

Gulf Coast Mariners Association



P. O. Box 3589
Houma, LA 70361-3589

Phone: (985) 879-3866
Fax: (985) 879-3911

GCMA Report # R-378

Date: September 22, 2003

HYDROGEN SULFIDE: A DANGER TO MARINERS

THE BASIC LESSON

Hydrogen Sulfide (H₂S) is a highly toxic and corrosive gas. It occurs naturally in many geologic formations. It is formed by the decomposition of organic animal and vegetable matter by bacteria. This decomposition can be recent as in rotting fish remnants in a fishing vessel's hold or muck in the bilge or may have occurred millions of years ago in a geologic formation that now contains petroleum. **When inhaled in high concentrations, H₂S can cause almost immediate death.**

Hydrogen sulfide has an offensive odor similar to rotten eggs, but it quickly deadens the sense of smell that makes your nose a very unreliable means of detecting this poisonous gas except in very low concentrations. If you first smell a trace of this odor, if you are in an enclosed space your **immediate action must be to get out** of the enclosed space into fresh air. If you are out doors, your **immediate action must be to get upwind of the odor**. These should be natural reactions – follow them. The last thing you want to do is to search for the source of the rotten egg-smell by following your nose and inhaling deeply or immerse yourself in a greater concentration of this toxic gas!

Without self-contained breathing equipment and the instruments to test the atmosphere, you are no match for H₂S. If you have not received **formal hydrogen sulfide training**, the preceding paragraphs are all you need to know for the moment!

IN GREATER DEPTH

While the human body breathes air composed primarily of nitrogen and oxygen, a hydrogen sulfide molecule contains two hydrogen atoms and one sulfur atom. The human body thrives on nitrogen and oxygen and not on hydrogen or sulfur. In fact, these gases are toxic (i.e., poisonous) to the human body. This is a substance you must learn to avoid.

Hydrogen sulfide is also a highly flammable gas. It burns in air in a range of concentrations between 4.3% to 45% – but even the lower limit is more than enough to kill you in an instant. It burns with a blue flame giving off sulfur dioxide gas (SO₂) that is also toxic. Hydrogen sulfide, at very low small quantities can paralyze your breathing system and kill you in minutes. In fact, the lethal limit is an exposure of only 600 parts per million. Because of its high toxicity and rapid action, it is one of the most dangerous gases found in industry. In the petroleum industry the terms “sour crude” or “sour gas” are terms that refer to the presence of H₂S. Unfortunately, “sour” does not accurately express the danger posed by this gas.

Hydrogen sulfide is found in oil and gas exploration, production, processing, refining and transportation. Many of our mariners work in the mineral and oil industry offshore and in inland waters. Many of our mariners also tow and transfer petroleum cargoes. But many of our mariners never receive formal H₂S training. Reports from our mariners indicate that formal training in the dangers of hydrogen sulfide should be much more widespread in because its toxicity could affect many of our mariners. This paper does not purport to substitute for such training but, among other things, suggests a greater need for such training.

Hydrogen sulfide commonly occurs in sewage treatment plants and sewage tanks. Almost every commercial vessel contains a sewage plant that often contains a storage tank where chemical reactions normally occur. Many of these sewage plants do not always function smoothly and may require disassembly and repair – often in enclosed shipboard spaces. Mariners called upon to perform these unpleasant tasks must consider the danger of H₂S in these areas and other areas such as:

- Working around offshore rigs and platforms, especially those required to be posted with dangerous gas warning signs.
- On OSVs or barges carrying used drilling mud or “produced water” for later disposal.
- When entering fishing boat holds that are not clean and may contain decaying fish.
- When pushing or transferring certain petroleum cargoes on tank barges, especially around recently opened hatch covers.

Hydrogen sulfide gas is approximately 19% heavier than air and tends to settle into low-lying areas or spaces with little or no ventilation.

OUR CONCERN FOR MARINERS

Although the American Petroleum Institute (API) recommends guidelines for establishing an effective training program, a review of U.S. Coast Guard Navigation and Vessel Inspection Circulars and Regulations reveal that there are neither guidelines nor regulations that directly protect or even warn our mariners about this danger. The following story, as reported to the Coast Guard in June 2003, illustrates part of the problem:

A liftboat received orders to work with a crew on a platform at Eugene Island 119 #33, went to that platform and jacked up. The platform reportedly had a sign clearly

warning of the danger of hydrogen sulfide gas. The work crew placed on the platform had gas masks and canisters of air in case of a gas leak. The work crew supervisor reportedly also had the same type of protection. The liftboat was required to jack up and stand by the platform. However, the vessel's crew was not furnished with detection equipment or personal protection gear against a possible hydrogen sulfide gas discharge.

It was reported to us that the Captain knew that he was putting his crew in danger by working in that field without proper protective equipment but was pressured by his company to do it anyway. The entire crew apparently was apprehensive. We later learned that the Captain, even after being warned of the danger by the crew, insisted on completing his work assignment. The work crew, equipped with breathing and testing equipment for themselves, never considered that the boat crew was not protected at the job site. However, it turned out that the boat company was not aware that the boat's charterer had sent the lift boat to work on that platform in that field and only found out about it weeks later.

Other mariners reported that they have carried men and equipment to similar platforms in the Gulf of Mexico containing toxic gas warning signs and were expected to tie alongside or tie off these platforms with no formal H₂S training, testing instruments or protective breathing apparatus.

In a Freedom of Information Act request we asked the Coast Guard Marine Safety Office these questions:

1. What Coast Guard regulations govern the training of personnel for H₂S hazards? *[We found that there were no Coast Guard regulations or NVICs that protected our mariners in this situation.]*
2. What Coast Guard regulations contain requirements for protective equipment that must be carried to protect crewmembers against H₂S hazards? *[There are none.]*
3. What Coast Guard policy letters are in effect in the Eighth District that requires vessel owners to protect their crews? *[There are none.]*
4. Who enforces these policies and regulations? *[Through our own investigation we discovered that the Minerals Management Service (MMS) has regulations addressing concerns with hydrogen sulfide.]*
5. What are the penalties for vessel owners who do not provide the required equipment and training? *[None that we know of.]*
6. What is the penalty for vessel masters who endanger their crews by allowing them to work in hazardous areas that are posted with appropriate warning signs? *[Suspension or revocation for negligence or incompetence.]*
7. What is the responsibility of the owners of platforms and drilling rigs as to notifying workers of H₂S dangers? *[Obligations of lessees is clear under MMS regulations.]*
8. Are there any regulations enforced by the Minerals Management Service or the U.S. Department of Labor that are applicable here? *[The MSO would not comment on regulations of other government agencies. However, we later learned that the Minerals Management Service Regulations has regulations, but the Coast Guard does not.]*

However, the Coast Guard is responsible for workplace safety on vessels on the OCS. The regulations in 33 CFR Subchapter N dealing only with outer continental shelf activities have been under revision for a number of years. GCMA has submitted a number of comments to the docket on other aspects of workplace protection for mariners.]

MMS H₂S REGULATIONS

[GCMA COMMENT: The Department of the Interior has comprehensive regulations that apply to its lessees on the outer continental shelf. However, the Coast Guard has no comparable regulations governing workplace safety to alert our mariners to the dangers of Hydrogen Sulfide gas either on the Outer Continental Shelf or for oilfield operations on inland waters or for petroleum shipped by barge.]

30 CFR §250.490 Hydrogen Sulfide.

(a) What precautions must I take when operating in an H₂S area? You must:

- (a)(1) Take all necessary and feasible precautions and measures to protect personnel from the toxic effects of H₂S and to mitigate damage to property and the environment caused by H₂S. You must follow the requirements of this section when conducting drilling, well-completion/well-workover, and production operations in zones with H₂S present and when conducting operations in zones where the presence of H₂S is unknown. You do not need to follow these requirements when operating in zones where the absence of H₂S has been confirmed; and
- (a)(2) Follow your approved contingency plan.

(b) Definitions. Terms used in this section have the following meanings:

• **Facility** means a vessel, a structure, or an artificial island used for drilling, well-completion, well-workover, and/or production operations.

• **H₂S absent** means:

- (b)(1) Drilling, logging, coring, testing, or producing operations have confirmed the absence of H₂S in concentrations that could potentially result in atmospheric concentrations of 20 ppm or more of H₂S; or
- (b)(2) Drilling in the surrounding areas and correlation of geological and seismic data with equivalent stratigraphic units have confirmed an absence of H₂S throughout the area to be drilled.

H₂S present means that drilling, logging, coring, testing, or producing operations have confirmed the presence of H₂S in concentrations and volumes that could potentially result in atmospheric concentrations of 20 ppm or more of H₂S.

H₂S unknown means the designation of a zone or geologic formation where neither the presence nor absence of H₂S has been confirmed.

Well-control fluid means drilling mud and completion or workover fluid as appropriate to the particular operation being conducted.

(c) Classifying an area for the presence of H₂S. You must:
(c)(1) Request and obtain an approved classification for the area from the Regional Supervisor before you begin operations. Classifications are "H₂S absent," H₂S present," or "H₂S unknown";
(c)(2) Submit your request with your application for permit to drill;
(c)(3) Support your request with available information such as geologic and geophysical data and correlations, well logs, formation tests, cores and analysis of formation fluids; and
(c)(4) Submit a request for reclassification of a zone when additional data indicate a different classification is needed.

(d) What do I do if conditions change? If you encounter H₂S that could potentially result in atmospheric concentrations of 20 ppm or more in areas not previously classified as having H₂S present, you must immediately notify MMS and begin to follow requirements for areas with H₂S present.

(e) What are the requirements for conducting simultaneous operations? When conducting any combination of drilling, well-completion, well-workover, and production operations simultaneously, you must follow the requirements in the section applicable to each individual operation.

(f) Requirements for submitting an H₂S Contingency Plan. Before you begin operations, you must submit an H₂S Contingency Plan to the District Supervisor for approval. Do not begin operations before the District Supervisor approves your plan. You must keep a copy of the approved plan in the field, and you must follow the plan at all times. Your plan must include:

- (f)(1) Safety procedures and rules that you will follow concerning equipment, drills, and smoking;
- (f)(2) **Training you provide for employees, contractors, and visitors;**
- (f)(3) Job position and title of the person responsible for the overall safety of personnel;
- (f)(4) Other key positions, how these positions fit into your organization, and what the functions, duties, and responsibilities of those job positions are;
- (f)(5) Actions that you will take when the concentration of H₂S in the atmosphere reaches 20 ppm, who will be responsible for those actions, and a description of the audible and visual alarms to be activated;
- (f)(6) Briefing areas where personnel will assemble during an H₂S alert. You must have at least two briefing areas on each facility and use the briefing area that is upwind of the H₂S source at any given time;
- (f)(7) Criteria you will use to decide when to evacuate the facility and procedures you will use to safely evacuate all personnel from the facility by vessel, capsule, or lifeboat. If you use helicopters during H₂S alerts, describe the types of H₂S emergencies during which you consider the risk of helicopter activity to be acceptable and the precautions you will take during the flights;
- (f)(8) **Procedures you will use to safely position all vessels attendant to the facility.** Indicate where you will locate the vessels with respect to wind direction. Include the distance from the facility and what procedures you will use to safely relocate the vessels in an emergency;

(f)(9) **How you will provide protective-breathing equipment for all personnel, including contractors and visitors;**

- (f)(10) The agencies and facilities you will notify in case of a release of H₂S (that constitutes an emergency), how you will notify them, and their telephone numbers. Include all facilities that might be exposed to atmospheric concentrations of 20 ppm or more of H₂S;
- (f)(11) The medical personnel and facilities you will use if needed, their addresses, and telephone numbers;
- (f)(12) H₂S detector locations in production facilities producing gas containing 20 ppm or more of H₂S. Include an "H₂S Detector Location Drawing" showing:
 - (f)(12)(i) **All vessels**, flare outlets, wellheads, and other equipment handling production containing H₂S;
 - (f)(12)(ii) Approximate maximum concentration of H₂S in the gas stream; and
 - (f)(12)(iii) Location of all H₂S sensors included in your contingency plan;
- (f)(13) Operational conditions when you expect to flare gas containing H₂S including the estimated maximum gas flow rate, H₂S concentration, and duration of flaring;
- (f)(14) Your assessment of the risks to personnel during flaring and what precautionary measures you will take;
- (f)(15) Primary and alternate methods to ignite the flare and procedures for sustaining ignition and monitoring the status of the flare (i.e., ignited or extinguished);
- (f)(16) Procedures to shut off the gas to the flare in the event the flare is extinguished;
- (f)(17) Portable or fixed **sulphur dioxide (SO₂)-detection system(s)** you will use to determine SO₂ concentration and exposure hazard when H₂S is burned;
- (f)(18) Increased monitoring and warning procedures you will take when the SO₂ concentration in the atmosphere reaches 2 ppm;
- (f)(19) **Personnel protection measures or evacuation procedures you will initiate when the SO₂ concentration in the atmosphere reaches 5 ppm;**
- (f)(20) Engineering controls to protect personnel from SO₂; and
- (f)(21) Any special equipment, procedures, or precautions you will use if you conduct any combination of drilling, well-completion, well-workover, and production operations simultaneously.

(g) **Training program.**

- (g)(1) When and how often do employees need to be trained? **All operators and contract personnel must complete an H₂S training program to meet the requirements of this section:**
 - (g)(1)(i) **Before beginning work** at the facility; and
 - (g)(1)(ii) **Each year**, within 1 year after completion of the previous class.
- (g)(2) What training documentation do I need? For each individual working on the platform, either:
 - (g)(2)(i) You must have documentation of this training at the facility where the individual is employed; or
 - (g)(2)(ii) The employee must carry a **training completion card.**
- (g)(3) What training do I need to give to visitors and employees previously trained on another facility?

(g)(3)(i) Trained employees or contractors transferred from another facility must attend a supplemental briefing on your H₂S equipment and procedures before beginning duty at your facility;

(g)(3)(ii) Visitors who will remain on your facility more than 24 hours must receive the training required for employees by paragraph (g)(4) of this section; and

(g)(3)(iii) Visitors who will depart before spending 24 hours on the facility are exempt from the training required for employees, but they must, upon arrival, complete a **briefing** that includes:

(g)(3)(iii)(A) Information on the location and use of an **assigned respirator**; practice in donning and adjusting the assigned respirator; information on the safe briefing areas, alarm system, and hazards of H₂S and SO₂; and

(g)(3)(iii)(B) Instructions on their responsibilities in the event of an H₂S release.

(g)(4) What training must I provide to all other employees? You must train all individuals on your facility on the:

(g)(4)(i) Hazards of H₂S and of SO₂ and the provisions for personnel safety contained in the H₂S Contingency Plan;

(g)(4)(ii) Proper use of safety equipment which the employee may be required to use;

(g)(4)(iii) Location of protective breathing equipment, H₂S detectors and alarms, ventilation equipment, briefing areas, warning systems, evacuation procedures, and the direction of prevailing winds;

(g)(4)(iv) **Restrictions and corrective measures concerning beards, spectacles, and contact lenses in conformance with ANSI Z88.2**, American National Standard for Respiratory Protection (incorporated by reference as specified in §250.198);

(g)(4)(v) Basic first-aid procedures applicable to victims of H₂S exposure. During all drills and training sessions, you must **address procedures for rescue and first aid for H₂S victims**;

(g)(4)(vi) Location of:

(g)(4)(vi)(A) The first-aid kit on the facility;

(g)(4)(vi)(B) Resuscitators; and

(g)(4)(vi)(C) Litter or other device on the facility.

(g)(4)(vii) Meaning of all warning signals.

(g)(5) Do I need to post safety information? You must **prominently post safety information** on the facility and on vessels serving the facility (i.e., basic first-aid, escape routes, instructions for use of life boats, etc.).

(h) Drills. (1) When and how often do I need to conduct drills on H₂S safety discussions on the facility? You must:

(h)(1)(i) Conduct a drill for each person at the facility during normal duty hours at least once every 7-day period. The drills must consist of a dry-run performance of personnel activities related to assigned jobs.

(h)(1)(ii) At a safety meeting or other meetings of all personnel, discuss drill performance, new H₂S considerations at the facility, and other updated H₂S information at least monthly.

(h)(2) What documentation do I need? **You must keep records of attendance** for:

(h)(2)(i) Drilling, well-completion, and well-workover operations at the facility until operations are completed; and

(h)(2)(ii) Production operations at the facility or at the nearest field office for 1 year.

(i) Visual and audible warning systems--(1) How must I install wind direction equipment? You must install wind-direction equipment in a location visible at all times to individuals on or in the immediate vicinity of the facility.

(i)(2) When do I need to display operational danger signs, display flags, or activate visual or audible alarms?

(i)(2)(i) You must display warning signs at all times on facilities with wells capable of producing H₂S and on facilities that process gas containing H₂S in concentrations of 20 ppm or more.

(i)(2)(ii) In addition to the signs, you must activate audible alarms and display flags or activate flashing red lights when atmospheric concentration of H₂S reaches 20 ppm.

(i)(3) What are the requirements for signs? Each sign must be a high-visibility yellow color with black lettering as follows:

Letter height	Wording
12 inches.....	Danger. Poisonous Gas. Hydrogen Sulfide.
7 inches.....	Do not approach if red flag is flying.
(Use appropriate wording at right)....	Do not approach if red lights are flashing.

(i)(4) May I use existing signs? You may use existing signs containing the words "Danger-Hydrogen Sulfide-H₂S," provided the words "Poisonous Gas. Do Not Approach if Red Flag is Flying" or "Red Lights are Flashing" in lettering of a minimum of 7 inches in height are displayed on a sign immediately adjacent to the existing sign.

(i)(5) What are the requirements for flashing lights or flags? You must activate a sufficient number of lights or hoist a sufficient number of flags to be visible to vessels and aircraft. Each light must be of sufficient intensity to be seen by approaching vessels or aircraft any time it is activated (day or night). Each flag must be red, rectangular, a minimum width of 3 feet, and a minimum height of 2 feet.

(i)(6) What is an audible warning system? An audible warning system is a public address system or siren, horn, or other similar warning device with a unique sound used only for H₂S.

(i)(7) Are there any other requirements for visual or audible warning devices? Yes, you must:

(i)(7)(i) Illuminate all signs and flags at night and under conditions of poor visibility; and

(i)(7)(ii) Use warning devices that are suitable for the electrical classification of the area.

(i)(8) What actions must I take when the alarms are activated? When the warning devices are activated, the designated responsible persons must inform personnel of the level of danger and issue instructions on the initiation of appropriate protective measures.

(j) H₂S-detection and H₂S monitoring equipment.--(1) What are the requirements for an H₂S detection system? An H₂S detection system must:

- (j)(1)(i) Be capable of sensing a minimum of 10 ppm of H₂S in the atmosphere; and
- (j)(1)(ii) Activate audible and visual alarms when the concentration of H₂S in the atmosphere reaches 20 ppm.
- (j)(2) Where must I have sensors for drilling, well-completion, and well-workover operations? You must locate sensors at the:
 - (j)(2)(i) Bell nipple;
 - (j)(2)(ii) Mud-return line receiver tank (possum belly);
 - (j)(2)(iii) Pipe-trip tank;
 - (j)(2)(iv) Shale shaker;
 - (j)(2)(v) Well-control fluid pit area;
 - (j)(2)(vi) Driller's station;
 - (j)(2)(vii) Living quarters; and
 - (j)(2)(viii) All other areas where H₂S may accumulate.

(j)(3) Do I need mud sensors? The District Supervisor may require mud sensors in the possum belly in cases where the ambient air sensors in the mud-return system do not consistently detect the presence of H₂S.

(j)(4) How often must I observe the sensors? During drilling, well-completion and well-workover operations, you must continuously observe the H₂S levels indicated by the monitors in the work areas during the following operations:

- (j)(4)(i) When you pull a wet string of drill pipe or workover string;
- (j)(4)(ii) When circulating bottoms-up after a drilling break;
- (j)(4)(iii) During cementing operations;
- (j)(4)(iv) During logging operations; and
- (j)(4)(v) When circulating to condition mud or other well-control fluid.

(j)(5) Where must I have sensors for production operations? On a platform where gas containing H₂S of 20 ppm or greater is produced, processed, or otherwise handled:

- (j)(5)(i) You must have a sensor in rooms, buildings, deck areas, or low-laying deck areas not otherwise covered by paragraph (j)(2) of this section, where atmospheric concentrations of H₂S could reach 20 ppm or more. You must have at least one sensor per 400 square feet of deck area or fractional part of 400 square feet;
- (j)(5)(ii) You must have a sensor in buildings where personnel have their living quarters;
- (j)(5)(iii) You must have a sensor within 10 feet of each vessel, compressor, wellhead, manifold, or pump, which could release enough H₂S to result in atmospheric concentrations of 20 ppm at a distance of 10 feet from the component;
- (j)(5)(iv) You may use one sensor to detect H₂S around multiple pieces of equipment, provided the sensor is located no more than 10 feet from each piece, except that you need to use at least two sensors to monitor compressors exceeding 50 horsepower;
- (j)(5)(v) You do not need to have sensors near wells that are shut in at the master valve and sealed closed;
- (j)(5)(vi) When you determine where to place sensors, you must consider:
 - (j)(5)(vi)(A) The location of system fittings, flanges, valves, and other devices subject to leaks to the atmosphere; and
 - (j)(5)(vi)(B) Design factors, such as the type of decking and the location of fire walls; and

(j)(5)(vii) The District Supervisor may require additional sensors or other monitoring capabilities, if warranted by site specific conditions.

(j)(6) How must I functionally test the H₂S Detectors?

(j)(6)(i) Personnel trained to calibrate the particular H₂S detector equipment being used must test detectors by exposing them to a known concentration in the range of 10 to 30 ppm of H₂S.

(j)(6)(ii) If the results of any functional test are not within 2 ppm or 10 percent, whichever is greater, of the applied concentration, recalibrate the instrument.

(j)(7) How often must I test my detectors?

(j)(7)(i) When conducting drilling, drill stem testing, well-completion, or well-workover operations in areas classified as H₂S present or H₂S unknown, test all detectors at least once every 24 hours. When drilling, begin functional testing before the bit is 1,500 feet (vertically) above the potential H₂S zone.

(j)(7)(ii) When conducting production operations, test all detectors at least every 14 days between tests.

(j)(7)(iii) If equipment requires calibration as a result of two consecutive functional tests, the District Supervisor may require that H₂S-detection and H₂S-monitoring equipment be functionally tested and calibrated more frequently.

(j)(8) What documentation must I keep?

(j)(8)(i) You must maintain records of testing and calibrations (in the drilling or production operations report, as applicable) at the facility to show the present status and history of each device, including dates and details concerning:

- (j)(8)(i)(A) Installation;
- (j)(8)(i)(B) Removal;
- (j)(8)(i)(C) Inspection;
- (j)(8)(i)(D) Repairs;
- (j)(8)(i)(E) Adjustments; and
- (j)(8)(i)(F) Reinstallation.

(j)(8)(ii) Records must be available for inspection by MMS personnel.

(j)(9) What are the requirements for nearby vessels? If vessels are stationed overnight alongside facilities in areas of H₂S present or H₂S unknown, you must equip vessels with an H₂S-detection system that activates audible and visual alarms when the concentration of H₂S in the atmosphere reaches 20 ppm. This requirement does not apply to vessels positioned upwind and at a safe distance from the facility in accordance with the positioning procedure described in the approved H₂S Contingency Plan.

(j)(10) What are the requirements for nearby facilities? The District Supervisor may require you to equip nearby facilities with portable or fixed H₂S detector(s) and to test and calibrate those detectors. To invoke this requirement, the District Supervisor will consider dispersion modeling results from a possible release to determine if 20 ppm H₂S concentration levels could be exceeded at nearby facilities.

(j)(11) What must I do to protect against SO₂ if I burn gas containing H₂S? You must:

(j)(11)(i) Monitor the SO₂ concentration in the air with portable or strategically placed fixed devices capable of detecting a minimum of 2 ppm of SO₂;

(j)(11)(ii) Take readings at least hourly and at any time personnel detect SO₂ odor or nasal irritation;

(j)(11)(iii) Implement the personnel protective measures specified in the H₂S Contingency Plan if the SO₂ concentration in the work area reaches 2 ppm; and

(j)(11)(iv) Calibrate devices every 3 months if you use fixed or portable electronic sensing devices to detect SO₂.

(j)(12) May I use alternative measures? You may follow alternative measures instead of those in paragraph (j)(11) of this section if you propose and the Regional Supervisor approves the alternative measures.

(j)(13) What are the **requirements for protective-breathing equipment**? In an area classified as H₂S present or H₂S unknown, you must:

(j)(13)(i) **Provide all personnel, including contractors and visitors on a facility, with immediate access to self-contained pressure-demand-type respirators with hoseline capability and breathing time of at least 15 minutes.**

(j)(13)(ii) Design, select, use, and maintain respirators in conformance with ANSI Z88.2 (incorporated by reference as specified in §250.198).

(j)(13)(iii) Make available at least two voice-transmission devices, which can be used while wearing a respirator, for use by designated personnel.

(j)(13)(iv) Make spectacle kits available as needed.

(j)(13)(v) Store protective-breathing equipment in a location that is quickly and easily accessible to all personnel.

(j)(13)(vi) Label all breathing-air bottles as containing breathing-quality air for human use.

(j)(13)(vii) **Ensure that vessels attendant to facilities carry appropriate protective-breathing equipment for each crewmember.** The District Supervisor may require additional protective-breathing equipment on certain vessels attendant to the facility.

(j)(13)(viii) During H₂S alerts, limit helicopter flights to and from facilities to the conditions specified in the H₂S Contingency Plan. During authorized flights, the flight crew and passengers must use pressure-demand-type respirators. You must train all members of flight crews in the use of the particular type(s) of respirator equipment made available.

(j)(13)(ix) As appropriate to the particular operation(s), (production, drilling, well-completion or well-workover operations, or any combination of them), provide a system of breathing-air manifolds, hoses, and masks at the facility and the briefing areas. You must provide a cascade air-bottle system for the breathing-air manifolds to refill individual protective-breathing apparatus bottles. The cascade air-bottle system may be recharged by a high-pressure compressor suitable for providing breathing-quality air, provided the compressor suction is located in an uncontaminated atmosphere.

(k) **Personnel safety equipment.**--(1) What additional personnel-safety equipment do I need? You must ensure that your facility has:

(k)(1)(i) **Portable H₂S detectors** capable of detecting a 10 ppm concentration of H₂S in the air available for use by all personnel;

(k)(1)(ii) **Retrieval ropes** with safety harnesses to retrieve incapacitated personnel from contaminated areas;

(k)(1)(iii) Chalkboards and/or note pads for communication purposes located on the rig floor, shale-shaker area, the cement-pump rooms, well-bay areas, production processing equipment area, gas compressor area, and pipeline-pump area;

(k)(1)(iv) Bull horns and flashing lights; and

(k)(1)(v) At least three **resuscitators** on manned facilities, and a number equal to the personnel on board, not to exceed three, on normally unmanned facilities, complete with face masks, oxygen bottles, and spare oxygen bottles.

(k)(2) What are the requirements for ventilation equipment? You must:

(k)(2)(i) Use only explosion-proof ventilation devices;

(k)(2)(ii) Install ventilation devices in areas where H₂S or SO₂ may accumulate; and

(k)(2)(iii) Provide movable ventilation devices in work areas. The movable ventilation devices must be multidirectional and capable of dispersing H₂S or SO₂ vapors away from working personnel.

(k)(3) What other personnel safety equipment do I need? You must have the following equipment readily available on each facility:

(k)(3)(i) A first-aid kit of appropriate size and content for the number of personnel on the facility; and

(k)(3)(ii) At least one litter or an equivalent device.

(l) Do I need to notify MMS in the event of an H₂S release? You must notify MMS without delay in the event of a gas release which results in a 15-minute time weighted average atmospheric concentration of H₂S of 20 ppm or more anywhere on the facility.

(m) Do I need to use special drilling, completion and workover fluids or procedures? When working in an area classified as H₂S present or H₂S unknown:

(m)(1) You may use either water- or oil-base muds in accordance with §250.300(b)(1).

(m)(2) If you use water-base well-control fluids, and if ambient air sensors detect H₂S, you must immediately conduct either the Garrett-Gas-Train test or a comparable test for soluble sulfides to confirm the presence of H₂S.

(m)(3) If the concentration detected by air sensors is over 20 ppm, personnel conducting the tests must don protective-breathing equipment conforming to paragraph (j)(13) of this section.

(m)(4) You must maintain on the facility sufficient quantities of additives for the control of H₂S, well-control fluid pH, and corrosion equipment.

(m)(4)(i) Scavengers. You must have scavengers for control of H₂S available on the facility. When H₂S is detected, you must add scavengers as needed. You must suspend drilling until the scavenger is circulated throughout the system.

(m)(4)(ii) Control pH. You must add additives for the control of pH to water-base well-control fluids in sufficient quantities to maintain pH of at least 10.0.

(m)(4)(iii) Corrosion inhibitors. You must add additives to the well-control fluid system as needed for the control of corrosion.

(m)(5) You must degas well-control fluids containing H₂S at the optimum location for the particular facility. You must collect the gases removed and burn them in a closed flare system conforming to paragraph (q)(6) of this section.

(n) What must I do in the event of a kick? In the event of a kick, you must use one of the following alternatives to dispose of the well-influx fluids giving consideration to personnel safety, possible environmental damage, and possible facility well-equipment damage:

(n)(1) Contain the well-fluid influx by shutting in the well and pumping the fluids back into the formation.

(n)(2) Control the kick by using appropriate well-control techniques to prevent formation fracturing in an open hole within the pressure limits of the well equipment (drill pipe, work string, casing, wellhead, BOP system, and related equipment). The disposal of H₂S and other gases must be through pressurized or atmospheric mud-separator equipment depending on volume, pressure and concentration of H₂S. The equipment must be designed to recover well-control fluids and burn the gases separated from the well-control fluid. The well-control fluid must be treated to neutralize H₂S and restore and maintain the proper quality.

(o) Well testing in a zone known to contain H₂S. When testing a well in a zone with H₂S present, you must do all of the following:

(o)(1) Before starting a well test, conduct safety meetings for all personnel who will be on the facility during the test. At the meetings, emphasize the use of protective-breathing equipment, first-aid procedures, and the Contingency Plan. Only competent personnel who are trained and are knowledgeable of the hazardous effects of H₂S must be engaged in these tests.

(o)(2) Perform well testing with the minimum number of personnel in the immediate vicinity of the rig floor and with the appropriate test equipment to safely and adequately perform the test. During the test, you must continuously monitor H₂S levels.

(o)(3) Not burn produced gases except through a flare which meets the requirements of paragraph (q)(6) of this section. Before flaring gas containing H₂S, you must activate SO₂ monitoring equipment in accordance with paragraph (j)(11) of this section. If you detect SO₂ in excess of 2 ppm, you must implement the personnel protective measures in your H₂S Contingency Plan, required by paragraph (f)(13)(iv) of this section. You must also follow the requirements of §250.1105. You must pipe gases from stored test fluids into the flare outlet and burn them.

(o)(4) Use downhole test tools and wellhead equipment suitable for H₂S service.

(o)(5) Use tubulars suitable for H₂S service. You must not use drill pipe for well testing without the prior approval of the District Supervisor. Water cushions must be thoroughly inhibited in order to prevent H₂S attack on metals. You must flush the test string fluid treated for this purpose after completion of the test.

(o)(6) Use surface test units and related equipment that is designed for H₂S service.

(p) Metallurgical properties of equipment. When operating in a zone with H₂S present, you must use equipment that is constructed of materials with metallurgical properties that resist or prevent sulfide stress cracking (also known as hydrogen embrittlement, stress corrosion cracking, or H₂S embrittlement), chloride-stress cracking, hydrogen-induced cracking, and other failure modes. You must do all of the following:

(p)(1) Use tubulars and other equipment, casing, tubing, drill pipe, couplings, flanges, and related equipment that is designed for H₂S service.

(p)(2) Use BOP system components, wellhead, pressure-control equipment, and related equipment exposed to H₂S-bearing fluids in conformance with NACE Standard MR0175-99 (incorporated by reference as specified in §250.198).

(p)(3) Use temporary downhole well-security devices such as retrievable packers and bridge plugs that are designed for H₂S service.

(p)(4) When producing in zones bearing H₂S, use equipment constructed of materials capable of resisting or preventing sulfide stress cracking.

(p)(5) Keep the use of welding to a minimum during the installation or modification of a production facility. Welding must be done in a manner that ensures resistance to sulfide stress cracking.

(q) General requirements when operating in an H₂S zone--
(1) Coring operations. When you conduct coring operations in H₂S-bearing zones, all personnel in the working area must wear protective-breathing equipment at least 10 stands in advance of retrieving the core barrel. Cores to be transported must be sealed and marked for the presence of H₂S.

(q)(2) Logging operations. You must treat and condition well-control fluid in use for logging operations to minimize the effects of H₂S on the logging equipment.

(q)(3) Stripping operations. Personnel must monitor displaced well-control fluid returns and wear protective-breathing equipment in the working area when the atmospheric concentration of H₂S reaches 20 ppm or if the well is under pressure.

(q)(4) Gas-cut well-control fluid or well kick from H₂S-bearing zone. If you decide to circulate out a kick, personnel in the working area during bottoms-up and extended-kill operations must wear protective-breathing equipment.

(q)(5) Drill- and workover-string design and precautions. Drill- and workover-strings must be designed consistent with the anticipated depth, conditions of the hole, and reservoir environment to be encountered. You must minimize exposure of the drill- or workover-string to high stresses as much as practical and consistent with well conditions. Proper handling techniques must be taken to minimize notching and stress concentrations. Precautions must be taken to minimize stresses caused by doglegs, improper stiffness ratios, improper torque, whip, abrasive wear on tool joints, and joint imbalance.

(q)(6) Flare system. The flare outlet must be of a diameter that allows easy non-restricted flow of gas. You must locate flare line outlets on the downside of the facility and as far from the facility as is feasible, taking into account the prevailing wind directions, the wake effects caused by the facility and adjacent structure(s), and the height of all such facilities and structures. You must equip the flare outlet with an automatic ignition system including a pilot-light gas source or an equivalent system. You must have alternate methods for igniting the flare. You must pipe to the flare system used for H₂S all vents from production process equipment, tanks, relief valves, burst plates, and similar devices.

(q)(7) Corrosion mitigation. You must use effective means of monitoring and controlling corrosion caused by acid gases (H₂S and CO₂) in both the downhole and surface portions of a production system. You must take specific corrosion monitoring and mitigating measures in areas of unusually severe corrosion where accumulation of water and/or higher concentration of H₂S exists.

(q)(8) Wireline lubricators. Lubricators which may be exposed to fluids containing H₂S must be of H₂S-resistant materials.

(q)(9) Fuel and/or instrument gas. You must not use gas containing H₂S for instrument gas. You must not use gas containing H₂S for fuel gas without the prior approval of the District Supervisor.

(q)(10) Sensing lines and devices. Metals used for sensing line and safety-control devices which are necessarily exposed to H₂S-bearing fluids must be constructed of H₂S-corrosion resistant materials or coated so as to resist H₂S corrosion.

(q)(11) Elastomer seals. You must use H₂S-resistant materials for all seals which may be exposed to fluids containing H₂S.

(q)(12) Water disposal. If you dispose of produced water by means other than subsurface injection, you must submit to the District Supervisor an analysis of the anticipated H₂S content of the water at the final treatment vessel and at the discharge point. The District Supervisor may require that the water be treated for removal of H₂S. The District Supervisor may require the submittal of an updated analysis if the water disposal rate or the potential H₂S content increases.

(q)(13) Deck drains. You must equip open deck drains with traps or similar devices to prevent the escape of H₂S gas into • the atmosphere.

(q)(14) Sealed voids. You must take precautions to eliminate sealed spaces in piping designs (e.g., slip-on flanges, reinforcing pads) which can be invaded by atomic hydrogen when H₂S is present.

[Source: 62 FR 3795, Jan. 27, 1997. Redesignated and amended at 63 FR 29479, 29485, May 29, 1998; 65 FR 15862, Mar. 24, 2000; 68 FR 8402, Feb. 20, 2003]

H₂S ON OIL TOWS

The cargoes that barge lines carry for their customers contain a variety of chemical compounds, one of the most unwelcome being hydrogen sulfide (H₂S). This compound is

found in many petroleum products, and is naturally present at differing concentrations in some crude oils. These crudes are commonly referred to as being "sour". **H₂S presents severe risk to personnel unless people are aware of its presence** and safe, effective procedures are followed. Personal protective gear is also required.

Towboat Captains are responsible for implementing and enforcing all the provisions of a company H₂S safety program on their vessels and each certificated tankerman must comply with the H₂S safety program. On towing vessels, individuals are responsible to themselves, their fellow employees and the company to ensure that they and fellow employees are trained in H₂S safety procedures and fully comply with their company's H₂S safety program.

The presence of sulfur and sulfur compounds in cargo normally indicates that some concentration of H₂S in vapor form will also be present. At the time an order for cargo is taken, the Dispatcher should determine if the cargo contains sulfur and/or H₂S. This information is then passed to crews when transmitting cargo movement orders. Before starting a transfer operation, the vessel's Person-In-Charge (PIC) must review the characteristics of the cargo, including possible presence of sulfur and/or H₂S, with the Person-In-Charge at the facility in a pre-transfer conference.

During the transfer of cargo that is known or suspected to contain H₂S, employees either engaged in the transfer, or who must board the barge(s), must wear personal exposure meters. If there is an indication that H₂S is present, such as smelling a rotten egg odor, immediately stop cargo transfer, clear the area of all personnel, and consult the Captain on how to safely proceed.

No reasonable person unnecessarily puts his life at risk. Being aware of the potential effects of H₂S should guide every person's actions. Safe work practices including **staying up-wind of any tank opening; opening tank hatches behind the cover and pulling the hatch toward you; keeping distance and upwind from vents, headers, and hatches; and actively monitoring atmosphere are all prudent activities that experienced people follow.** Limiting the chances of creating a work environment with an H₂S atmosphere is everybody's goal. These actions include, but are not limited to:

- Using closed systems and equipment such as a vapor recovery system.
- Ensuring that all hose connections are tight.
- Verifying that gaskets are in place and in good condition.
- Securing all openings that are not absolutely required for the cargo transfer.

Be aware that H₂S and other potentially hazardous cargo vapors can drift from the immediate area. So, it is important for persons on other vessels in the area such as on another barge or towboat to be alert for such vapors. If you detect such vapors tell the Person-In-Charge of the transfer immediately so he can stop the transfer and take necessary steps to clear the atmosphere and correct the condition.

Persons transferring cargo that contains H₂S require the highest level of respiratory protection. Only devices that are specifically designed for H₂S may be used.

Although the concentration of H₂S differs in various types of petroleum products, precautions to prevent over-exposure remain the same. The federal government established

permissible exposure limits (PEL) for H₂S. This means a person can be exposed up to 10 parts per million (ppm) over an 8-hour time weighted average. Another permissible exposure level is called a short-term exposure limit (STEL). The STEL is an exposure between 10 and 15 ppm for no more than 15-minute intervals, but there must be no more than 4 STEL exposures in a 24-hour period with a minimum of 60 minutes between each STEL.

Hydrogen sulfide attacks the respiratory system and the sense of smell and is recognizable by its "rotten egg" odor, even at low concentrations.

Here are several common sense procedures to eliminate personnel exposures to H₂S. First, always follow safe work practices: for example, open tank hatches behind the cover and pull the hatch open towards you, keeping as great a distance from vapor sources as possible, limiting activities down wind of any vapor source, using respiratory protection, actively monitoring the atmosphere for the presence of H₂S, etc. Second, use "engineering controls" (i.e., equipment) such as vapor recovery systems to reduce exposures.

While a company can educate its employees to recognize H₂S and the hazards associated with it, the methods to avoid a possible exposure, and supply employees with protective equipment, it is each individual's responsibility to use every precaution in the workplace to ensure individual safety.

Responsible employers require their personnel to follow all safe work practices to eliminate over exposures to H₂S and provide all vessel personnel with the proper training to recognize the hazards associated with H₂S and the proper detection and respiratory equipment. Towboats moving petroleum cargoes usually carry digital H₂S monitors with calibration kits and respiratory equipment to conduct transfers of H₂S cargoes.

Before arriving at a facility in which an H₂S cargo is to be transferred, the towing vessel officer on watch calls an equipment supplier to gather the required protective equipment and deliver it to the facility. Because not all H₂S transfers are the same, the necessary equipment will differ between loading and discharging. The following is typical of what equipment is necessary for each type of transfer:

- Discharge: 2 - Scott 30 minute rescue units; 2 - Scott 30 minute spare cylinders; 1 - Trigas monitor (H₂S, LEL, O₂)
- Loading: 2 - 4S cubic foot air cylinders; 1 - 100 it section of low pressure air hose; 2 - 200 it sections of low pressure air hose; 2 - 50 ft sections of low pressure air hose; 1 - 2 person manifold; 1 - Regulator; 1 - Scott 30 minute rescue unit; 1 - Trigas monitor (H₂S, LEL, O₂)
- Load (with vapor control): 2 - Scott 30 minute rescue units; 4 - Scott 30 minute spare cylinders; 1 - Trigas monitor (H₂S, LEL, O₂)

Before any transfer of a product containing H₂S, complete these items:

- Conduct a pre-transfer conference to establish the roles of each individual involved in the transfer and the procedures used for the transfer.
- Establish emergency hand signals for emergency egress, equipment problems, etc. It is hard to communicate with the background noise and when using a full face mask.
- Monitor the atmosphere and establish a safe zone where no H₂S vapors are present.
- Check to see that all the equipment works before you need

to use it!

- Calibrate the towboat's H₂S monitor.

During each transfer two (2) persons must start the transfer operation using one person to tanker the barge while the other assists, especially with air monitoring. If the concentration of H₂S in the atmosphere exceeds 10 ppm, use the supplied-air following proper procedures.

The person assisting the tankerman must monitor the supplied-air system. The two individuals on watch during the transfer must maintain visual contact with each other to ensure the safety of the other person. If the atmospheric monitors show less than 10 ppm, supplied-air is not required. As the operation draws to a close, be sure to notify the safety equipment supplier to pick up his equipment.

Once the transfer is complete and the towboat and its tow leave the facility, the Captain must ensure that periodic monitoring is conducted on his towboat while in transit to the next facility. This ensures that the H₂S concentrations onboard the towboat fall below the permissible exposure levels. The Captain also must ensure that H₂S monitoring continues if a non-H₂S cargo is loaded following an H₂S cargo discharge since the residual product from the last load may cause H₂S concentrations above the permissible levels. If the monitoring reveals that H₂S exceeds the permissible levels, stop the transfer and notify the person on-call to order the proper protective H₂S equipment from the equipment provider.

GCMA REQUESTS TO U.S. COAST GUARD

[GCMA REQUEST: We request that 30 CFR §250.490 on Hydrogen Sulfide be incorporated by reference in 33 CFR Subchapter N, Outer Continental Shelf Regulations.]

[GCMA REQUEST: We request that the Coast Guard prepare guidance in the form of a Navigation and Vessel Inspection Circular warning of the dangers of Hydrogen Sulfide in the mineral and oil, towing and fishing industries.]