

## **AMSYS ENERGY LLC**

### **8.0 Hydrogen Sulfide Safety (H<sub>2</sub>S)**

**8.1** Hydrogen Sulfide (H<sub>2</sub>S) is a highly toxic and colorless gas. In concentrations as low as 1000 ppm, or 1/10 of 1%, it can cause unconsciousness, breathing to stop, and death in a few minutes. Even low concentrations can affect the eyes and the respiratory system.

**8.1.1** When the amount of H<sub>2</sub>S gas absorbed into the blood system exceeds that which the blood system can oxygenize, systemic poisoning occurs, creating an effect on the central nervous system. Labored respiration occurs shortly and respiratory paralysis will follow immediately at concentrations of 700 ppm and above. Death will occur by asphyxiation unless the exposed person is removed immediately to fresh air and breathing is stimulated by artificial resuscitation.

**8.2** There are many hazards associated with H<sub>2</sub>S. In addition to asphyxiation, exposures to H<sub>2</sub>S may result in eye disorders, heart disorders, and nerve disorders.

**8.2.1** Symptoms of low level exposure may include one or more of the following, increasing with length of exposure:

**8.2.1.1** Fatigue.

**8.2.1.2** Irritation to Eyes.

**8.2.1.3** Headache.

## **AMSYS ENERGY LLC**

**8.2.1.4** Dizziness.

**8.2.1.5** Excitement.

**8.2.1.6** Coughing.

**8.2.1.7** Drowsiness.

**8.2.1.8** Nausea.

**8.2.1.9** Sensation of pain in nose, throat, and chest.

**8.2.2** Another characteristic of H<sub>2</sub>S is its offensive odor of rotten eggs. However, H<sub>2</sub>S rapidly deadens your sense of smell, so odor is a very unreliable means of detection. Due to its rapid effects, H<sub>2</sub>S is considered one of the most dangerous industrial gases.

**8.3** H<sub>2</sub>S is found in a variety of industries. However, Amsys Energy LLC is concerned foremost with operations associated with services provided for the oil & gas industry and chemical processing industry. H<sub>2</sub>S gas may be found in many facets of production, including but not limited to, well heads, storage tanks, pipelines, treating equipment, and even low lying areas such as pits or cellars.

**8.4** The characteristic properties of H<sub>2</sub>S are:

**8.4.1** Odor. Very offensive, commonly referred to as the odor of rotten eggs.

**8.4.2** Color. H<sub>2</sub>S is colorless.

**8.4.3** Flammability. H<sub>2</sub>S is highly flammable and burns with a blue flame.

**8.4.4** Explosive Limits. 4.3% to 46% by volume in air. H<sub>2</sub>S forms explosive mixtures with oxygen.

**8.4.5** Vapor Density is 1.189 (air = 1). H<sub>2</sub>S is heavier than air and will settle in low

## **AMSYS ENERGY LLC**

lying areas unless disbursed.

**8.4.6** Solubility. H<sub>2</sub>S is water soluble.

**8.4.7** Corrosive. H<sub>2</sub>S is highly corrosive to certain metals.

**8.4.8** Ignition Temperature. 500 degrees F.

**8.4.9** Boiling Temperature. 76 degrees F.

**8.4.10** When burned, H<sub>2</sub>S burns with a blue flame and produces another poisonous gas, Sulfur dioxide (SO<sub>2</sub>). Sulfur dioxide is toxic, very irritating to eyes and lungs, and can also cause serious injury or death.

**8.5** The effects of H<sub>2</sub>S depend on the following factors:

Duration: The length of time an individual is exposed.

Frequency: How often an individual has been exposed.

Intensity: The dosage or concentration of exposure.

Individual Susceptibility: The individual's physiological make-up.

**8.5.1** Symptoms of H<sub>2</sub>S exposure vary considerably due to an individual's physiological make-up. Studies indicate that some people are more susceptible than others to exposure at the same levels of exposure. Factors that may effect susceptibility are but not limited to the following: previous exposure, some types of health problems, alcoholism or psychiatric problems. Some individuals' previous exposure may increase their susceptibility rather than build up a tolerance to H<sub>2</sub>S. Health problems reducing tolerance might be such problems as a perforated ear drum, emphysema, angina pectoris, myocardial infarction or progressive or severe hypertension, diabetes, Grand Mal epilepsy, eye infections, or anemia. A perforated ear drum would allow

## **AMSYS ENERGY LLC**

air passage into the respiratory tract through the Eustachian tube. Alcoholics and individuals who have consumed alcohol within 24 hours of exposure and persons having psychiatric problems are at risk at any level of H<sub>2</sub>S exposure.

**8.5.1.1** The following table indicates normal effects on humans at specified concentration levels. Persons with the above mentioned factors may be more quickly or more intensely affected by exposure to levels as listed.

Amount of H<sub>2</sub>S Effect

10 ppm Unpleasant odor, safe for eight hour exposures.

100 ppm Kills sense of smell in three to five minutes. May cause eyes and throat to sting.

200 ppm Kills sense of smell rapidly. Stings eyes and throat.

500 ppm Dizziness, loss of reasoning ability, breathing paralyzed within 30 minutes,

artificial respiration required at once.

1000 ppm Unconsciousness at once, followed by death within minutes

**8.6** Areas where H<sub>2</sub>S may be present or suspected shall be periodically tested to determine employee exposure to H<sub>2</sub>S. testing should be repeated when a change occurs that could have an effect on H<sub>2</sub>S concentrations.

**8.6.1** No employee shall enter an area where H<sub>2</sub>S levels are or may reasonably be expected to be greater than 10 ppm by volume in air, without satisfying the requirements established in this section and approval from management.

## **AMSYS ENERGY LLC**

**8.7** Training shall be provided for each employee required to work in environments that may be or suspected to be an H<sub>2</sub>S containing environment.

Training will be given prior to assignment and shall consist of the following:

**8.7.1** Hazards and characteristics of both H<sub>2</sub>S and SO<sub>2</sub>.

**8.7.2** Toxicity and properties of H<sub>2</sub>S and SO<sub>2</sub> .

**8.7.3** H<sub>2</sub>S detection devices and their use.

**8.7.4** Respiratory Protection. Its use and limitations.

**8.7.5** Exposure levels and symptoms of exposure.

**8.7.6** First Aid and equipment of rescue.

**8.7.7** The "Buddy System" and emergency procedures including rescue and evacuation procedures.

**8.7.8** H<sub>2</sub>S alarms and contingency plans.

**8.7.9** Site specific planning development

**8.7.10** Training shall be documented and maintained for permanent record.

**8.7.11** Refresher courses shall be conducted annually.

**8.8** Protective breathing equipment (respirators) are required in an environment exceeding 10 ppm H<sub>2</sub>S content. Two common types suitable for use in H<sub>2</sub>S environments are the self contained breathing apparatus (SCBA) and supplied air or airline respirator.

**8.8.1** Personnel required to use respirator protection devices shall be examined by a physician to determine the individual's physical ability to perform work while wearing a respirator. (See Respirator Program Section 10 of this manual.)

## **AMSYS ENERGY LLC**

**8.8.2** Respirators require a "facial seal" to be effective. This following is a list of items that could prevent a respirator mask from sealing.

**8.8.2.1** Beard or long facial hair.

**8.8.2.2** Long or bushy sideburns.

**8.8.2.3** Hair down on forehead.

**8.8.2.4** Eyeglass temples protruding past seal on mask.

**8.8.2.5** Facial scars.

**8.8.2.6** See Respirator Program Section 8 of this manual for additional information and fit testing instructions.

**8.9** Detection devices and alarms are essential instrumentation for H<sub>2</sub>S operations. There are a variety of detection devices available for use. However, two main types are commonly used, mechanical detectors and electronic detectors. Personal monitors will alarm when PEL exceeds the 10 ppm for low level and 20 ppm for high level according to the 1910 standard.

**8.9.1** Testing shall be performed in areas designated as H<sub>2</sub>S areas or areas suspected to contain H<sub>2</sub>S.

**8.9.2** Anytime a situation requires the use of a hand held detection device your are required to wear a proper breathing apparatus.

**8.9.3** Detection alarm systems are installed on many permanent sites where a continuous possibility of encountering H<sub>2</sub>S is possible. These electronic detection units continuously monitor the area in which the sensor heads are located, whether stationary or portable. It is important to find out what the alarms and settings are for each permanent system. Regardless of the cause

## **AMSYS ENERGY LLC**

of the alarm, you should treat every alarm as real until proven otherwise.

8.10 Wind direction consciousness is important at all times. Because H<sub>2</sub>S is heavier than air, you should remain upwind from a source of H<sub>2</sub>S. In the event of an alarm, you should move upwind, or crosswind and if at all possible uphill. Unless dispersed, H<sub>2</sub>S will remain concentrated, so you must avoid low lying areas.

**8.10.1** You should be familiar with wind socks and wind direction indicator locations

and use them to maintain an upwind position.

**8.11** Briefing areas and escape routes should be set up according to wind direction. A minimum of two briefing areas are required at least 250 feet away from well heads. At least one briefing area should be upwind at all times.

Briefing areas shall have a sign prominently displayed and visible from anywhere on the site. Briefing areas are numbered and are to be used as refill stations for SCBAs. All personnel shall go to the briefing area upwind, as indicated by wind direction devices, in the event of an alarm.

**8.12** Condition signs are commonly used to communicate the current conditions at most well sites containing H<sub>2</sub>S. They will generally be colored flags displayed on a large sign and consist of three different colors to indicate the condition stage.

**Stage #1** Green Flag Normal Conditions.

**Stage #2** Yellow Flag There is a possibility of encountering H<sub>2</sub>S or it has already been encountered in small quantities (1 ppm to 20 ppm).

**Stage #3** Red Flag Extreme Danger. Special operations are being

## **AMSYS ENERGY LLC**

done or there is a real possibility of encountering H<sub>2</sub>S in harmful quantities (over 20 ppm).

**8.12.1** Do not approach an H<sub>2</sub>S location without proper authorization and a breathing apparatus while the red flag is displayed.

**8.13** Escape and rescue should be the first consideration when arriving on a H<sub>2</sub>S site. You should first note the location of windsocks, H<sub>2</sub>S alarms, briefing areas, and escape routes. In addition, check in with the safety supervisor or proper company representative and be assigned a "buddy".

**8.13.1** The procedures to be followed during your activity on location are:

**8.13.1.1** Always know where your "buddy" is and make certain he knows where you are.

**8.13.1.2** Always have your assigned breathing apparatus readily accessible and ready for use.

**8.13.1.3** Should alarms sound, don breathing apparatus and go immediately to the "safe" upwind briefing area.

**8.13.1.4** Stay constantly aware of wind direction.

**8.13.1.5** Before you attempt to assist someone else, make positively sure that you are adequately protected yourself.

**8.13.1.6** Should a rescue be required, you should attempt to drag the victim by grabbing his shirt collar and supporting the head. If clothing is unsuitable as a handhold, the victims arms may be stretched above the head, crossing the

## **AMSYS ENERGY LLC**

wrists, and using the arms to drag the victim. Be certain to support the victim's head.

**8.13.1.6.1** Rescue by lifeline is another method where several people from a clear area

can pull the victim out while a person wearing SCBA equipment supports the victim's head.

**8.14** Contingency planning should be performed and available to all personnel.

Some items covered in contingency plans are listed below:

**8.14.1** General Information and Physiological response to H<sub>2</sub>S and SO<sub>2</sub> exposure.

**8.14.2** Safety Procedures, Equipment, Training and Smoking Rules.

**8.14.3** Procedures for operating conditions.

**8.14.3.1** Normal operations

**8.14.3.2** Potential Danger

**8.14.3.3** Extreme Danger

**8.14.4** The responsibility of personnel for each operating condition.

**8.14.5** Designation of "Safe" briefing areas.

**8.14.6** Designation of escape routes.

**8.14.7** Evacuation plan including alarm system explanation.

**8.14.8** Agencies to be notified in the event of an emergency. Includes definitions of emergencies at varying degrees.

**8.14.9** A list of all residents, their location and phone numbers within a two mile radius of exposure.

**8.14.10** A layout of site location and its proximity to local maps and topography sketch.

## **AMSYS ENERGY LLC**

**8.15** All personnel should read and become familiar with the contingency plan and

be prepared to follow its procedures during an actual release of H<sub>2</sub>S.

**8.16** Each individual assigned to work in a H<sub>2</sub>S area, as a portion of this necessary training should be trained in first aid and CPR. Each individual should review first aid and CPR guidelines and procedures at the start of each operation.