Section 56.0
HYDROGEN SULFIDE

A. Purpose

JAGUAR ENERGY SERVICES, LLC is committed to protect the health and well being of all of its employees. The purpose of this procedure is to provide guidance for **JAGUAR ENERGY SERVICES, LLC** personnel who perform work at locations that contain Hydrogen Sulfide (H_2S) and help **JAGUAR ENERGY SERVICES, LLC** comply with OSHA 29 CFR 1910.134 and 29 CFR 1910.1000.

B. Scope

This procedure applies to **JAGUAR ENERGY SERVICES, LLC** personnel working at any worksite that might contain Hydrogen Sulfide.

C. Responsibilities

1. The Safety Coordinator or his/her designee is responsible for ensuring that employees have completed the training required by this procedure.
   - (a) Additional responsibilities include:
     - (i) The implementation of this Policy.
     - (ii) Documentation of completion by each employee.
     - (iii) Wallet cards and certificates will be issued.
     - (iv) Ensuring that this procedure is followed in work done at a client's or **JAGUAR ENERGY SERVICES, LLC** location.
     - (v) Ensuring that proper records are maintained on all work performed where H_2S are present.
     - (vi) For reviewing and revising the procedure as required.

2. The Safety Director is responsible for aiding in the implementation of this Procedure.
   - (a) Additional responsibilities include:
     - (i) Keeping the Safety Coordinator informed of any incidents related to this Procedure.

(ii) Providing appropriate safety equipment to **JAGUAR ENERGY SERVICES, LLC** personnel.

(iii) Issuing personal gas monitors to each employee, and providing the necessary training on it's use, care, and calibration.

(iv) Issuing emergency escape packs to each employee, and providing the necessary training on its use, care, and refilling the cylinder with breathing air.

(v) Investigating all employee concerns regarding H_2S on **JAGUAR ENERGY SERVICES, LLC** or client's premises.

(vi) Reviewing current technical information available on H_2S and reporting any significant new health threats.

(vii) Reviewing current technical information available on H_2S.

(viii) Maintaining medical surveillance records on personnel working with H_2S.

(i) The Assistant Secretary of Labor, affected employees and designated employees' representatives shall have access to this program**.**

(ix) Investigating all employee concerns regarding H_2S on **JAGUAR ENERGY SERVICES, LLC** or client premises.

(x) Informing the Safety Coordinator of any suspected or newly identified sources of H_2S at **JAGUAR ENERGY SERVICES, LLC** or client's premises.

3. The Supervisor is responsible for providing assistance in the implementation of this policy.

(a) Additional responsibilities include:

(i) Informing the Safety Director of any incidents involving H_2S.

(ii) Informing the Safety Director of any suspected or newly identified sources of H_2S at **JAGUAR ENERGY SERVICES, LLC** or client's premises.

(iii) Ensuring that all employees are informed of any suspected or newly identified sources of H_2S on **JAGUAR ENERGY SERVICES, LLC** or client's premises.

(iv) Making suggestions to management for ways to improve this Policy.

(v) Adhering to the rules and guidelines in this procedure.

(vi) Informing the Safety Director of any employee concerns or potential exposure incidents involving **JAGUAR ENERGY SERVICES, LLC** employees and H_2S.

4. **JAGUAR ENERGY SERVICES, LLC** personnel are responsible for recognizing and anticipating all job hazards that could involve exposure to H_2S, and complying with **JAGUAR ENERGY SERVICES, LLC** and customer H_2S procedures.

(a) Additional responsibilities include

(i) Completing the training required by this procedure.

(ii) Adhering to the rules and guidelines in this procedure.

(iii) Reporting to their supervisor any suspected or newly identified sources of H_2S on **JAGUAR ENERGY SERVICES, LLC** or client's premises.

D. Procedure

Hydrogen Sulfide (H_2S) is a highly toxic (Poisonous), colorless gas. It is formed by the decay of organic materials. It is found in natural oil and gas reservoirs, sewers and cesspools, or stagnant water such as swamps. It can also be produced in a variety of industrial processes.

1. H_2S is one of the leading causes of sudden death in the workplace! No one is immune to H_2S and no one can build up a tolerance for it. It is extremely toxic at relatively low concentrations; therefore, even small amounts of this toxic gas can cause great physical damage.

2. Other names for H_2S include:

(a) Sour Gas

(b) Stink Damp

(c) Sulfuretted Hydrogen

(d) Sour Crude

(e) Rotten Egg Gas

(f) Hydrosulfuric Acid

(g) Sulfur Hydride

3. Each employee should become familiar with these different names used to refer to Hydrogen Sulfide, so that he will always know what he is dealing with and be aware of the dangers involved in working around this toxic gas.

4. Formation of H_2S.

It is formed naturally by the decay of organic materials. It is found in natural oil and gas reservoirs, landfills, sewers and cesspools, or stagnant water such as swamps. It can also be produced in a variety of industrial processes.

(a) It is a by product of the reaction of hydrogen with other sulfur containing molecules found in crude oil, by the hydro-treating processes in the refining of sour crudes.

(b) Hydrogen Sulfide is dissolved in sour crude.

(c) When the sour crude that contains H_2S is brought to the surface, hydrogen sulfide and other associated gasses are released.

(d) The release of hydrogen sulfide is greatly accelerated by heat, especially during the separation process.

(e) H_2S is also extremely flammable and concentrations well below the lower explosive limit present a serious health threat.

5. Sources of H_2S in field operations and facilities.

H_2S can be located in many places throughout petroleum and gas processing facilities. It can be in crude oil, in the empty tank space above stored crude, or trapped in pockets in processing equipment.

(a) Areas where H_2S may be located include:

- (i) Tank batteries and adjoining producing fields.
- (ii) Gas wells and lines.
- (iii) Gas compressor stations.
- (iv) Gas treating and processing plants.
- (v) Sites that use landfill gas as turbine fuel.
- (vi) Offshore production platforms.
- (vii) Chemical processing facilities.
- (viii) Purchased gas cylinders of H_2S.
- (ix) Turbine lube oil tanks.
- (x) De-gassing vessels and flues.

(b) Petroleum industry facilities are not the only source of hydrogen sulfide. H_2S may also be found in the following locations:

- (i) Landfills.
- (ii) Sewer systems and waste water treatment facilities.
- (iii) Agricultural areas.

(iv) Volcanic gases and sulfur springs.
(v) Swamps.
(vi) Underground pits and passages.
(vii) Mining operations.
(viii) Public Utilities.

6. Some of the activities in which there might be a potential for exposure to hydrogen sulfide are:
(a) Drilling operations.
(b) Recycled Drilling Mud.
(c) Water from sour crude wells.
(d) Blowout.
(e) Tank batteries and wells.
(f) Tank gauging.
(g) Field maintenance of wells.
(h) Entry into pits, vessels and tanks.
(i) Leaks in pumps or lines.
(j) Water flood operations.
(k) Workover operations.
(l) Injection well house.
(m) Steam flood or fire flood operations.
(n) Refining operations.

7. Chemical and physical properties of H_2S.
Hydrogen Sulfide has many varied characteristics. A thorough knowledge of the hazards associated with H_2S, and proper planning will ensure confidence and safety while working in areas containing H_2S.

(a) **Toxicity** - H_2S is a highly toxic (poisonous) gas which is deadly to humans and animals.
(i) When exposed to high concentrations, it will cause death in a very short period of time.

(b) **Color** - H_2S has no visible color, therefore when it is released into work areas it cannot be seen.
(i) It has been given the name "Silent Killer."

(c) **Odor -** At low concentrations, H_2S has an offensive odor.
(i) Many times the odor is described as a "rotten-egg smell."
(ii) It often smells differently to various individuals, and sometimes is described as a sweet, sickening odor.
(iii) This offensive odor indicates the presence of H_2S, but does not indicate the level of concentration present.

(i) This is because the sense of smell is deadened at higher concentrations, by the poisoning of the cells in the mouth and nose that detect odors.

(ii) The odor of H_2S then becomes tolerable or seems to disappear leading to a false sense of security.

(d) **Solubility** - H_2S is soluble in water and hydrocarbons, that is, H_2S will absorb into most liquids.

(e) **Corrosiveness -** H_2S is highly corrosive to certain metals.

(i) This is because it readily combines with water (H_2O) to form H_2SO_3, (Sulfuric acid) which is a very strong acid.

(ii) Valves, piping, and refinery process equipment suffer extreme corrosion damage due to the presence of water and H_2S combined.

(f) **Specific gravity -** H_2S specific gravity is 1.2, (specific gravity of air = 1.0).

(i) This makes H_2S 20% heavier than air.

(ii) It can be dispersed great distances with only a slight breeze.

(iii) Because of its weight, H_2S will tend to collect in low lying areas such as pits, ditches, cellars, or other poorly ventilated areas.

(iv) H_2S will also collect at the bottom of tanks and vessels,

(g) **Flammability -** H_2S is very flammable when mixed with air.

(i) The LEL, or lower explosive limit is 4.0%.

(ii) The UEL, or upper explosive limit is 44.0%.

(iii) At concentrations in free air between the upper and lower explosive limits, an explosive mixture is present.

(iv) All that is required to produce an explosion or fire is an ignition source.

(v) H_2S has an ignition temperature of only 500□F.

(vi) Examples of ignition sources are static electricity, burning cigarettes, electric arcs, sparking, welding operations, etc.

(h) **Toxic by-products** - When ignited, H_2S produces Sulfur Dioxide (SO_2). SO_2 is extremely hazardous when inhaled and may leave victims disabled with pneumonia and respiratory damage.

(i) All personnel should be instructed to stay away from flare stacks and burning pits when H_2S is flared or ignited.

8. Routes of exposure to H_2S

The three common routes of entry into the human body that are encountered are:

(a) Inhalation through the respiratory system.
(b) Contact with the eyes, nose, or throat.
(c) Swallowing.
(d) Contact with the skin.

9. Health effects

The greatest danger of H_2S is death by inhalation. However, H_2S contact with eyes or skin can also produce painful irritations.

(a) When H_2S has been inhaled, it travels directly through the lungs and into the bloodstream.
  (i) In an effort to protect itself, the body breaks down or oxidizes the H_2S as quickly as possible into a harmless compound.
  (ii) In excess quantities, the body cannot oxidize it all.
  (iii) H_2S builds up in the blood stream and poisoning takes place.
  (iv) H_2S poisoning affects the nerve centers in the brain, which control breathing causing paralysis of that system.
  (v) The lungs stop working and the person suffocates.
  (vi) H_2S contact with eyes or skin can also produce painful irritations.
  (vii) The target organs are the eyes, the respiratory system, and the central nervous system.

10. The health effects of exposure to H_2S vary depending on the concentration. Hydrogen Sulfide in the blood is detoxified rapidly, and symptoms of poisoning may disappear when inhalation of the gas ceases. The effects that H_2S has on the individual will depend on the following factors:

(a) **Duration** - the length of time the individual is exposed.
(b) **Frequency** - how often the individual is exposed.
(c) **Intensity** - how much exposure to high concentrations the individual has received.

(d) **Sensitivity -** Symptoms will vary depending upon how sensitive each individual is to H_2S.

(e) **Special Health Problems** - Special health problems can increase the effect of H_2S in individuals.

(i) Individuals who have special health problems are at greater risk, and their exposure to H_2S should be minimized or avoided.

(ii) Some of these special health problems are:

(i) Punctured ear drum (May allow the passage of air through the ear and into the respiratory tract).
(ii) Emphysema.
(iii) Asthma.
(iv) Diabetes.
(v) Epilepsy.
(vi) Eye infections.
(vii) Anemia.
(viii) Alcoholism or consumption of alcohol within the past 24 hours.

11. Symptoms of exposure

Personnel exposed to H_2S may display all or part of the following symptoms:

(a) Poisoning by Inhalation:

(i) Inability or difficulty in breathing.
(ii) Coughing.
(iii) Dizziness.
(iv) Dryness in the nose and throat.
(v) Fatigue.
(vi) Headache.
(vii) Irrational behavior.
(viii) Loss of appetite / upset stomach.
(ix) Loss of consciousness.
(x) Nausea.
(xi) Loss of smell.
(xii) Lung damage.
(xiii) Coma.
(xiv) Death.

(b) Contact with eyes:

(i) Pain or burning sensation in eyes.
(ii) Blurred vision.
(iii) Painful secretion of tears.
(iv) Contact lenses can contribute to eye irritation.
(v) Tissue damage / eye disease.

(c) Contact with skin:

(i) Skin discoloration.
(ii) Skin irritation, (H_2S combines with perspiration).

12. These symptoms may take hours to develop or may appear in seconds if the concentration of H_2S is extreme.
    (a) If an individual notices any of these symptoms in himself or in others, seek medical attention immediately.
    (b) The health effects of H_2S at various concentrations are summarized in the chart below.

13. Concentration levels.

Some individuals are more sensitive to H_2S and will be effected by smaller concentrations. Others may be less sensitive and can withstand greater concentration levels without adverse effects.

(a) High concentrations of H_2S, especially those capable of causing serious health effects, cannot be detected by the sense of smell.
    (i) This phenomenon is known as olfactory fatigue.
    (ii) The sense of smell is “overwhelmed” and becomes an unreliable means of detecting an odor.
(b) However, to be safe, he should never assume that he can withstand large concentrations of the gas.
(c) Always follow these guidelines and respect the effects that H_2S can have.
    (i) This will ensure his/her/her safety when working around the H_2S.

WARNING

DO NOT ATTEMPT TO DETERMINE THE LEVEL OF H_2S CONCENTRATION WITH THE SENSE OF SMELL.

(d) H_2S concentration levels are measured in parts per million (PPM).
    (i) This is a term that all employees should be familiar with and understand.
    (ii) PPM refers to the amount (parts) of H_2S in a million parts of air.
    (iii) Example: 10 ppm = 10 parts of H_2S in a million parts of air.

PERCENT	PARTS PER MILLION (ppm)
0.0002%……. (2/10,000 of %)	2 ppm
0.001%……(1/1,000 of %)	10 ppm
0.01%……..(1/100 of %)	100 ppm
0.02%……..(2/100 of %)	200 ppm
0.05%……..(5/100 of %)	500 ppm
0.07%.....(7/100 of %)	700 ppm
0.10%……..(1/10 of %)	1000 ppm
1.0%	10,000 ppm

The following table identifies various concentration levels of H_2S in parts per million (ppm) and the physical effects of each at various exposure durations.

PPM*	0-2 Minutes	2-15 Minutes	15-30 Minutes	30 Minutes to 1 Hour	1-4 Hours	4-8 Hours	8-48 Hours
20-100				Mild conjunctivitis respiratory tract irritation	Symptoms worsen; Fatigue; Headache	Symptoms worsen	
100-150		Coughing: irritation of eyes, loss of sense of smell		Throat irritation	Salivation and mucous discharge; sharp pain in eyes; coughing.	Increased symptoms . *	Death. *
150-200		Loss of sense of smell	Throat and eye irritation	Throat and eye irritation	Difficult breathing; blurred vision; light shy	Death	
200-350	Irritation of eyes; Loss of sense of smell	Irritation of eyes;	Painful secretion of tears; weariness	Light shy; pain in eyes; difficult breathing; conjunctivitis	Hemorrhage and death*		

350-450	Irritation of eyes; loss of sense of smell	Difficult respirations ; coughing; irritation of eyes	Increased eye irritation; dull pain in head; weariness; light shy	Dizziness; weakness; increased eye irritation; death	Death*		
450-700	Respiratory disturbances; eye irritation; collapse*	Coughing ; collapse; unconsciousness	Palpitation of heart ; death.				
700 or greater	Collapse, unconsciousness, death						

Susceptibility varies greatly between individuals "Data secured from experiments of dogs which have a susceptibility similar to men. **PPM - parts per million.

(a) H_2S at concentrations of 1% = 10,000 ppm, 2% = 20,000 ppm and so on.
  (i) These are lethal concentrations and will result in death in only a few minutes.

(b) Every one should familiarize himself with these concentration levels and their physical effects, and refer back to this table periodically to refresh his/her/her memory.

2. Exposure Limits

The following limits have been established by the Standards Completion Program, and incorporates exposure limits set by the National Institute for Safety & Health, (NIOSH), and the Occupational Safety and Health Administration, (OSHA).

(a) **IDLH** - Immediately Dangerous to Life or Health = 100 ppm. Exposure to H_2S at this level for just a minute or two can result in coma and death.

(b) **REL** - Recommended Exposure Limit = 10 ppm, (NIOSH).
  (i) This is a time weighted average for a 10-hour per day / 40 –hour workweek exposure.

(c) **PEL** – Permissible Exposure Limit = 20 ppm, (OSHA).
  (i) PEL's are time weighted average concentration during an 8-hour day of a 40-hour workweek.
  (ii) This is the ceiling limit and should not be exceeded at any time!

(iii) 50 ppm, 10-minute maximum peak, once if no other measurable exposure occurs, (OSHA).

3. Methods of detection of H_2S.

Detection of hydrogen sulfide in the work place is essential to implementing an effective safety program. There are many ways that personnel can be alerted to the presence of H_2S.

(a) His/her nose is usually the first.
- (i) You can smell as little as 1 ppm.
- (ii) If the concentration of gas is in the 100 - 150 ppm range, the sense of smell is quickly lost, giving a false sense of security.

Never rely on your sense of smell to detect concentration levels of H_2S.

(b) There are many types of test equipment in use to detect hydrogen sulfide.
- (i) The equipment may be a fixed location detector, or a portable detector attached to the clothing or carried by a shoulder strap.
- (ii) Detectors are designed to measure the amount of H_2S present in the atmosphere.
- (iii) Detectors may function with special chemicals or with electronic sensors.

(c) The most important concern with any H_2S detector is the proper placement of the sensor units.
- (i) Since H_2S is heavier than air, it will settle in low areas.
- (ii) The portable units are usually attached to the clothing or carried and should be placed waist high.
- (iii) The electronic devices have portable sensor heads that should be placed in low areas.

(d) Lead Acetate Paper
- (i) As H_2S comes in contact with lead acetate impregnated paper the reaction creates lead sulfide, causing the paper to change color from white to different shades of brown.
- (ii) The depth of color change is dependent on the level of hydrogen sulfide concentration.
- (iii) Three to five minutes reaction time is necessary for the detector to function.
  - (i) This time delay is excessive and can be extremely dangerous in areas with a high concentration of H_2S.
  - (ii) Therefore, this method should only be considered as an indicator and

not used to determine exposure levels!

(e) Hand Operated Tube Detectors

(i) This type of detector incorporates a hand pump or syringe, and a glass detector tube.

(ii) An air sample is drawn into the tube by operating the hand pump or syringe.

(iii) The tube contains a chemical agent which absorbs and reacts to the air and gas being analyzed.

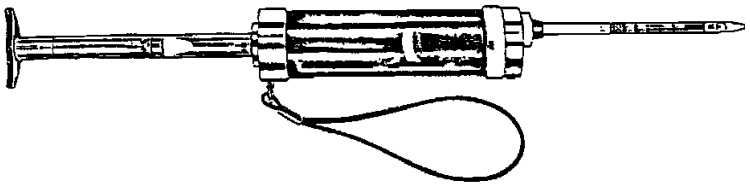
(iv) The tube contains a scale which will indicate the H_2S concentration in ppm if any is present in the air.

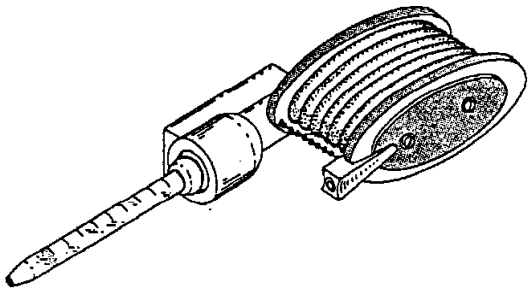
(v) When H_2S is drawn into the top of the tube, it will react with the chemical agent and cause a discoloration in the tube.

(vi) This discoloration will seep down the tube until it reaches the appropriate reading on the scale.

(vii) This reading is the concentration of H_2S in the atmosphere.

(viii) Reading these types of detectors is much like reading the mercury in a thermometer.





(f) There are a large number of manufactures of tubes, and there are some important differences in the way that the tubes are designed.

(g) Different tubes are designed to measure different gases.

(h) It is very important that you use only the tubes designed to measure H_2S when testing for H_2S.

(i) The tubes are scaled differently.

(i) Some are designed to measure only low concentrations, some measure high concentrations, and some measure both.

(j) All tubes come with instructions on the use, cleaning, and maintenance.
- (i) These instructions should be read and followed carefully.
- (ii) You should follow the manufacturer's recommendations for storage of the tubes, and check for the expiration dates of the tubes.
- (iii) Out of date tubes should never be used and should be discarded as soon as possible.

(k) The main advantage that the tube detectors have over lead acetate detectors is their increased accuracy and measuring capability.
- (i) The tube detectors are usually capable of measuring up to 1,000 ppm of H_2S.

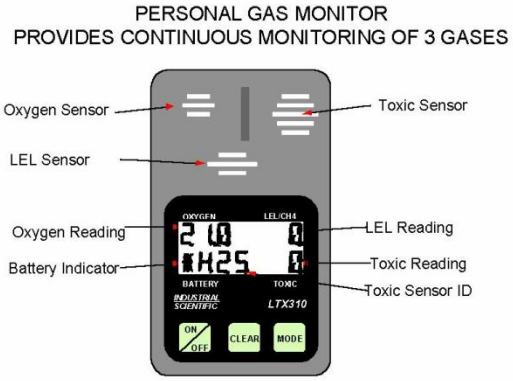
(l) The disadvantage of tube detectors is that personnel must be exposed to the atmosphere before detection is possible.

4. Personal Gas Monitors

This is the recommended detector that is provided by **JAGUAR ENERGY SERVICES, LLC** to each employee that is assigned to work in potentially hazardous atmospheres.

(a) This type of detector consists of an electrochemical H_2S sensor, a catalytic diffusion LEL sensor, an oxygen sensor, with a digital display contained in a light weight, battery operated, portable unit.

(b) These units are designed to be worn or carried by personnel that may be exposed to H_2S in the work environment.



(c) When H_2S contacts the sensor, the sensor sends a signal to the controlling mechanism.

(i) The controller receives the signal and provides a reading of the H_2S concentration (in ppm) on the meter.

(ii) If the H_2S concentration rises above the preset low level alarm of 10ppm, an alarm will sound.

(iii) If the concentration rises above 20 ppm, the high alarm level will sound continuously.

(iv) The alarm should always be tested before each use.

(v) Follow the manufacturer's recommendations for testing the alarm.

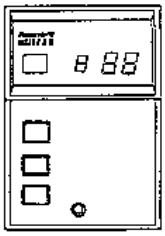
(d) The detector is supplied with an AC and a DC battery charger.

(e) An external audible alarm that can be clipped to the collar or a vibrating alarm for use in high noise areas is included, and the kit comes with various accessories and a storage / transportation case.

5. The main advantage that these types of detectors have over the other detectors covered so far is their quick reaction time (90% of the reading within 30 seconds), and the alarm system built into the device which immediately warns workers of dangerous levels of H_2S.

6. The disadvantage of using these types of detectors is that personnel have to be exposed to the atmosphere before detection is possible.
   (a) This is true of all the detectors covered so far, therefore, if hazardous levels of H_2S are suspected, all must not enter the area until declared safe to do so by an authorized person.

7. Fixed Detectors
   Fixed detectors are permanently installed, electrically operated, and provide continuous 24 hour protection.
   (a) They consist of a sensor head(s) which can be placed at various locations throughout a plant or platform, and are attached to a separate controller unit.
   (b) The sensor head is permanently mounted in the area to be monitored. (i.e., well head, pump, compressor, process area, etc.)
   (c) The controller unit is usually located outside the hazardous area. (i.e., in a building, office, or protected area.)



8. The fixed detectors work on the same principle as the personal detectors.
   (a) When H_2S contacts the sensor head(s), a signal is sent to the controller unit.
   (b) The controller unit analyzes the data and provides an exact reading of the H_2S concentration (in ppm) on a digital or needle type indicator.
   (c) The controller also is equipped with relay devices which activate warning alarms and/or lights, when a specified amount of H_2S has been detected.

9. These types of detectors can also be used to detect other types of gases, such as Carbon Dioxide (CO_2), Carbon monoxide (CO), and Methane (CH_4).
   (a) The response time for these detectors ranges from 10 to 35 seconds.
   (b) The controller unit, depending on the brand and model, can monitor multiple sensors.
   (c) The main advantages that fixed detectors have over the other types of detectors is that they provide 24 hour protection, and allow the hazardous area to be monitored without exposing personnel to the unknown atmosphere.

10. Calibration for both fixed and personal detectors on a regular basis is important to the H_2S program.
   (a) Manufacturer's recommendations and specifications should be followed in the care, maintenance, calibration, and use.
   (b) Records of calibrations for personal gas monitors must be maintained by the District office.

11. Methods of protection from exposure to H_2S

Engineering controls should be used to maintain H_2S limits below the recommended exposure limit.
   (a) The use of enclosed processes is an effective method of controlling H_2S.
      (i) Local exhaust ventilation may also be used.
   (b) A work permit system must be in place, and the procedures followed prior to venting and opening of any process system.
      (i) Venting and flaring of gas must not be within 150 feet of work areas.
      (ii) Vent and flare stacks must be designed to allow proper dispersal of H_2S without exposing workers.
   (c) All work areas including enclosed spaces such as rooms or buildings, which ordinarily are safe to enter and work but which, in the event of system failure inside, could contain H_2S at hazardous concentrations, must be continuously monitored for H_2S and include an alarm system that is audible both inside and outside the enclosed space.
   (d) An easily visible and distinctive warning light must be included as a part of the alarm system for high noise areas.

12. Personal Protective Equipment

JAGUAR ENERGY SERVICES, LLC Personal Protective Equipment procedure includes additional information on all PPE requirements.

(a) Personal monitoring
  (i) Personal gas monitors shall be provided for each employee.
  (ii) The employee shall be trained in the use, care, and calibration of the equipment.

(b) Only NIOSH-certified self-contained breathing apparatus or airline respirator with escape SCBA should be used.
  (i) The employee shall be trained in the use and care of the equipment.

(c) Emergency Escape Breathing Packs
  (i) Employees shall be provided a 10-minute emergency escape air pack.
  (ii) The employee shall be trained in the use and care of the equipment.

(d) Customers shall provide rescue personnel and equipment.

13. Safe Work Practices for H_2S Areas

If an individual must work in an environment containing Hydrogen Sulfide, there are a number of safety precautions that he/she should be familiar with and use in his/her/her daily activities.

(a) He can work safely in an H_2S environment without incident if he/she makes certain that all personnel (employees, contract workers, and visitors) who come into his/her/her worksite are aware of and following these safety precautions.

(b) Therefore, it is his/her responsibility to ensure his/her own safety and the safety of those he/she works with.

14. Precautions

The following precautions must be taken in areas of possible exposure to H_2S.

(a) All personnel must be informed about the characteristics of H_2S, its dangers, safety procedures to be used when it is encountered, and the rescue and first aid procedures.

(b) Personal protective equipment and first-aid equipment must be available to all personnel.
  (i) They must know the location of the equipment and be trained in the proper use of the equipment (this includes third party personnel).

(c) Whenever H_2S is suspected, a test must be made determine its presence/concentration and a site specific work plan must be developed by the client, Senior Field Representative, or other qualified individual.
  (i) Do not attempt to determine the presence and concentration of H_2S by its odor.
  (ii) The sense of smell is rapidly paralyzed by the gas.

(d) Personnel must never be allowed to enter any area suspected to have dangerous levels (about 20 ppm) of H_2S without a back-up person who is stationed outside of the hazardous area.
  (i) Both must wear the proper respiratory protection.
  (ii) If the worker entering the hazardous area is more than an arm's length away from the back-up person, the worker must wear a safety belt secured to a lifeline and held by the back-up person.

NOTE OF CAUTION WHEN ENTERING A WORK AREA, IF YOU OBSERVE A LARGE NUMBER OF DEAD INSECTS AND OR BIRDS, BE ON THE ALERT FOR H_2S.

(a) Personal Gas Monitor
  (i) Personnel are required to wear their personal H_2S gas monitor, Industrial Scientific Model LTX 310 (or equivalent), with the low alarm set at 10 ppm, and the high alarm set at 20 ppm.
  (ii) The monitor is to be worn at all times at waist level for early detection.

(b) Emergency Escape Air Packs
  (i) Personnel shall keep a 10-minute emergency escape air pack within easy reach of their immediate work area when working in customer facilities where H_2S is present.

(c) Facial hair
  (i) All employees must be clean-shaven.
  (ii) In the event that a respirator is required, this allows positive sealing of the face plate.

(d) Customer Emergency Plan
  (i) As with all customer sites, it is imperative that all personnel are familiar with the local emergency procedures.
  (ii) Each time the customer site is entered, employees must ask the personnel in charge if there have been any changes to the

emergency plan since training was last received.

(e) Employees must review the local site specific facility contingency plan prior to first entry into the plant, and as often as necessary to maintain a thorough understanding of emergency procedures.

(i) At least two escape routes must be marked, and the employee must be aware of them and the evacuation plans of all work locations.

(ii) Assembly areas and alternates must be identified.

(iii) Types of alarms and their sound must be understood.

(iv) Emergency phone numbers, (ambulance, police, fire department, doctors, hospital, etc.), must be posted in visible and readily accessible locations.

(f) Warning Signs

(i) The following warning signs shall be posted in readily visible locations at or near entrances to areas in which hydrogen sulfide is stored, handled, used, produced, or potential for release exists:

WARNING – HAZARDOUS AREA
HYDROGEN SULFIDE
EXTREME HEALTH HAZARD
FATAL OR HARMFUL IF INHALED

(g) Fixed Alarm Systems

(i) Where fixed alarm systems for H_2S are present, personnel must ensure that the alarm can be easily heard and recognized in the work area.

(h) In high noise areas where equipment such as gas turbines, compressors, pumps, or construction equipment is operating, a visible alarm must be available.

(i) The customer representative shall be requested to perform a test to ensure that alarms are audible and visible.

(i) Portable Alarm Systems

(i) If portable alarm systems for H_2S are in use by the customer, personnel must:

(i) Familiarize themselves with the sound of the alarm system prior to beginning work.

(ii) Ask a customer representative to activate the alarm as a test.

(iii) Find out why the portable alarm systems are in use.

(iv) If the probability of a leak is increased due to work tasks being conducted in the area, vacate the area and return when the operation has been completed.

(j) Wind Socks, Streamers, or Vanes

(i) Devices that indicate wind direction must be located at strategic points throughout the facility, where there is a potential for a gas release.

(ii) These must be visible from the work area.

(iii) Personnel must observe wind direction prior to and during work in an area where H_2S is potentially present.

(k) Do Not Enter Low Areas or Confined Spaces**.**

(i) Recognize that H_2S has a vapor density of 1.2 and is heavier than air.

(ii) H_2S can collect in low-lying areas.

(iii) Do not enter any ditch, trench, dike, or other area where H_2S can collect unless proper air sampling procedures have been completed or a fixed alarm system is in place.

(iv) **JAGUAR ENERGY SERVICES, LLC** has a confined (Refer Section 39.0) Confined Space Entry procedure to be followed if an employee is required to enter a confined space with a potentially hazardous atmosphere.

(i) All employees will be trained under 29 CFR 1910.146.g.

(l) Opening Process Equipment

(i) Certain work activities at customer sites that involve open process equipment can increase the potential for an H_2S release.

(ii) Personnel should schedule work at times other than when the customer is preparing to open equipment such as pumps, lines, vessels, tanks, or other equipment that have been in H_2S service.

(m) Observing good “Lock Out Tag Out” procedures, all process equipment must be double blocked and bled prior to performing any work.

(n) Leaks

(i) Whenever H_2S is suspected, or a leak detected, a test must be made by the customer

Safety Department or other qualified individual, to determine the presence and concentration of H_2S.

(o) Ventilation

(i) Adequate ventilation must be maintained in all work areas.

(p) Communications

(i) It is the responsibility of all personnel to maintain reliable communications within the area where there is a danger of H_2S exposure.

(q) Other Warning Signs

(r) Observe the area for any large number of dead birds or insects. This may indicate a release of H_2S.

2. Emergency Response & Rescue

A rescue attempt without the proper training and personal protective equipment can result in the rescuer also becoming a victim.

(a) Fifty percent of fatalities are the result of would be rescuers, who do not take necessary precautions before attempting a rescue.

(b) A natural reaction is to immediately rush to the side of the victim.

(i) However, rushing into the hazardous area without protecting one's self first, will probably result in two victims instead of one.

(ii) This is the main reason why many rescue efforts fail.

(iii) Those who try to rescue the victims are overcome themselves by the H_2S.

(c) Employees who are not trained in H_2S rescue techniques should not attempt an H_2S rescue.

(i) Any person attempting an H_2S rescue (generally specially trained customer employee or fire department personnel) will only do so with the use of a Self Contained Breathing Apparatus (SCBA) or supplied air respirator.

(ii) Employees who are not trained on these devices should not attempt to use them or assist in any rescue efforts.

3. In the event that a fellow worker is overcome by H_2S, quick reaction to the emergency situation is essential.

(a) Depending on the concentration level of the exposure, seconds could mean the difference between life or death.

WARNING

UNDER NO CIRCUMSTANCES WILL AN EMPLOYEE ENTER AN AREA TO RESCUE AN INDIVIDUAL WITHOUT PROPER RESPIRATORY EQUIPMENT.

(a) Before attempting any type of rescue, protect yourself first!

2. When attempting a rescue of someone overcome by H_2S, use the following procedure:
   (a) Call for help.
   (b) Put on a respirator while outside of the contaminated area. If you are inside of, or close to the contaminated area, hold your breath until you have put on a respirator.
   (c) Move calmly, carefully, and quickly to the victim's side, and move the victim to a safe area upwind or crosswind of the hazardous areas.
   (d) Do not evacuate the victim in a downwind direction.

3. CPR & First-Aid Procedures for H_2S exposure

Once the victim has been removed from the hazardous area, CPR or First Aid should be administered at once until help arrives and the victim can be transported to a medical facility.
   (a) Before CPR or First Aid can be administered, the effects of the H_2S on the victim must be properly diagnosed.
   (b) Every employee should be familiar with the symptoms which were covered earlier, so that they can quickly identify how the individual has been affected.

4. Inhalation of H2S

It is important to move the victim to a fresh air environment as soon as possible.
   (a) Immediately notify emergency response personnel.
   (b) If the victim is breathing and conscious, then recovery can be expected to be rapid.
   (c) If the victim is not breathing, CPR must be administered following these steps:
      (i) Begin artificial respiration using the back press method to clear the victim's lungs.
      (ii) Be careful not to inhale contaminated air from the victim’s lungs, which could result in the first aid provider also being exposed.

(iii) Begin cardio pulmonary resuscitation using a mouth-to-mouth barrier.

(iv) CPR should be continued until the victim starts breathing on his/her or her own, or until an emergency medical team relieves you.

(v) If breathing is slow, labored or impaired, provide the victim oxygen. Do not administer oxygen around ignition sources.

(vi) Remove all contaminated clothing and keep the victim warm and quiet.

(vii) Treat victims for shock.

(viii) Transport the victim to a medical facility as soon as possible.

(ix) All H_2S exposure victims must receive medical attention, and remain under observation until released by a physician.

(i) This includes anyone who shows signs of exposure including persistent eye irritation, faintness and sluggishness, or unconsciousness.

5. Contact with eyes

Prolonged contact with liquids or gases containing Hydrogen Sulfide in low concentrations, or short eye contact with high concentrations will cause painful irritation.

(a) If symptoms indicate eye irritation, the following steps should be taken:

(i) Flush the eyes with fresh water for at least 15 minutes.

(i) Do not use a hose or other pressurized device.

(ii) Apply cool compresses to the eyes.

(iii) Transport victim to a doctor, preferably an eye specialist, as soon as possible.

6. Contact with Skin

When combined with perspiration, H_2S produces a mild solution of sulfuric acid which causes skin irritations.

(a) Skin discoloration is also possible after contact with liquids or gases containing H_2S.

(i) If skin contact is suspected or is known to have occurred, the affected area should be thoroughly washed with fresh water for at least 15 minutes.

(ii) If the victim experiences discomfort or if the irritation is extreme, transport the victim to a doctor as soon as possible.

7. Emergency Procedures

If presence of H_2S is detected, or if an H_2S alarm is activated, all employees must evacuate the area immediately, report to an upwind assembly point, and do not reenter without proper respiratory protection.

(a) It is important for employees to be familiar with, and understand, the customer's facility emergency plan prior to an actual emergency, so that appropriate actions can be taken.

(b) Once notified of the presence of H_2S in the work area, all personnel must immediately evacuate the area.

(c) To safely evacuate the area:

(i) Follow a path that is upwind and diagonally away from the leak.

(ii) If an upwind escape route is not possible, a cross wind path is the next best option.

(iii) Do not exit the area along a downwind route as this may place you in the path of the H_2S release.

B. Training Requirements

1. All personnel, prior to any assignment to a location with H2S, will be trained on the following topics:

(a) Description, formation, and sources of H_2S.
(b) Chemical & physical characteristics of H_2S.
(c) Sources of H_2S.
(d) Human physiology and medical evaluation
(e) Concentration levels of H_2S.
(f) Exposure limits.
(g) Routes of exposure.
(h) Health effects of H_2S.
(i) Symptoms of exposure.
(j) Methods for detection and monitoring of H_2S.
(k) Methods of protection from exposure to H_2S.
(l) Work Practices
(m) Engineering controls
(n) Transportation of H_2S cargoes
(o) Personal protective equipment.
(p) H_2S safe work practices.

(q) Use of Contingency Plan, Emergency Response & Rescue Procedures.
(r) State and Federal regulatory requirements
(s) H_2S release and dispersion models
(t) Burning, Flaring, and Venting of H_2S
(u) Rescue techniques, CPR & First Aid for H_2S, and post exposure evaluation.
(v) Emergency procedures.
(w) Hands-on training with SCBA's
(x) Contents of this procedure**.**

2. The personnel being trained will be issued a wallet card and certificate upon successful completion of this training.

C. Training Frequency

Employees will be trained according to the following schedule:
(a) Initially upon hire.
(b) Upon assignment to a location with H2S.
(c) Every 12 months thereafter.

D. Definitions

1. Hydrogen Sulfide (H_2S)A colorless gas with a pungent, rotten egg odor that is present in many process streams in petroleum and gas processing facilities and landfill operations.

2. Permissible Exposure Limit, (PEL).
The legal maximum level of contaminant in the air of the workplace.

3. Immediately Dangerous to Life or Health (IDLH).
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.
(a) For example, substances such as cadmium, nickel carbonyl, and hydrogen fluoride can produce immediate temporary effects that may or may not require medical treatment, but can be followed by sudden and possible fatal collapse 12 -72 hours later.

4. Olfactory Fatigue.

A condition in which the olfactory system, or ability to smell, is overwhelmed and no longer able to detect certain odors.

(a) Olfactory fatigue may occur suddenly with a large exposure or slowly, over a period of time, to smaller concentrations.