

# **EMERGENCY PROCEDURES**

## **DRILLING CREW ACTIONS**

1. All personnel will don their protective breathing apparatus. The drilling crew will take necessary precaution as indicated in OPERATING PROCEDURES.
2. The "Buddy System" will be implemented. All personnel will act upon directions from the Operator's Representative.
3. If there are nonessential personnel on location, they will move off location.
4. Entrance to the location will be patrolled, and the proper well condition flag will be displayed at the entrance to the location.

## **IN THE EVENT OF AN ACCIDENTAL RELEASE OF POTENTIALLY HAZARDOUS VOLUME OF H<sub>2</sub>S, THE FOLLOWING PROCEDURES WILL BE TAKEN:**

1. All personnel on location will be accounted for and emergency search should begin for any missing.
2. All search missions will be conducted under fresh air masks in teams of two. Should the search team need to approach the well, safety harness and rope should be used.
3. All individual companies and agencies should be contacted according to the EMERGENCY CALL LIST.
4. An assigned crew member will blockade the entrance to the location. No unauthorized personnel will be allowed entry into the location.
5. The Operator's Representative will remain on location and attempt to regain control of the well.
6. The Company's designated representatives will begin evacuation of those persons in immediate danger.

## **TEMPORARY SERVICE PERSONNEL**

All service personnel, such as cementing crews, logging crews, specialists, mechanics and welders will furnish their own safety equipment as required to comply with OSHA and HEC PETROLEUM, INC.

### **VISITORS**

Visitors and nonessential personnel will be prohibited from remaining in, or entering a contaminated area where Hydrogen Sulfide concentration in the atmosphere exceeds 15 ppm.

## **EMERGENCY PROCEDURES**

**NOTE:** WHEN HYDROGEN SULFIDE MIGHT BE ENCOUNTERED, NO PERSONNEL ON LOCATION WILL BE PERMITTED TO SLEEP IN VEHICLES.

## **INSTRUCTIONS FOR IGNITING THE WELL**

THE DECISION TO IGNITE THE WELL IS THE RESPONSIBILITY OF THE HEC PETROLEUM, INC. REPRESENTATIVE. In the event he is incapacitated or unavailable, it becomes the responsibility of the NABORS DRILLING U.S.A. COMPANY TOOL PUSHER.

The decision to ignite the well should be made only as a last resort and in the situation where it is clear that:

1. Human life is in danger
2. There is no hope of controlling the well under current conditions.

The HEC PETROLEUM, INC. Corporate Office should be notified as soon as possible. The first phase of evacuation should be initiated immediately.

Once the decision has been made the following procedures should be followed:

1. Four (4) people, wearing self-contained breathing apparatus will be needed for the actual lighting of the well. They must first establish the flammable perimeter by using an explosimeter. This should be established at 30% to 40% of the lower flammable limits.
2. After the flammable perimeter has been established and everyone removed from the area, the ignition team should select a site upwind of the well, from which to ignite. This site should offer the maximum protection and have a clear path for retreat from the area.
3. The ignition team should have safety belts and lanyards attached and manned before attempting ignition. If the leak is not ignited on the first attempt, move in 20 to 30 feet and fire again. Continue to monitor with the explosimeter and never fire from an area with over 75% of the Lower explosive Limit (LL). If having trouble igniting the well, try firing 40 degrees to 90 degrees on either side of the well.
4. After ignition or attempted ignition, the toxic perimeter must be established and evacuation continued until the well is contained.
5. All personnel will act only as directed by the person in charge of the operations.

### **REMEMBER:**

After the well is ignited, burning Hydrogen Sulfide (H<sub>2</sub>S) will convert to Sulfur Dioxide (SO<sub>2</sub>), which is also a highly toxic gas.

**DO NOT ASSUME THE AREA IS SAFE AFTER THE WELL IS IGNITED**

## **EQUIPMENT TO BE PROVIDED BY SAFETY INTERNATIONAL**

### **SAFETY TRAILER PACKAGE # 2**

- 1.) One (1) Safety Trailer Containing an 6-Bottle Breathing Air Cascade System.
- 2.) 750 Feet of Air Line Hose
- 3.) Four (4) Breathing Air Manifolds
- 4.) Four (4) 30-Minute Rescue Units
- 5.) Five (5) Work/Escape Units
- 6.) Five (5) Escape Capsules
- 7.) One (1) Filler Hose for the Work/Escape and Rescue Units
- 8.) One (1) Location Sign with Flags
- 9.) Two (2) Briefing Area Signs
- 10.) Two (2) Windsocks
- 11.) One (1) Electronic Monitor with Three (3) Sensor Heads, Warning Light and Siren

## **TRAINING**

Every person working in any capacity on the lease will be required to review the emergency procedures and will participate in the training program.

HEC PETROLEUM, INC. will provide personnel to direct the training program and indoctrinate all authorized persons on the lease in the proper use of the safety equipment.

The training personnel will work individually with each member until they are satisfied that the crew member is familiar with the emergency procedures and the training program. This should be accomplished prior to an individual's work operation.

Training will include hands-on use of all equipment in order to familiarize the trainees with the safety equipment.

## **DRILLSITE LOCATION**

1. The drilling rig should be situated on location such that the prevailing winds blow across the rig toward the reserve pit or at right angles to a line from the rig to the reserve pit.
2. The entrance to the location should be designed so that it can be barricaded if Hydrogen Sulfide emergency conditions arise. An auxiliary exit (or entrance) should be available in case of a catastrophe; a shift in wind direction would not preclude escape from the location. Appropriate warning signs and flags should be placed at all location entrances.
3. Once H<sub>2</sub>S safety procedures are established on location, no beards or facial hair which will interfere with face seal or mask will be allowed on location.
4. A minimum of two BRIEFING AREAS will be established, not less than 250 feet from the wellhead and in such location that at least one area will be up-wind from the well at all times. Upon recognition of an emergency situation, all personnel should assemble at the designated briefing areas for instructions.
5. A safety equipment trailer will be stationed at one of the briefing areas.
6. Windsocks will be installed and wind streamers (6 to 8 feet above ground level) placed at the location entrance. Windsocks shall be illuminated for night time operations. Personnel should develop wind direction consciousness.
7. The mud logging trailer will be located so as to minimize the danger from gas that breaks out of the drilling fluid.
8. Shale shaker mud tanks will be located so as to minimize the danger from gas that breaks out of the drilling fluid.
9. Electric power plant(s) will be located as far from the well bore as practical so that it may be used under conditions where it otherwise would have to be shut down.
10. When approaching depth where Hydrogen Sulfide may be encountered, appropriate warning signs will be posted on all access roads to the location and at the foot of all stairways to the derrick floor.
11. Appropriate smoking areas will be designated and smoking will be prohibited elsewhere.

## **BLOWOUT PREVENTION EQUIPMENT**

1. A kill line of ample strength and length will be laid to a safe point to allow pumping into the well in an emergency situation.
2. The closing unit should be located a safe distance from the well bore and positioned for maximum utilization based on the prevailing wind direction.
3. BOP equipment will be tested in accordance with standard company practice.



### **SPECIAL EQUIPMENT**

1. Flare lines should be as long as practical, securely staked.
2. An electronic Hydrogen Sulfide monitor will be installed with a combination visual and audible alarm system located where it can be seen and/or heard throughout the drilling location.
3. The electronic Hydrogen Sulfide monitoring system will be calibrated to actuate the low alarm (visual alarm) at a concentration of 10 ppm Hydrogen Sulfide in the atmosphere and the high alarm at a concentration of 15 ppm Hydrogen Sulfide in the atmosphere.
4. Extra equipment will be available if required to provide adequate respiratory protection for all personnel on location.

### **DRILL STEM TEST**

1. All drill stem tests of Hydrogen Sulfide zones will be approved by the Oil Conservation Division.
2. Drill stem testing of Hydrogen Sulfide zones will be permitted only during daylight hours.
3. All nonessential personnel will be moved to "Safe Briefing Area".
4. Put on air mask before formation fluids are expected at the surface and continue "MASKS ON" until flares are lighted and work areas test no more than 10 ppm Hydrogen Sulfide and the area has been declared safe.

## **SAFETY TRAINING**

1. Hydrogen Sulfide Safety Training will be provided to all personnel at 1,000 feet above the expected H<sub>2</sub>S formation. The training sessions will cover, but will not be limited to the following
  - a. General information on H<sub>2</sub>S and SO<sub>2</sub> gas
  - b. Hazards of H<sub>2</sub>S and SO<sub>2</sub> gas
  - c. Safety equipment on location
  - d. Proper use and care of personal protective equipment
  - e. Operational procedures in dealing with H<sub>2</sub>S gas
  - f. Evacuation procedures
  - g. Chemicals to be used in mud to control H<sub>2</sub>S
  - h. First aid, reviving an H<sub>2</sub>S victim, toxicity, etc.
  - i. Designated safe briefing areas (S.B.A.)
  - j. Metallurgical considerations

**NOTE:** Once H<sub>2</sub>S Safety Procedures are established on location, no beards or facial hair which will interfere with face seal or mask will be allowed on location.

2. When H<sub>2</sub>S alarm is activated:
  - a. Mask up
  - b. Raise tool joints above the rotary table and shut down pump
  - c. Close in hydril
  - d. Go to Safe Briefing Area

## **SAFETY INTERNATIONAL FIELD SUPERVISOR QUALIFICATIONS**

Safety International, Inc. is proud of the training and qualifications of our staff of field personnel. We know that our customers are provided with the best service available in the H<sub>2</sub>S safety business. We also know that we have by far, the most rigid requirements for basic qualifications, and the most extensive training program of any H<sub>2</sub>S company.

Safety International, Inc. personnel will be qualified in Basic H<sub>2</sub>S Safety Training, which includes the maintenance of equipment, training of personnel, and general oil field safety. Specifically, all are trained in Basic First Aid and Cardiopulmonary Resuscitation (CPR).

Safety International, Inc. will provide all needed materials for training of personnel on location as required.

### **CORPORATE OFFICE**

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### **FIELD OFFICE**

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## **EMERGENCY CONDITIONS**

### **Operating Conditions**

#### A. Emergency Procedures and Definition of Warning Flags

1. Condition: YELLOW -- NORMAL OPERATION

2. Condition: ORANGE -- POTENTIAL DANGER, CAUTION

a. **Cause for condition:**

- \* Circulating up drilling breaks
- \* Trip gas after trip
- \* Circulating out gas on choke
- \* Poisonous gas present, but below threshold concentrations

b. **Safety actions:**

- \* Check safety equipment and keep it with you
- \* Be alert for a change in conditions
- \* Follow instructions

3. **Condition:** RED -- EXTREME DANGER

a. **Cause for condition:**

- \* Uncontrolled flow from the well with lethal concentrations of H<sub>2</sub>S

b. **Safety actions:**

- \* Masks On. All personnel will have protective breathing equipment with them. All personnel will stay in safe briefing area unless instructed to do otherwise.
- \* The decision to ignite the well is the responsibility of the company representative and should be made only as a last resort, when it is clear that:
  - I. Human life is endangered
  - ii There is no hope of controlling the well under prevailing conditions
- \* Order evacuation of local people within the danger zone.

## **THE USE OF SELF CONTAINED BREATHING EQUIPMENT**

1. Respirators shall be inspected frequently at random, to insure that they are properly used, cleaned and maintained
2. Anyone who may use the respirators shall be trained in how to insure proper face piece to face seal. They shall wear respirators in normal air and then wear it in a test atmosphere. (Note: such items as facial hair - beard or sideburns - and eyeglass temple pieces will not allow a proper seal). Anyone who may be reasonably expected to wear respirators should have these items removed before entering a toxic atmosphere. A special mask must be obtained for anyone who must wear eye glasses. Contact lenses should not be allowed.
3. Maintenance and care of respirators:
  - A. A program for maintenance and care of respirators shall include the following:
    - \* Inspection for defects, including leak checks
    - \* Cleaning and disinfecting
    - \* Repair
    - \* Storage
  - B. Inspection: Self contained breathing apparatus for emergency use shall be inspected monthly for the following and a permanent record kept of these inspections.
    - \* Fully charged cylinders
    - \* Regulator and warning device operation
    - \* Condition of face piece and connections
    - \* Elastic or rubber parts shall be stretched or massaged to keep them pliable and prevent deterioration.
  - C. Routinely used respirators shall be collected, cleaned and disinfected as frequently as necessary to insure proper protection is provided.

4. A person assigned a task that requires use of self contained breathing equipment, should be certified, physically fit for breathing equipment usage by the local physician at least annually.
5. Respirators should be worn:
  - A. When breaking out any line where H<sub>2</sub>S can reasonably be expected.
  - B. When sampling air in areas to determine if toxic concentrations of H<sub>2</sub>S exist.
  - C. When working in areas where over 15 ppm H<sub>2</sub>S has been detected.
  - D. At any time there is a doubt as to the H<sub>2</sub>S concentration in the zone to be entered.

## **PHYSICAL EFFECTS OF HYDROGEN SULFIDE POISONING**

### **THE PRINCIPAL HAZARD IS DEATH BY INHALATION**

When the amount of gas absorbed into the bloodstream exceeds that which is readily oxidized, systemic poisoning results, with a general action on the nervous system. Labored respiration occurs shortly and respiratory paralysis may follow immediately at concentrations of 700 ppm and above. This condition may be reached almost without warning as the originally detected odor of H<sub>2</sub>S may have disappeared due to olfactory paralysis. Death then occurs from asphyxiation unless the exposed person is removed immediately to fresh air and breathing is stimulated by artificial respiration. Other levels of exposure may cause the following symptoms individually or in combination:

1. Headache
2. Dizziness
3. Excitement
4. Nausea or gastro-intestinal disturbances
5. Dryness and sensation of pain in nose, throat, and chest
6. Coughing
7. Drowsiness

All personnel should be alerted to the fact that detection of H<sub>2</sub>S solely by sense of smell is highly dangerous, as the sense of smell is rapidly paralyzed by the gas. 10 ppm of H<sub>2</sub>S detected should be treated as if it were 700 ppm.



### **CHARACTERISTICS OF HYDROGEN SULFIDE**

1. Extremely toxic (Poisonous)
2. Heavier than air and colorless
3. Has the odor of rotten eggs, in small amounts
4. Burns with a blue flame and produces Sulphur Dioxide ( $\text{SO}_2$ ) Gas, which is very irritating to eyes and lungs. The  $\text{SO}_2$  is as toxic as  $\text{H}_2\text{S}$ , but the severe discomfort at low concentrations acts as a barrier to human exposure to toxic levels of this gas.
5.  $\text{H}_2\text{S}$  forms explosive mixture with air between 4.3% and 46% by volume
6.  $\text{H}_2\text{S}$  is soluble in water but becomes less soluble as the water temperature increases.
7. The toxicity of Hydrogen Sulfide is second only to Hydrogen Cyanide and is between 5 and 6 times more toxic than Carbon Monoxide.
8. Produces irritation to eyes, throat and respiratory tract.

## **TREATMENT OF HYDROGEN SULFIDE POISONING**

### **INHALATION**

As Hydrogen Sulfide in the blood oxidizes rapidly, symptoms of acute poisoning pass off when inhalation of the gas ceases. It is important, therefore, to get the victim of poisoning to fresh air as quickly as possible. He should be kept at rest and chilling should be prevented. If respiration is slow, labored or impaired, artificial respiration may be necessary.

Most persons overcome by Hydrogen Sulfide may be revived if artificial respiration is applied before heart action ceases. Victims of poisoning should be under the care of a physician as soon as possible. Irritation due to sub acute poisoning may lead to serious complications such as pneumonia. Under those conditions, treatment by the physician necessarily would be symptomatic. The patient should be kept in fresh air.

### **CONTACT WITH EYES**

Eye contact with liquid and/or gas containing Hydrogen Sulfide will cause painful irritation (conjunctivitis). Keep patient in a darkened room, apply ice compresses to eyes, put ice on forehead, and send for a physician. The irritation caused by exposure to Hydrogen Sulfide requires treatment by a physician, preferably an eye specialist. The prognosis for recovery in these cases is usually good.

### **CONTACT WITH SKIN**

Skin absorption is very low. Skin discoloration is possible after contact with liquids containing Hydrogen Sulfide. If such skin contact is suspected, the area should be thoroughly washed.

## **EFFECTS OF HYDROGEN SULFIDE ON METAL**

Hydrogen Sulfide dissolves in water to form a weak acid that can cause some pitting, particularly in the presence of Oxygen and/or Carbon Dioxide. However, the most significant action of  $H_2S$  is its contribution to a form of Hydrogen embrittlement known as Sulfide Stress Cracking. Sulfide Stress Cracking is a result of metals being subjected to high stress levels in a corrosive environment where  $H_2S$  is present. The metal will often fail in a brittle manner. Sulfide stress cracking of steel is dependent upon and determined by:

1. Strength (hardness) of the steel-the higher the strength, the greater the susceptibility to sulfide stress cracking. Steels having yield strengths up to 95,000 psi and hardness up to Rc22 are generally resistant to sulfide stress cracking. These limitations can be extended slightly higher for properly quenched and tempered materials.
2. Total member stress (load) - higher the stress level (load) the greater the susceptibility to sulfide stress cracking.
3. Corrosive environment - corrosive reactions, acids, bacterial action, thermal degradation of low Ph fluid environment.

## **PROCEDURAL CHECK LIST**

### **PERFORM EACH TOUR BY THE DRILLING CONTRACTOR PERSONNEL**

1. Check fire extinguishers to see that they have the proper charge.
2. Check pressure on breathing air cascade system to make sure they are charged to full volume.
3. Check pump pressure on stand pipe gauge and choke manifold gauge to assure proper communication between gauges and also comparison of pressure reading on each gauge.
4. Make a visual check of H<sub>2</sub>S monitoring system.

### **PERFORM EACH WEEK BY DRILLING CONTRACTOR PERSONNEL:**

1. Blowout preventer drills
2. Check nitrogen supply pressure on BOP accumulator standby

### **PERFORM EACH WEEK BY SAFETY INTERNATIONAL PERSONNEL OR DAILY ON SUPERVISION**

1. Check each piece of breathing equipment to make sure that demand regulator is working. This requires that the bottle be opened and the mask assembly be put on tight enough so that when you inhale, you get air.
2. Check butane supply for burn pit for volume and to make sure 1" line is not plugged. Check automatic ignition system.
3. Check all work units for operation; demand regulator, escape bottle air volume, supply bottle air volume.
4. Check breathing equipment mask assembly to see that straps are loosened and turned back ready to put on.
5. Check pressure on breathing equipment air bottles to make sure they are charged to full volume.
6. Confirm pressure on all supply air bottles
7. Perform breathing equipment drills with onsite personnel.