. Hydrogen sulfide may be used in the manufacture of inorganic sulfides, sulfuric acid and mercaptans. Potential employee exposures can occur during the following operations:

- Drilling Operations
- Recycled Drilling Mud
- Water from Sour Crude Wells
- Blowouts
- Tank Gauging (tanks at producing, pipeline & refining operations)
- Piping
- Field Maintenance
- Tank Batteries & Wells, etc.
- Storage & Handling Facilities

Characteristics of Hydrogen Sulfide

Hydrogen sulfide (H₂S) is a colorless gas with a powerful nauseating smell of rotten eggs. The odor is a poor warning property because hydrogen sulfide exposure quickly deadens the sense of smell. The gas is heavier than air and may collect in low areas such as sewers, pits, tunnels or gullies. High airborne levels of hydrogen sulfide (between 4.3 and 46.0 percent of gas by volume in the air) may catch fire if there is a source of ignition. If the gas is burned, toxic products such as sulfur dioxide will be formed. Hydrogen sulfide is incompatible with oxidizing agents, such as nitric acid and chlorine trifluoride, and may react violently or ignite spontaneously.

	HYDROGEN SULFIDE PROGRAM	Document No.:	HSE-OP-009
		Department:	Operations
		Revision Date:	31 MAR 2010
Release authorized by:	D. Slattery	Page	Page 2 of 8

Health Effects on the Body

Hydrogen sulfide is extremely toxic. It may cause death instantaneously in high airborne concentrations. Low levels may be extremely irritating to the lungs, nose, throat and eyes.

Hydrogen sulfide can be detected by smell at levels as low as 0.13 parts hydrogen sulfide per million parts air (ppm). Odor cannot be used as a warning because the gas can deaden the sense of smell within 2 to 15 minutes in exposures of approximately 100 ppm.

A single breath of hydrogen sulfide at about 1000 ppm may paralyze the respiratory system and result in coma and death. Convulsions may also occur. Prolonged exposure at about 250 ppm hydrogen sulfide may cause the lung tissue to swell and fill up with water (pulmonary edema).

This effect may occur after the exposed worker recovers from the irritant effects of the gas. Exposures of 20 to 50 ppm hydrogen sulfide for one hour may cause inflammation of the cornea and the delicate lining of the eye and eyelid (a condition called keratoconjunctivitis). Exposures for long periods at 50 ppm may cause severe irritation of the nose, throat and lungs. Workers exposed to lower concentrations of hydrogen sulfide may develop headaches, eye disorders and chronic bronchitis.

Scope

This program applies to any worker(s) engaged in work activities in or near an area where they may potentially be exposed to harmful levels of Hydrogen Sulfide (H₂S). In the event the Company is hired to perform work for another Contractor, the Company shall be aware of the owner's contingency and emergency plan provisions. Employees must be aware of and follow provisions of site specific contingency plans. Trinity will develop and implement a Code of Practice when and if:


- a pure substance in an amount exceeding 10 kilograms, or
- in a mixture in which the amount of the substance is more than 10 kilograms and at a concentration of 0.1 percent by weight or more at a worksite.

Strict adherence to the Company's Confined Space Entry Program shall be observed when employees will be working inside tanks, vessels or in other situations that fall into the Confined Space Entry Program. Employees shall be trained per the requirements of applicable safety regulations.

General

The Company will ensure that all potential sources of Hydrogen Sulfide within the facility(s) or host employers are evaluated. This standard practice instruction is intended to address comprehensively the issues of; evaluating and identifying potential sources of Hydrogen Sulfide, evaluating the associated potential hazards, communicating information concerning these hazards, and establishing appropriate procedures, and protective measures for employees.

Responsibility

	HYDROGEN SULFIDE PROGRAM	Document No.:	HSE-OP-009
		Department:	Operations
		Revision Date:	31 MAR 2010
Release authorized by:	D. Slattery	Page	Page 3 of 8

The Training and Compliance Manager is responsible for all facets of this program and has full authority to make necessary decisions to ensure success of the program. The Training and Compliance Manager is the authorized to amend these instructions and is authorized to halt any operation of the Company where there is danger of serious personal injury.

Related Programs

The following safety programs are to be used in conjunction with this program:

- Process Safety Management Program.
- Confined Space Entry Program.
- Hazard Communication Program.
- Respiratory Protection Program
- Personal Protective Equipment

Employer Responsibilities

A worker may not be exposed to H₂S at a concentration exceeding its ceiling limit at any time.

Note: the ceiling limit can not exceed at any time, without respiratory equipment, of 15 ppm.

In order to protect workers from the hazards of hydrogen sulfide, there are several control options available to the employer. These may include "engineering out" the hazard, putting safe work procedures in place or using administrative controls. Administrative controls involve such approaches as job rotation, work assignment or time periods away from hydrogen sulfide.


The method(s) used will depend on the condition at the work site. If such measures are inadequate to protect workers, or in the event of an emergency, appropriate breathing apparatus providing positive pressure to the facepiece must be provided. Workers must also be trained in its use. The Respiratory Protection Program chapter shall be consulted and provides information on the selection, care and use of respiratory protective equipment.

Other personal protective equipment must also be provided if necessary. If personal protective equipment is used, it must be properly selected and cared for. At the minimum, a NIOSH-certified self-contained breathing apparatus or airline respirator with escape SCBA shall be used.

Worker Responsibilities

Current regulations require the worker to take reasonable care of himself and others at the work site. This includes co-operating with the employer for the purpose of protecting himself and others. The worker must:

- become aware of the associated hazards and follow work practices and procedures developed by the employer;
- wear protective equipment supplied by the employer to ensure protection and follow instructions on correct usage.

	HYDROGEN SULFIDE PROGRAM	Document No.:	HSE-OP-009
		Department:	Operations
		Revision Date:	31 MAR 2010
Release authorized by:	D. Slattery	Page	Page 4 of 8

Respiratory Protection

NIOSH-certified, self-contained breathing apparatus or airline respirator with escape SCBA will be required for employees potentially exposed to hydrogen sulfide above the PEL.

In Case of an Emergency

Workers and employers both have responsibilities in emergency situations.

The employer must:

- be aware of owner's contingency plan provisions.
- have emergency procedures developed in advance of any potential emergency involving hydrogen sulfide leaks;
- ensure that workers are aware of the procedures, are trained and are adequately supervised in an emergency;
- provide workers with appropriate breathing apparatus providing positive pressure to full facepieces;
- ensure that workers use other protective equipment necessary for use in an emergency.


The worker must:

- vacate the area immediately if a sensor alarm is activated and shall not reenter without proper respiratory protection;
- avoid breathing hydrogen sulfide while quickly leaving the area for fresh air;
- move an exposed person who has breathed large amounts of hydrogen sulfide to fresh air at once. If breathing has stopped, perform artificial respiration;
- notify someone else and put into effect the established emergency rescue procedures whenever an exposed person is overcome;
- not re-enter a hydrogen sulfide-filled area of unknown concentration unless equipped with full facepiece positive pressure breathing apparatus;
- be prepared to assist fellow workers, while making sure the correct emergency procedures are followed. It is important not to take unnecessary risks when rescuing or assisting a fellow worker.
- be aware of and follow provisions of site-specific contingency plans.

Requirements

The requirements of this Program are the minimum acceptable standards with regard to work activities conduct in or near areas where workers may potentially be exposed to harmful levels of hydrogen sulfide. The management representative may, after consideration of all appropriate factors, require corrective actions and abatement periods that in some cases, vary from those specified in this Program and that he/she determines to be necessary to protect public health and safety, or the environment.

General Requirements

	HYDROGEN SULFIDE PROGRAM	Document No.:	HSE-OP-009
		Department:	Operations
		Revision Date:	31 MAR 2010
Release authorized by:	D. Slattery	Page	Page 5 of 8

The Company will establish Hydrogen Sulfide operational procedures through the use of this document.

Facility Evaluation

The Company shall evaluate our facility(s) or host employer facilities to determine if any work area meets the criteria for designation as a Hydrogen Sulfide Hazard Area.

Permit-Required Confined Space Program


The Company will implement our confined space program when performing work in areas designated as a confined space. The permit-required confined space program will conform to the requirements of applicable safety regulations. The Company shall:

- Implement the measures necessary to prevent unauthorized entry.
- Identify and evaluate the hazards of permit spaces before employees enter them.
- Pre-Entry requirements. Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:
 - Specifying acceptable entry conditions.
 - Isolating the permit space.
 - Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards.
 - Provide pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards.
 - Verify that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.
 - Develop and utilize checklists based on this standard practice instruction.

Equipment Requirements

Provide the following equipment at no cost to employees, maintain that equipment properly, and ensure that employees are trained in the proper use of the equipment:

- Testing and monitoring equipment needed to determine if hazardous conditions exist or to verify that they do not exist.
- Ventilating equipment needed to obtain acceptable air quality entry conditions.
- Communications equipment necessary for communication between personnel involved in the entry operation.
- Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees.
 - NIOSH-certified, self-contained breathing apparatus or airline respirators with escape SCBA should be used.
- Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency.


	HYDROGEN SULFIDE PROGRAM	Document No.:	HSE-OP-009
		Department:	Operations
		Revision Date:	31 MAR 2010
Release authorized by:	D. Slattery	Page	Page 6 of 8

- Barriers and shields as required protecting workers from pedestrian and vehicular traffic.
- Ladders, needed for safe ingress and egress by authorized entrants.
- Rescue, Retrieval, and Emergency equipment needed to extract or treat injured personnel, except to the extent that the equipment and or service is provided by rescue services that are immediately available.
- Any other equipment necessary for safe entry into and rescue from permitted spaces at our facility.
- Principal equipment needed to conduct confined space operations. The below listed safety equipment will be maintained where required for confined space operations.
 - Multi-gas monitors
 - Ventilation equipment
 - Rescue tripod/davit arm and winch system
 - Body harnesses
 - Extraction cable and lanyards
 - Air compressors (as required)
 - Supplied air respirators (as required)
 - Air purifying respirators (as required)
 - SCBA equipment (as required)
 - Emergency escape breathing apparatus (as required)
 - Radio communication system (as required)
 - Signage (as required)
 - Lock-out/tag-out equipment (as required)
 - Intrinsically safe lighting equipment
 - Personal protective clothing
 - Hearing protection equipment
 - Head protection equipment
 - Eye protection equipment
 - First aid kits
 - Time keeping equipment
 - Hand tools
 - Escape ladders for depths of four feet or shoulder height

Procedures for Atmospheric Testing

Atmospheric testing for Hydrogen Sulfide Hazard Areas is required for two distinct purposes: Evaluation of the hazards of the work area and verification that acceptable entry conditions for entry into that area exist. Personal and/or area monitors will be used to detect H₂S. The monitors will be set to alarm when the PEL exceeds the preset level of 20 PPM. When an alarm sounds, vacate the area and do not re-enter without proper respiratory protection.

Evaluation Testing

	HYDROGEN SULFIDE PROGRAM	Document No.:	HSE-OP-009
		Department:	Operations
		Revision Date:	31 MAR 2010
Release authorized by:	D. Slattery	Page	Page 7 of 8

This company will ensure that the atmosphere is analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise. Evaluation and interpretation of these data, and development of the entry procedure, will be done by, or reviewed by, a technically qualified professional (e.g., certified industrial hygienist, registered safety engineer, certified safety professional, certified marine engineer, etc.) based on evaluation of all serious hazards. The internal atmosphere will be tested, with a calibrated direct-reading instrument, for the following conditions in the order given:

- Oxygen content (19.5% - 23.5%)
- Flammable gases and vapors
- Potential toxic air contaminants
- Airborne combustible dusts Site Specific

Verification Testing

The atmosphere of a work area designated as a permit space which may contain a hazardous atmosphere will be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions. Results of testing (i.e., actual concentration, etc.) will be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition. The atmosphere will be verified, with a calibrated direct-reading instrument, for the following conditions in the order given:

- Oxygen content (19.5% - 23.5%)
- Flammable gases and vapors
- Potential toxic air contaminants
- Airborne combustible dusts Site Specific


Duration of Testing

Measurement of values for each atmospheric parameter will be made for at least the minimum response time of the test instrument specified by the manufacturer.

Testing Stratified Atmospheres

When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope will 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 will be slowed to accommodate the sampling speed and detector response. The stratified atmosphere will be tested, with a calibrated direct-reading instrument, for the following conditions in the order given:

- Oxygen content (19.5% - 23.5%)
- Flammable gases and vapors
- Potential toxic air contaminants
- Airborne combustible dusts Site Specific

	HYDROGEN SULFIDE PROGRAM	Document No.:	HSE-OP-009
		Department:	Operations
		Revision Date:	31 MAR 2010
Release authorized by:	D. Slattery	Page	Page 8 of 8

Emergency First Aid Procedures

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance in accordance with local procedures.

- Eye Exposure: Wash immediately with large amounts of water. Lifting the lower and upper lids occasionally, get medical attention as soon as possible.
- Skin Exposure: Immediately flush with copious amounts of water. Remove any clothing contaminated, and flush exposed skin areas, get medical attention as soon as possible.
- Respiratory Exposure: Get the victim to open, fresh air immediately. If breathing has stopped perform CPR. Keep the victim warm and at rest. Get medical attention as soon as possible.
- Rescue Considerations. Don't become a second victim. Move the affected person from the hazardous area. If the exposed person has been overcome, initiate local emergency notification procedures. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

Employee Training

The Training and Compliance Manager shall ensure that all personnel who will be working at the job site will be properly trained in H₂S awareness and contingency procedures.

If a worker may be exposed to harmful levels of H₂S at a work site, the Company must identify the health hazards associated with the exposure and assess the worker's exposure. The employer must ensure that a worker who may be exposed:

- is informed of the health hazards associated with exposure,
- is informed of measurements made of airborne concentrations, and
- is trained in procedures developed by the employer to minimize the worker's exposure and understands the procedures.

A worker who is provided with training must use the procedures appropriately and apply the training. Employees are required to complete competency training in H₂S and rescue.