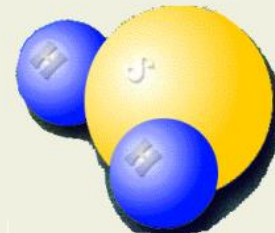




H₂S

Hydrogen Sulfide Training



HYDROGEN SULFIDE (H₂S) TRAINING COURSE



Company Philosophy

It is the policy of GUPCO to operate all locations such that no person is exposed to Hydrogen Sulfide concentrations which may put life or health at risk.

It is your responsibility to be aware of the properties and toxicity of H₂S gas.

You must be able to recognize its presence and know how to protect yourself from its lethal effects.

You are responsible for you own safety.

Training and Competency

ALL personnel, whether regularly assigned or employed on an unscheduled basis shall be informed of the hazards of H₂S.

All staff who will be required to enter a H₂S area as part of their normal work will be trained to a level of competence in line with the risks involved.

Hydrogen Sulfide

- H₂S gas is commonly measured in parts per million (ppm)
 - How much is a ppm?
1 drop of water in a bathtub.
1 meter or 1 step in 1000 kms
- **1% H₂S gas is equal to 10,000 ppm**
- **In the Ras Shukheir area, concentrations of over 3000 ppm have been recorded.**

H₂S is a Poisonous Gas

- The effects of exposure can range from minor discomfort to death.
- It is not enough to be able to recognize the gas and know where it is likely to occur.
- You need to know how much it takes to harm you and to know specific locations where a release may occur.
- **Your first response is to get out of the area, upwind or cross wind from the release.**

Classification of H₂S Areas

- There are 2 Classifications of H₂S areas in the Ras Shukheir facility.
- Sweet or non-sour: Areas where concentrations of H₂S in the process stream and equipment are below 10 ppm.
- H₂S areas or sour: Areas where the concentration of the process stream and equipment are over 10 ppm.
- The Off Shore Central Production area is considered a H₂S area. Sweet platforms are October , July, Ramadon.

Physical Properties of H₂S

- Color – H₂S is colorless, it is invisible. You cannot rely on your eyes to detect its presence. This is another hazard of working around areas that contain H₂S gas.
- Odor – H₂S has a distinctive, offensive smell, similar to “rotten eggs”. This is why it is sometimes called “Sour gas”. At concentrations of 100 ppm it will paralyze your sense of smell which can make it fatal to rely on your nose as a detection device.
- Vapor Density – Hydrogen Sulfide gas is **HEAVIER THAN AIR**. In highly concentrated mixtures it will tend to settle in low lying areas like pits, cellars, or tanks. In lower concentrations it will be mixed with other gases and move with the gas.
- H₂S can travel in any direction, depending on pressure, temperature or swirling winds.

Physical Properties of H₂S Gas

- Explosive Limits – Flammable Range

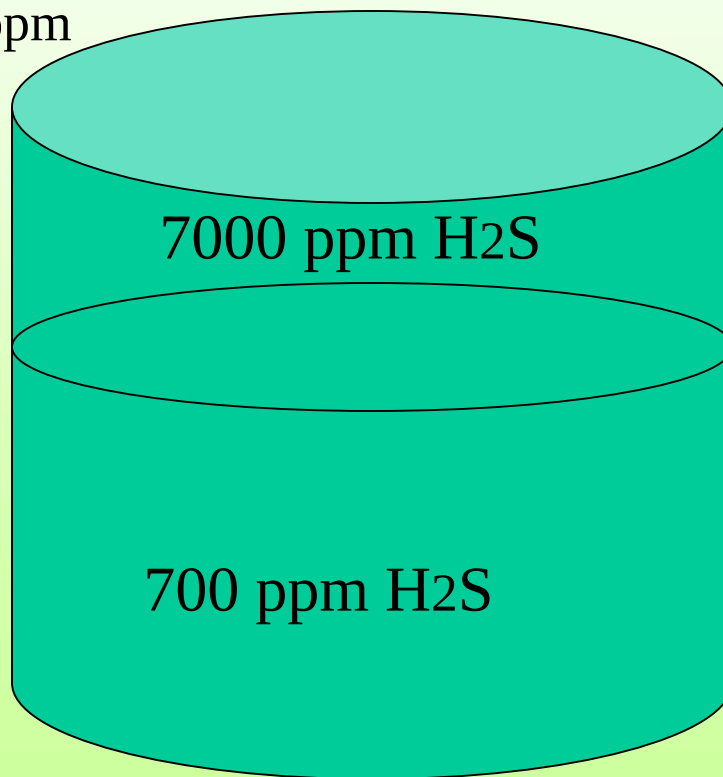
H₂S gas when mixed with air will explode. It has a wide explosive range (4.3 – 44%) which is very wide when compared with other gases.

- Flammability – H₂S burns with a distinctive blue flame which produces Sulphur Dioxide (SO₂). This hazardous gas irritates the eyes and lungs, and can be potentially fatal. ANY EXPOSURE TO SO₂ SHOULD BE AVOIDED.

- Solubility – **H₂S gas dissolves in liquids, which means that it can be present in any container or vessel used to carry or hold well fluids including oil, water, emulsion and sludge. H₂S will be released when this liquid is agitated, depressured, or heated.**

Liquid and Gas

Crude oil being discharged into a storage tank may contain only 70 ppm H₂S in liquid. The concentration in the vapor space could exceed 7000 ppm



H₂S gas dissolves in liquid and will break out of the liquid when heated, agitated, or depressured

Physical Properties of H₂S Gas

- Attacks most metals, especially in the presence of water, forming sulfides which are usually insoluble precipitates.
- Dissolves in water forming a weak acid (hydrosulfuric acid).

These 6 physical properties of H₂S gas help provide a good picture of its characteristics. This information will help you avoid being exposed.

HYDROGEN SULFIDE (H₂S) TRAINING COURSE

PHYSIOLOGICAL EFFECTS

Concentration	Time	Effect	Action to be Taken
0.02 ppm	instant	Threshold of smell (sensitive nose)	
0.2 ppm	instant	Rotten eggs odor detectable by most people	
10 ppm	8 hours	TWA – time weighted average. The average exposure based on an eight hour exposure period.	Breathing air must be worn over 10 ppm
15 ppm	15 min	Short term Exposure Limit It is irritating to the eyes and the mucous membranes of the nose, throat and lungs.	
20 ppm		Ceiling limit The maximum concentration to which a worker can be exposed to even instantaneously.	

HYDROGEN SULFIDE (H₂S) TRAINING COURSE

PHYSIOLOGICAL EFFECTS

Concentration	Time	Effect	Action to be Taken
50 ppm		Irritation to respiratory tract As above.	Place person exposed in fresh air. Call a doctor
100 ppm		Olfactory paralysis It tends to paralyze the olfactory nerve when affected for 3 to 15 minutes, so the ability to smell it is lost in a few minutes. Stings eyes and throat.	Place person exposed in fresh air. Call a doctor
200 ppm		Immediate paralysis of olfactory nerve. It is severely stinging to the eyes and throat, and extended exposure will cause chemical pneumonitis (pulmonary edema). Affects eyes and respiratory organs severely.	Place person exposed in fresh air, stay with the person and monitor. Call a doctor.
500 ppm		Disturbance of balance centre. Difficulty in breathing, possible breathing stop, unconsciousness, potentially lethal	Place person exposed in fresh air. Stay with the person and monitor the person Call a doctor (or arrange medivac).
700 ppm		Death may occur in minutes.	

H₂S High Risk Areas

- **H₂S can accumulate in enclosed areas such as:**
 1. Compressor enclosures
 2. Instrumentation cabinets with H₂S supply
 3. Drain systems
 4. Sump Caissons
- Make sure that these areas are checked with a H₂S portable monitor before doing work or opening these enclosures.

Common H₂S Leak Areas

- Vent lines
- Relief valves
- Sample points
- Drains
- Flanges
- Seals
- Packings
- Fittings
- Valves
- Turbines

How H₂S Affects You

- When H₂S is inhaled, it passes directly through the lungs into the bloodstream. To protect itself the body breaks down the gases into a harmless compound.
- If you breath in more than the body can break down, it builds up in the blood and you will go unconscious.
- The areas of the brain which control breathing become paralyzed, the lungs stop working and the person is asphyxiated

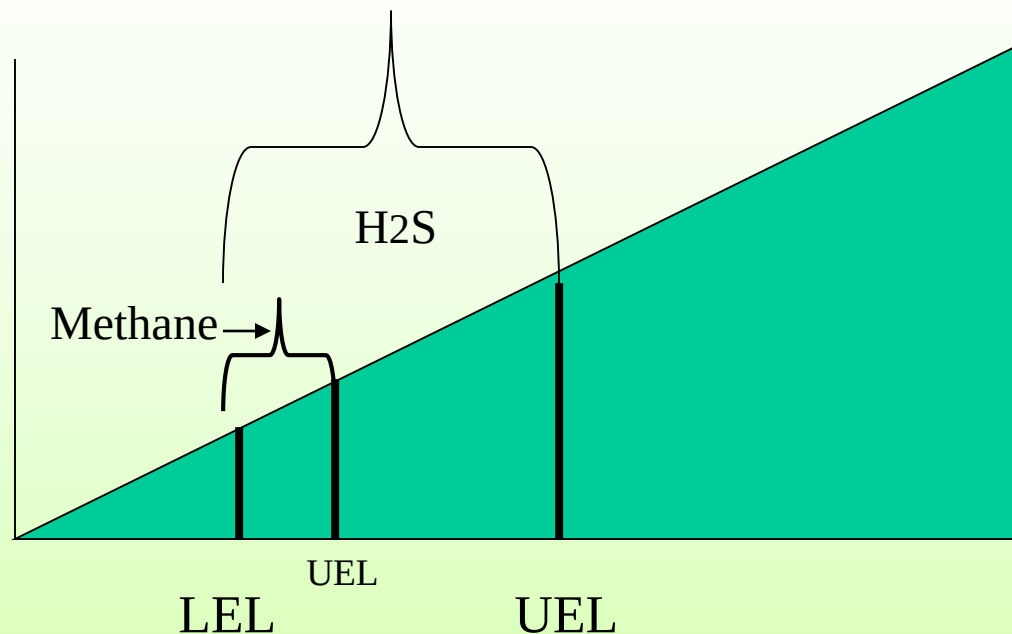
Testing for H₂S Gas

Detection Systems

- Fixed Gas Detection – not used at R/S
- Portable Gas Detection – Industrial Scientific and Triple plus - measure O₂, LEL, and H₂S.
- Area Gas Detectors – Crowcom detectors
- Personal Gas Monitors – Gasman 11, alarms at 5 ppm and 10 ppm. Only monitors for H₂S
- Chemical Detector Tubes – used by the Lab technicians

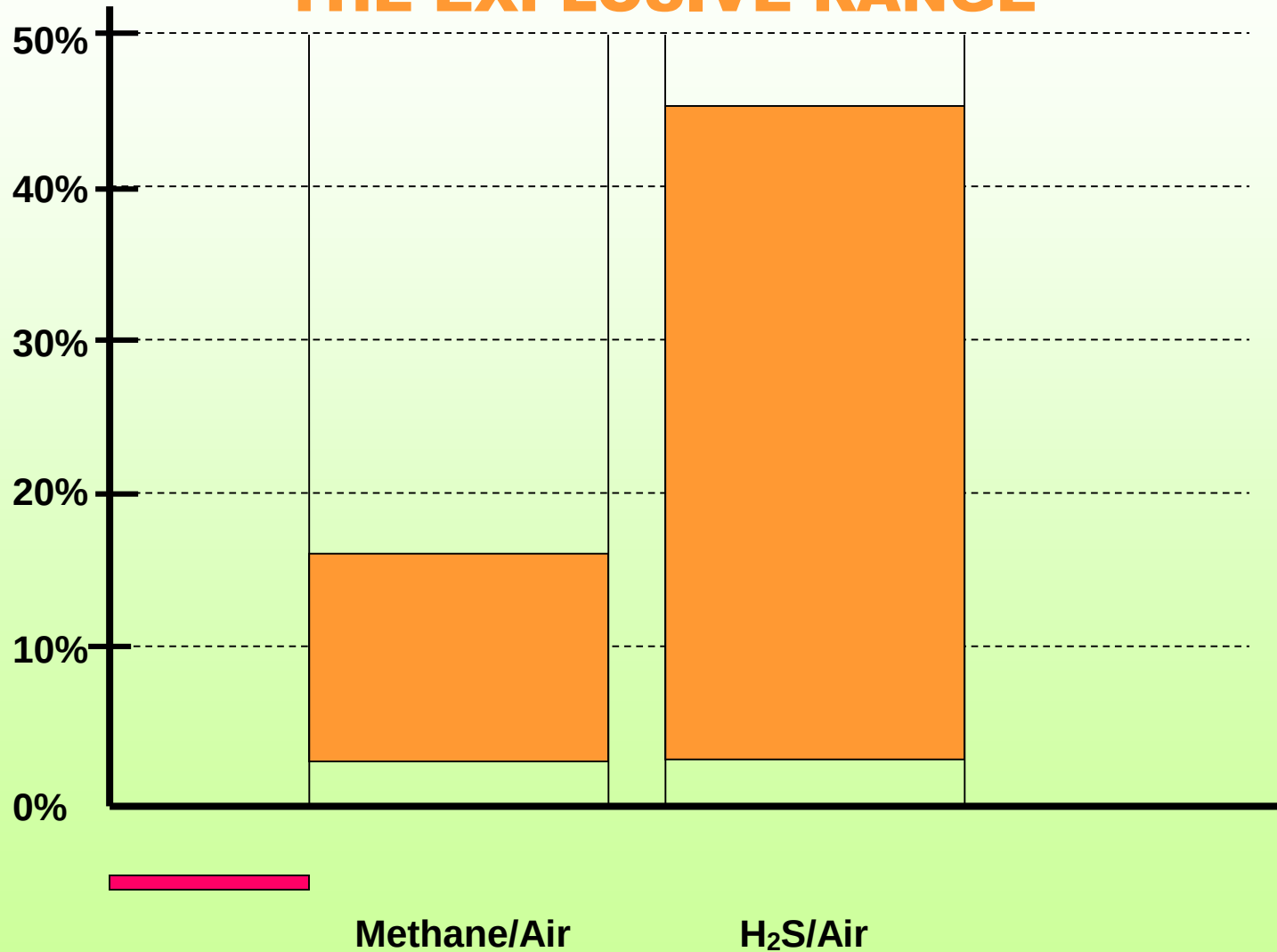
Pre-Use Gas Detector Checks

- Select the correct gas detector for the job
- Check that the detector is within the calibration date
- Ensure that it is in good shape, no damage
- Check that the battery life is sufficient
- Check that the sensor head membranes are clean and not blocked
- Check the detector zeros in a clean environment
LEL=0%, H₂S=0, Oxygen=20.9%

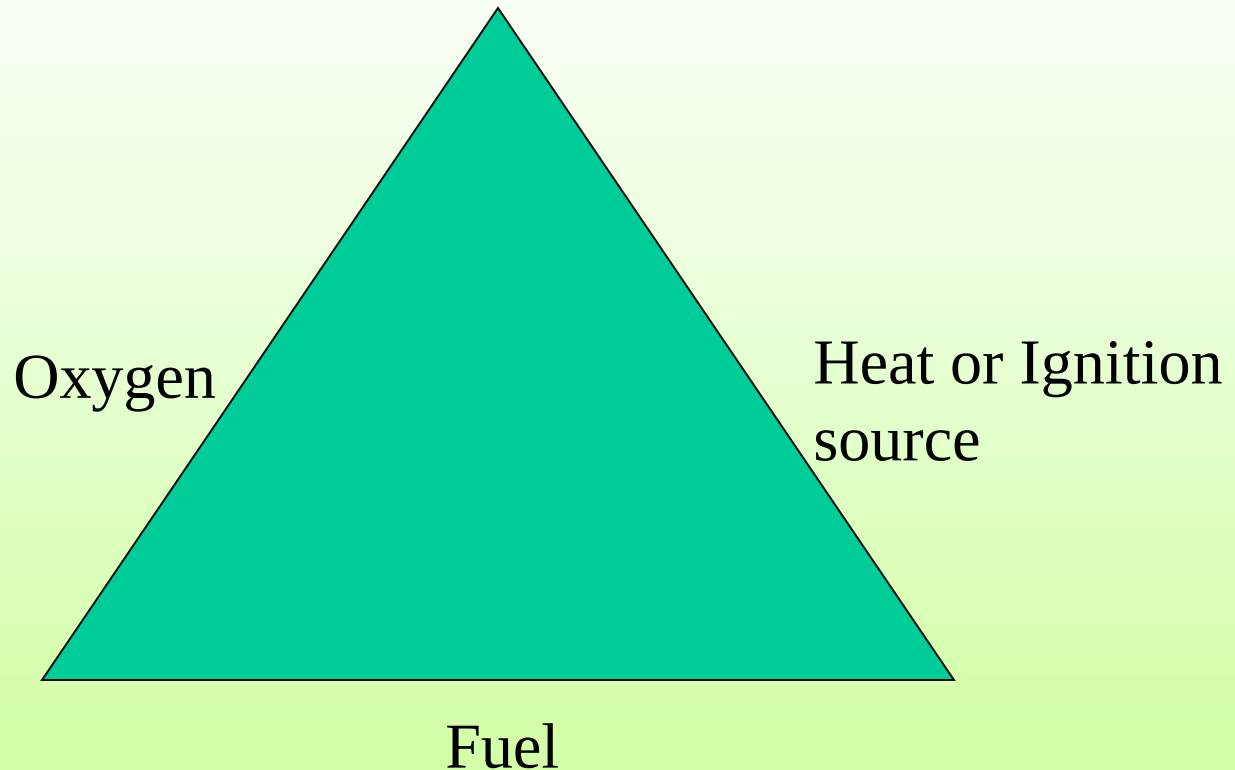


AT the LEL point, 100% will show on the gas monitor. This tells you that you are in the explosive range of the gas. The range of methane gas is from 5% to 15%. H₂S gas has a range of 4.3% to 44%. **If the concentration is below the LEL the mixture is too lean to burn, if it is above the UEL it is too rich to burn.**

THE EXPLOSIVE RANGE



Fire Triangle



Fuel and Oxygen have to exist in the right combination to explode when a heat source is available.

If there is too much fuel, what's missing that you need to breath?

Respiratory Protective Equipment

- SCBA - 30 minute, Self Contained Breathing Apparatus
- SABA – Supplied Air Breathing Apparatus
- 10 Minute Escape Packs
- Compressed Airline Breathing Apparatus – cascade system used with wireline and well servicing operations.
- **Note: It is your responsibility to familiarize yourself with the SCBA at your location.**

Components of SCBA

- Air Supply – air cylinder, cylinder valve, cylinder pressure gauge.
- Regulator Assembly – high pressure system, pressure regulator, bypass/purge valve, pressure gauge, low pressure alarm.
- Face piece Assembly – face piece, low pressure hose, nose cup, exhalation valve, head harness.
- Harness Assembly

Instructions for Donning SCBA

- Prepare Equipment – check cylinder pressure, face piece, and harness.
- Put on Cylinder – adjust and tighten straps.
- Put on Face piece – Tighten straps starting at the chin first.
- Negative Pressure Test – Block face piece opening and breath in to check for seal and breath out to check exhalation valve.
- Connect Air – Open cylinder, connect regulator, and breath.

Cleaning and Maintenance

- Immediately after use, Breathing Air equipment must be cleaned and properly stored. The face piece must be sanitized with a commercial disinfectant that is approved for use by the manufacturer.
- Inspections should be done at a minimum once per week and cover:
 1. Checking the pressure of the cylinder
 2. Condition of breathing hose
 3. Condition of mask, straps fully extended and pulled over the front of the mask
 4. Mask protected in a plastic bag
 5. All parts are clean and in good condition.

Rescue Procedures

- **Step 1 – Evacuate Immediately** – if there is an release of H₂S you must evacuate the areas immediately, moving upwind or crosswind and to a higher location.
- **Step 2 – Sound the Alarm** – notify the control room that there is a H₂S release and where. Ask for help.
- **Step 3 – Assess the Situation** – quickly assess if there are other hazards that could put you at risk. (explosive mixture)
- **Step 4 – Protect yourself by putting on SCBA** – Always don breathing air before attempting a rescue. Use SCBA packs and never escape packs for performing a rescue.

Rescue Procedure

- **Step 5 – Rescue the victim** – You may rescue by yourself if you know help is coming. Move victim upwind to fresh air.
- **Step 6 – Revive the Victim** – assess the victim for vital signs. If not breathing artificial respiration must be started.
- **Step 7 – Get Medical Aid** – All H₂S victims require medical attention. Never leave the victim alone.

Rescue Techniques

- Collar Drag – 1 person rescue
 1. Place victim on their back.
 2. Unzip victim's coveralls 15-20 cm.
 3. Roll up the collar of the victim's coveralls so you can get a firm grip.
 4. Lift victim to semi-sitting position.
 5. Support the victim's head on your forearms.
 6. Drag victim to a safe area.

Rescue Techniques

- Two-Arm Drag
 1. Place the victim on their back.
 2. Squat behind the victim.
 3. Lift the victim to a semi-sitting position, while supporting the head and neck.
 4. Use your thigh or knee to support the victim's back.
 5. Put your arms under the victim's armpits.
 6. Cross the victim's arms and get a firm hold on the victims wrists.
 7. Lift victim up against your chest as you stand using your legs to lift.
 8. Drag the victim to a safe area.

Rescue Techniques

- Two-Rescuer Drag
 1. Place the victim on their back and unzip their coveralls 15-20 cm.
 2. Lift and prop the victim into a semi-sitting position.
 3. Rescuers stand on each side of the victim, facing away from the victim's feet.
 4. Rescuers place their closest hand inside the victim's collar getting a firm grip of the coveralls.
 5. Working together, drag the victim to safety, supporting the victim's neck with your forearms and the collar of the victim's coveralls.

Rescue Techniques

- **Two-Rescuer Carry or Lift**
 1. Place the victim on their back.
 2. One rescuer goes to the victim's head and supports the head and neck.
 3. The other rescuer squats at the victim's feet, grips the victim's wrist(s) and slowly pulls the victim into a sitting position.
 4. The rescuer at the head then squats behind the victim, reaches under the armpits and grasps the victims wrist(s).
 5. The rescuer at the feet crosses the victim's legs at the ankles and prepares to lift.
 6. Together, the rescuers lift the victim evenly.
 7. Facing forward, they carry the victim to a safe area.

Rescue Breathing

1. Determine unresponsiveness
2. Open the airway.
3. Give 2 slow breaths
4. Check for a pulse
5. If no pulse, begin chest compressions. 15 compressions and 2 slow breaths.
6. After 4 cycles or 1 minute, check pulse again.

Note: you should be trained in CPR before administering.

Breaking Containment

Examples of breaking containment:

1. Launching and receiving pigs.
2. De-pressuring equipment to atmosphere
3. Wireline lubricator rig up
4. Orifice plate changes
5. Pipe repairs
6. Gas/liquid sampling
7. Compressor maintenance (replacing valves)

Breaking Containment

- The following conditions must exist before breaking containment in a sour or H₂S area classification.
 1. H₂S concentration must be known
 2. PTW, risk assessment, pre-job must be held
 3. Personal H₂S monitors must be worn
 4. Wind direction must be known
 5. No other workers in the vicinity
 6. Equipment must be isolated, drained, depressured
 7. SCBA is to be kept on hand.

Breaking Containment

If H₂S concentration is over 100 ppm.

1. Workers must wear breathing air before breaking containment and until the atmosphere is proved to be below 10 ppm.
2. Safety standby positioned in case of emergency
3. At no time are workers allowed to work in atmospheres over 10 ppm.

Boarding Platforms and Satellites

- When concentrations of H₂S in the gas stream are between 10 – 500 ppm.
 1. H₂S Procedure must be followed as well as Breaking Containment Guidelines.
 2. Satellites will be equipped with 4 emergency escape packs and 1 SCBA.
 3. Boats to approach from downwind side with portable H₂S detector turned on.
 4. If any levels detected then no boarding will take place until the OIM is contacted.
 5. Boats to be equipped with with 2 – 30 minute SCBA, 1 portable detector, and personal H₂S monitors for each worker boarding the platform.

Boarding Platforms and Satellites

1. By Helicopter, observe the platform for any abnormal conditions.
2. Workers to wear personal H₂S monitors making note of wind direction and any abnormal conditions.
3. If H₂S detected, move upwind or crosswind from the leak. The R/S emergency # must be contacted 2800.
4. A Safety Standby Man is required for work done under breathing air in atmospheres over 100 ppm.

Boarding Platforms and Satellites

- Additional requirements for platforms over 500 ppm H₂S. (Edfu, M20).
 1. Minimum 3 personnel to board the satellite platform. One person to serve as safety stand-by.
 2. 4 escape packs, and 3 SCBA's and 2 spare bottles stored on platform.
 3. Boat equipped with 3-SCBA's, portable gas detector and personal H₂S monitors for all workers. Spare air bottles should also be available.
 4. Area must be checked with a portable H₂S detector by the safety man before work is to begin.

Safety Standby

- To be used as an observer and back-up during specific work procedures. Not part of the work crew, only concerned with safety of workers.
- Must have knowledge of:
 1. Site specific job procedures
 2. Operating procedures for the safety equipment.
 3. How to communicate to the supervisor
 4. Trained in First Aid, CPR, H₂S, and Rescue procedures.
 5. Mandatory when workers are under mask in atmospheres greater than 100 ppm.

Safety Standby

- Duties to include
 1. Rescue
 2. Fire watch
 3. Atmosphere monitoring
 4. Ensure air supply is workers using SABA
 5. Provide communication
 6. Attend the pre-job meeting
 7. In the event of an emergency will activate the 7 step rescue plan

Give examples of where you would require a safety standby.

Emergency Evacuation

- The normal muster point for an uncontrolled release of H₂S gas will be the Helideck.
- Remember that there may be a greater risk of explosion if there is an uncontrolled release of gas.
- Never walk through a gas cloud to get to the muster point as YOU may be the source of ignition.
- If a hazard such as a gas leak is blocking the access to the muster point, an alternate muster location must be communicated by the OIM or lead operator.

Examples of Breaking Containment

- Pigging – as a class, discuss what the procedure should be to pig the 12” line from Edfu to Morgan 36. List the steps to do this job. The line contains 800 ppm H₂S.

Example

- Follow pigging procedure for launching pig.
- PTW and a pre-job meeting.
- 2 men working under mask with a safety standby.
- Assure valves are swung to receive pig at Morgan 36.
- Personal H₂S monitors, portable gas monitor, 3 SCBA, radio with extra battery.
- 3 operators, all clean shaven.
- Depressure the pig trap, purge with sea water, drain, open vents. Trap should still be opened under mask with workers staying up wind or crosswind.
- How about receiving the pig at Morgan 36. What would be different?

Questions and Exam

- Any questions?
- Closed book exam. The exam should take no longer than 30 minutes.
- A H₂S training certificate will be issued after receiving a mark of 80% or more.
- Please print your name on the exam clearly.

Training Agenda

- Class size should be limited to 16.
- 2 different styles of SCBA, 2 portable gas detectors, sample gas, 2 personal H₂S monitors. Students should demonstrate use.
- LEL and UEL should be explained in detail using drawings.
- All student should demonstrate donning SCBA, masks should be wiped clean after every use.
- The rescue techniques should be demonstrated and the 7 step rescue plan should be demonstrated.
- Test can be corrected in class.
- Estimated time of course – 4-5 hours.