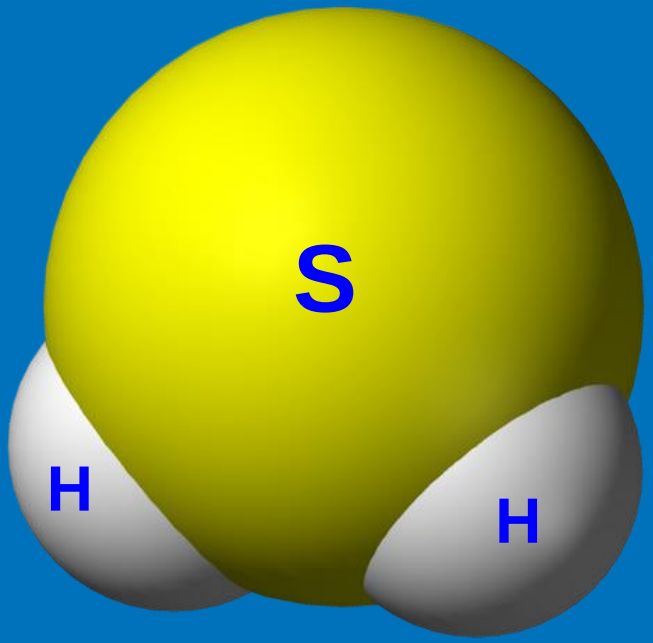
H_2S Hazards



Objective :

1) To raise awareness and bring competency among employees and contractors on safe handling of H_2S through
   - Physical & chemical properties,
   - Toxicity & concentration levels,
   - Personal protective equipment and its use,
   - Detection measures,
   - Rescue and First aid..

2) To mitigate H_2S exposure to personnel.

H2S Authorization Program for WK Fields' Employees & Contractors

What shall you learn?

- Properties and health hazards of Hydrogen Sulphide
- Safe handling of H_2S and its detection methods
- Symptoms of H2S exposure
- Respiratory protection and associated PPEs
- Emergency Response
- Responsibilities during H_2S emergency

H2S Authorization Program for WK Fields' Employees & Contractors

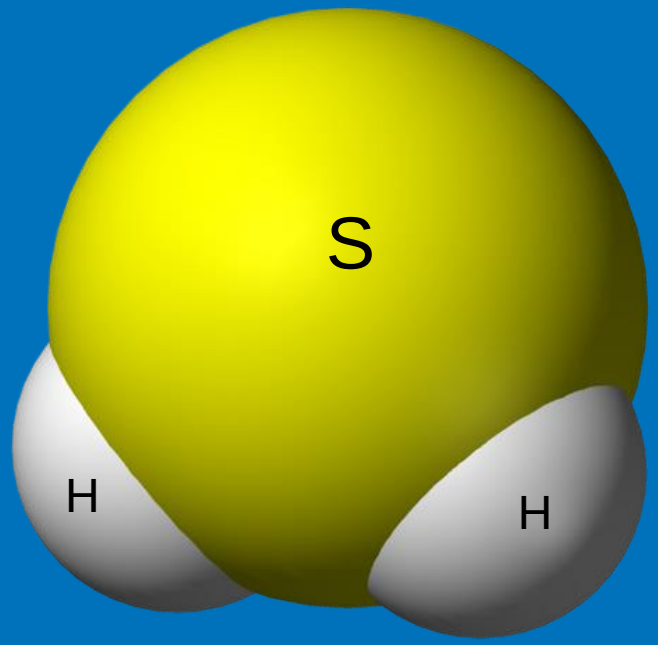
Course Content

- Physical characteristics
- Hazards of H2S exposure
- How to avoid exposure
- Emergency Response
- Responsibilities of Personnel
- Assessment

What is H2S?

H2S is naturally occurring chemical produced by bacteria as it decomposes organic material.

It may develop in low oxygen environments, such as, sewers, swamps and polluted water.



Physical Characteristics

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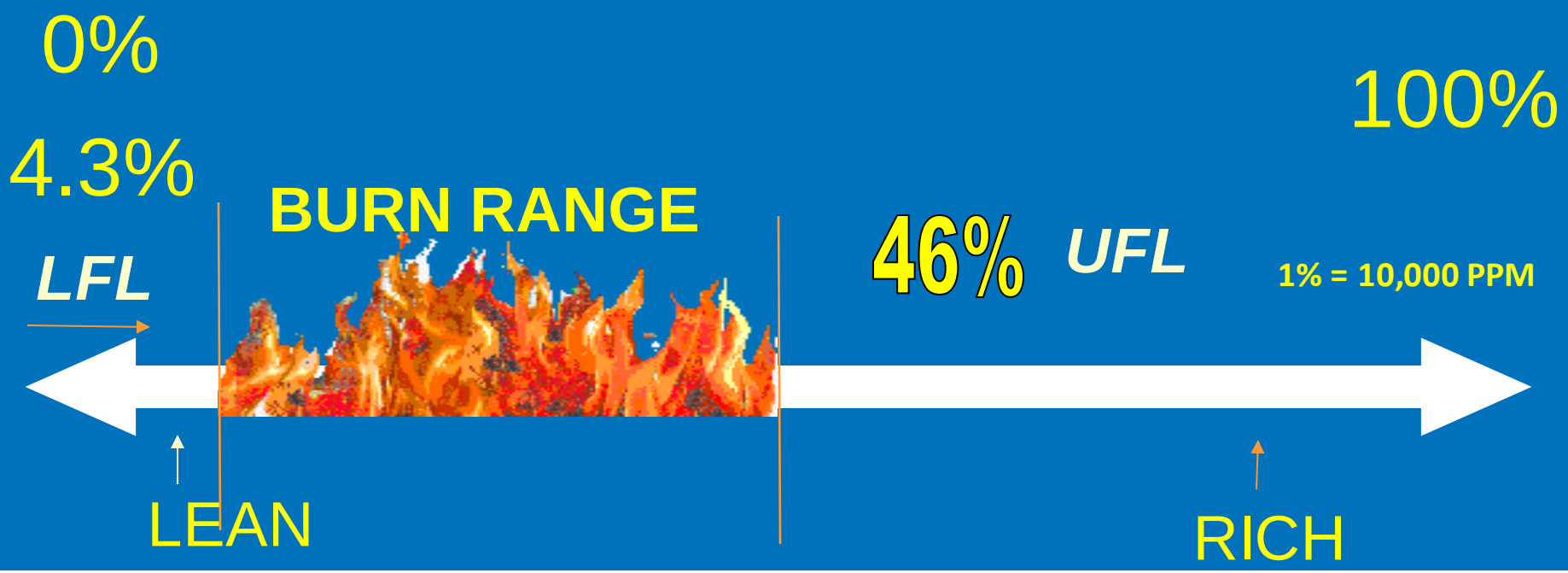
Characteristics of H_2S

- It is a compound of hydrogen and sulfur. Chemical formulae is H_2S
- Occurs naturally as a contaminant in crude oil and gas
- it normally exists in gaseous form. At low pressure, it liquefies.
- Colorless gas under atmospheric conditions.
- H_2S is also heavier than air and tend to accumulate at low lying areas.
- Highly flammable (4.3 % to 46% v/v).
- Toxic by inhalation and ingestion.
- Highly corrosive and cause weld cracking leading to HIC & SOHIC in equipment.
- **Remember** :

Hydrogen Sulfide exposure is one of the leading causes of work-related deaths in the petroleum industry.

Flammable



Auto Ignition Temperature

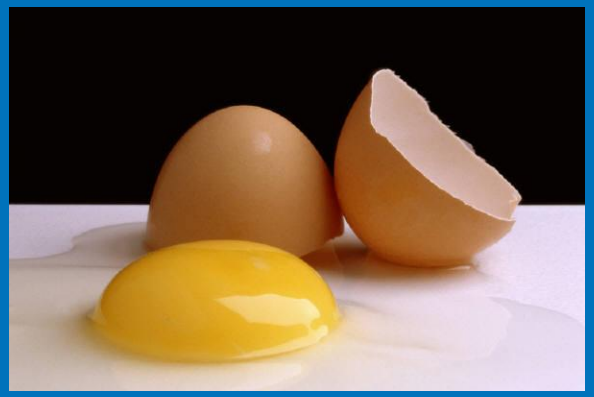
Hydrogen Sulfide will automatically ignite at 500 ^{0}F.

End of lit cigarette – **1400 ^{0}F**

Diesel exhaust – 600 to 2400 ^{0}F

While working in KOC, chances are you might have smelled the "rotten eggs" odor that characterizes hydrogen sulfide gas.

Because of its odor, H2S is also known as "sour gas".



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- Hydrogen Sulfide is extremely dangerous gas.
- H2S exposure may take place during
  - Refining
  - Storage,
  - Transportation
  - Production

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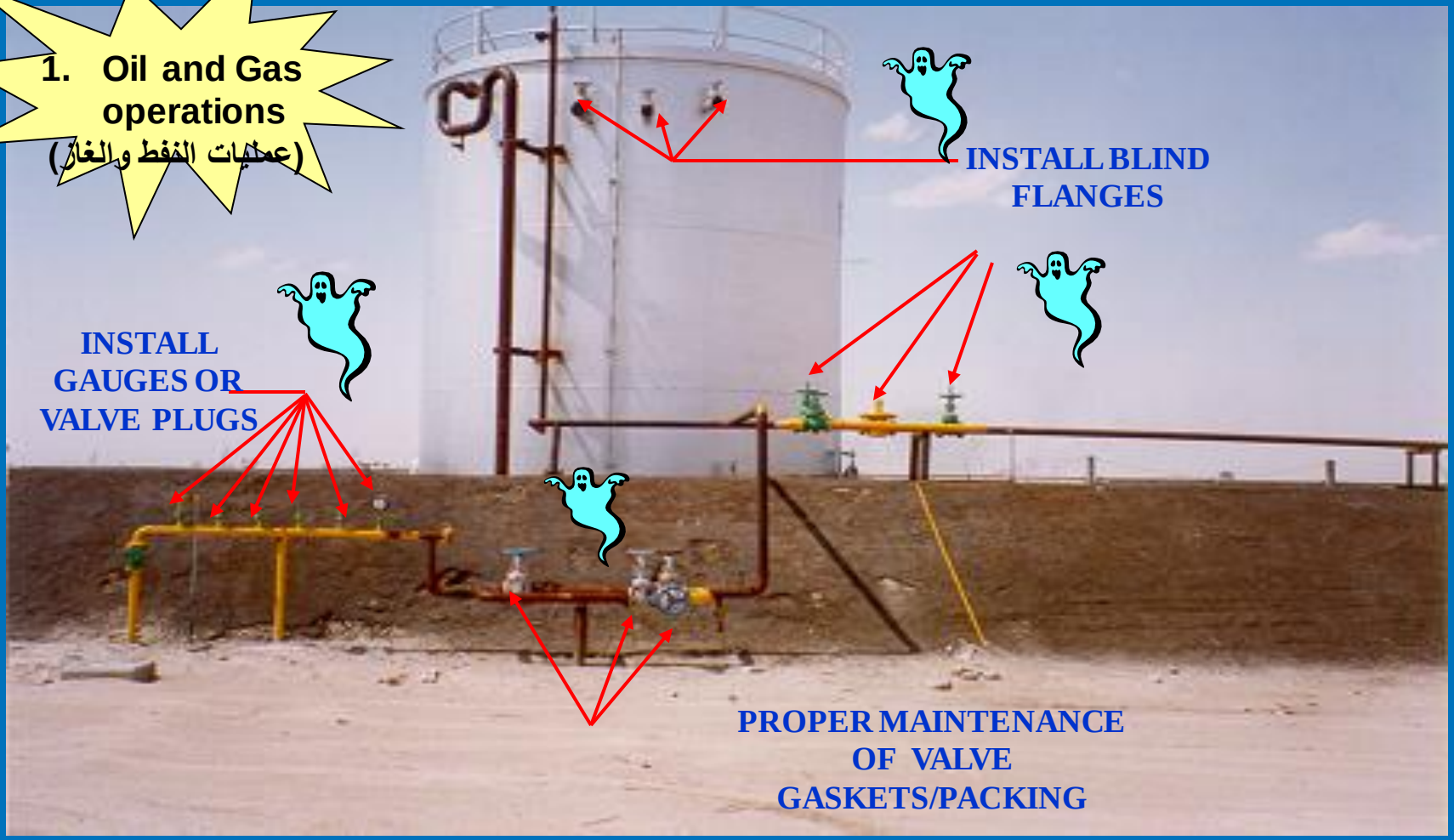
1. Oil and Gas operations
(عمليات النفط والغاز)



Hydrogen Sulfide in small concentrations is easily detectable because of its odor of rotten eggs.

Your sense of smell can detect H2S in concentrations of up to 25-30 PPM.

Or .....You may end up lying here!

Do you know why?

Never rely on your sense of smell to detect H2S!

Kuwait Oil Company
شركة نفط الكويت
إحدى شركات مؤسسة البترول الكويتية
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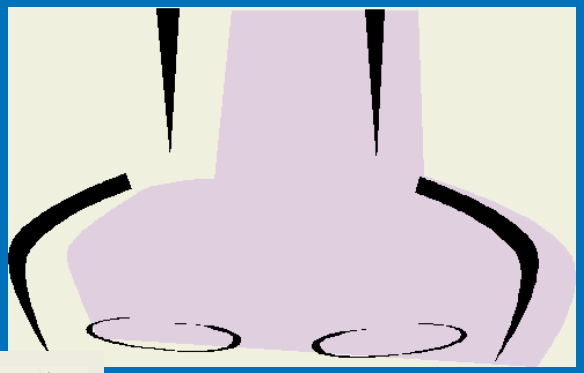
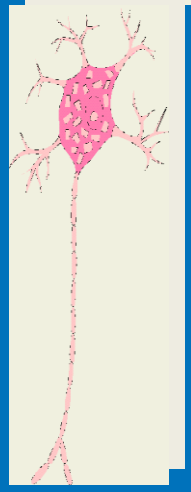
Paralysis of Olfactory nerve at low conc.

High concentrations of H2S cannot be detected by the sense of smell since paralysis of the olfactory nerve (your nose smeller) can occur at low levels.

Once the nerve is paralyzed, the sense of smell is lost.





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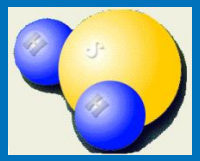
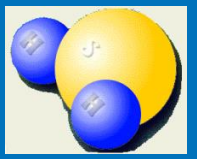


Hydrogen Sulfide has a density 1.189 times (19%) that of air. Since it is heavier, it tends to settle in low lying areas.

The gas can easily be dispersed by wind or fine water spray.

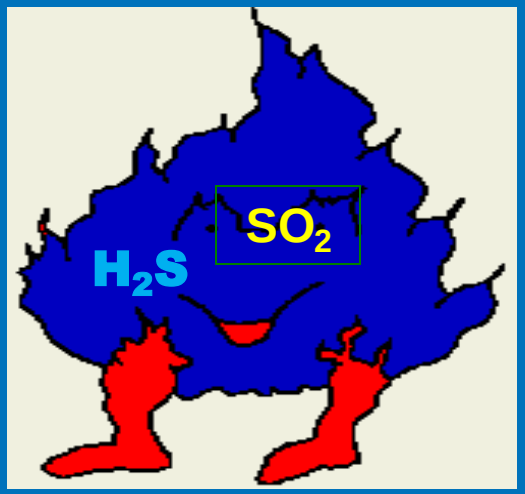


Hydrogen Sulfide gas is 3 times more flammable than natural gas, so the potential of fire or explosion is always a potential danger.

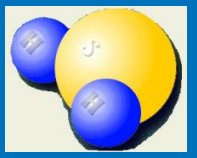
It will ignite at approximately 500 degrees F.

Combustion Product

Hydrogen Sulfide burns with a **blue flame** and forms **sulfur dioxide** which is also a toxic gas with higher toxicity.

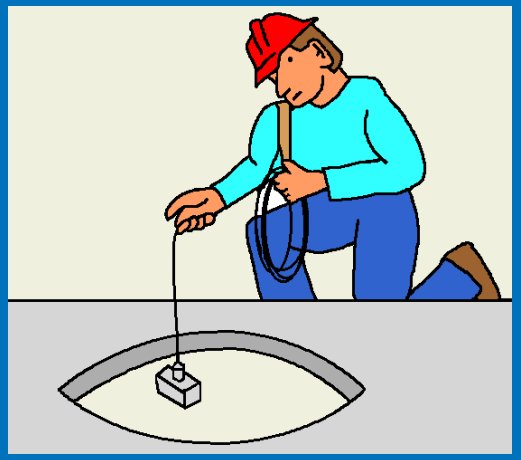


Sulfur dioxide is **heavier** than H_2S and has a very **distinct odor**.



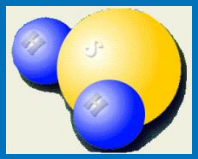
Because it is water soluble, hydrogen sulfide is often present in waste water areas.

Presence in confined spaces :



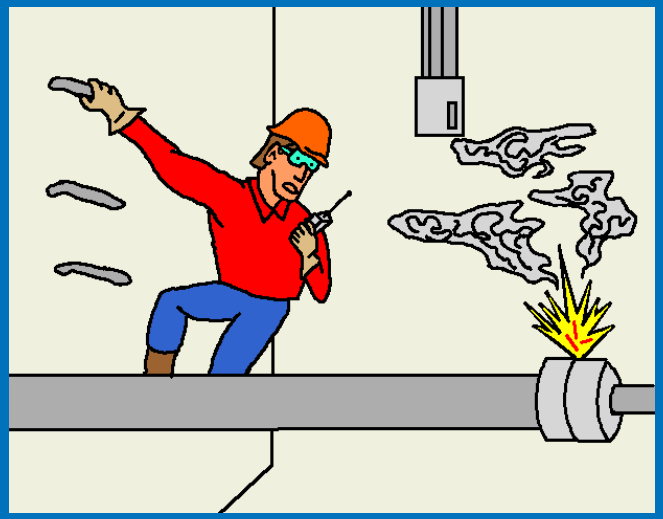
Hydrogen sulfide vapors can also collect inside confined spaces. Storage tanks, tank dikes or poorly ventilated areas can harbor H_2S.

Natural air circulation or fans will disperse the gas.



Adversely impact integrity of equipment, leading to unanticipated failures

H2S is very **corrosive** and can cause severe **stress cracking** in steel and other metals.



Routine maintenance & inspection should include checking vessels/pipes, pipe seals and fittings for corrosion.

Hazards of Exposure to H2S

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Hydrogen Sulfide Gas is a toxic (poisonous) gas that can kill you the first time you breath it!

Fire Hazard:

- H2S is highly flammable and burns with blue flame producing SO2 gas.
- SO2 is more toxic than H2S.
- H2S reacts with iron to produce Pyrophoric Iron sulphide.
- Pyrophoric Iron sulphide is deposited on surfaces of the equipment in the form of rust.
- In the presence of O2 it spontaneously Auto ignites to burn due to Exothermic reaction. This is known to have caused explosion in petroleum industry.

HEALTH HAZARD

Hydrogen sulfide enters the body through the air we breathe. The amount of H2S in the air is measured in ppm.

PEL-TWA, STEL, IDLH

Permissible Exposure Limit Time Weighted Average (PEL-TWA) = 10 ppm (8 Hrs work or 40 hrs a week)

10 ppm

STEL

Short Term Exposure (STEL) = 15 ppm (15 Min)

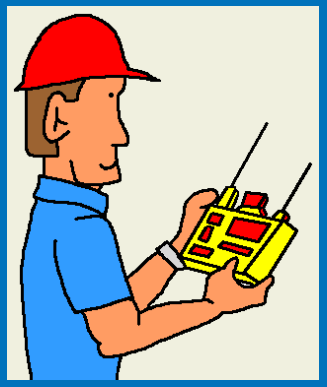
15 ppm

IDLH : Immediately Dangerous to Life & Health

100 ppm

How exposure to hydrogen sulfide affects you depends on:

1) the concentration of the gas



2) the duration of the exposure

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Lets review the health effects at various concentration of H2S.

H2S Conc.	Health Effect
10 ppm TLV-TWA	Some workers may experience eye irritation.
15 ppm TLV STEL	Some workers may experience eye irritation.
100 ppm IDLH	Deadens sense of smell in 3 to 15 mins. May cause coughing, burning of the eyes and respiratory tract.
200 ppm	Immediate loss of smell. Pronounced eye and respiratory tract irritation.
300 ppm	Respiratory disturbances after 30 min. Dizziness, severe irritation to eyes and respiratory tract.
500 ppm	Respiratory disturbances in 2 to 15 mins dizziness, collapse and unconscious after 30 to 60 mins.
700 ppm	Loss of consciousness quickly. Breathing will stop and death will result if not rescued promptly.
1000 ppm	Immediate unconsciousness. Death in 3 to 5 minutes.

How to Avoid Exposure to H2S

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- Areas with 'Risk of H_2S release' should be designated H2S hazardous area and marked with WARNING SIGNS.
- Only certified trained personnel may enter into these areas with appropriate PPEs.
- Employees in H_2S hazardous area shall always carry
  - H2S Personal monitor
  - Escape mask

- If the risk to H_2S release is sufficiently high, only essential staff shall enter equipped with escape sets (SCBA sets).
- In H_2S Hazardous area, there should be at least one Escape set for each member of the workforce.

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Sources of H2S in WK Field Process :

Process	H2S Source
Crude Oil & Gas from Well	In crude and Natural gas streams.
Confined Space Entry	Inspection & Maint. Of Tanks, Vessels, Trenches, Pits, Sumps and roofs of floating roof tanks.
Oil Processing	In Vapor Recovery System, Condensate Recovery Units, Sulphur Recovery Units and Sour Water Tanks, Pits and Flares (SO2).
Gas Plants	Fugitive emissions from Process equipment, Emergency Reliefs Systems and Flares (SO2).
Tank Gauging/ Tank Vents	From open gauge hatches on storage tanks
Other Operations	Cleaning of Piping, Vessel and Tanks containing sludge. Venting of gas system. Drawing water from tanks, repairing leaks in pumps and lines, release from tanks breather valves (PRVs), Pump packing or seals, Well heads, Pits, Sumps, Trenches and Sewers, Pigging operations.

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Protecting personnel from H2S exposure :

TL Operations shall consider the following requirements to make the emergency plan more effective:

1) Provision of information about operations, BA Set, Escape mask, location of detectors, wind socks, Alarm Manual Call Points,

Assembly Point, Mustering Procedure etc.

2) Provision of Standby safety/rescue/medical team positioned upwind.

3) Provision of barriers and warning notices to keep away unauthorized personnel.

4) Use of Public address systems to communicate with personnel in H2S emergencies.

5) Use of Portable air movers to assist dispersion.

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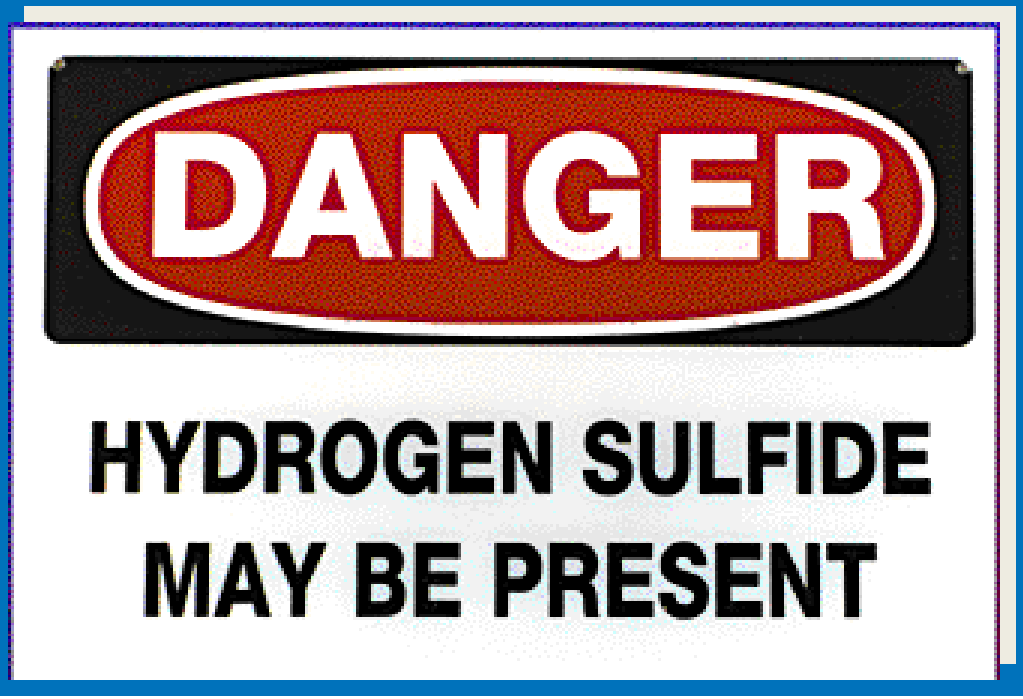
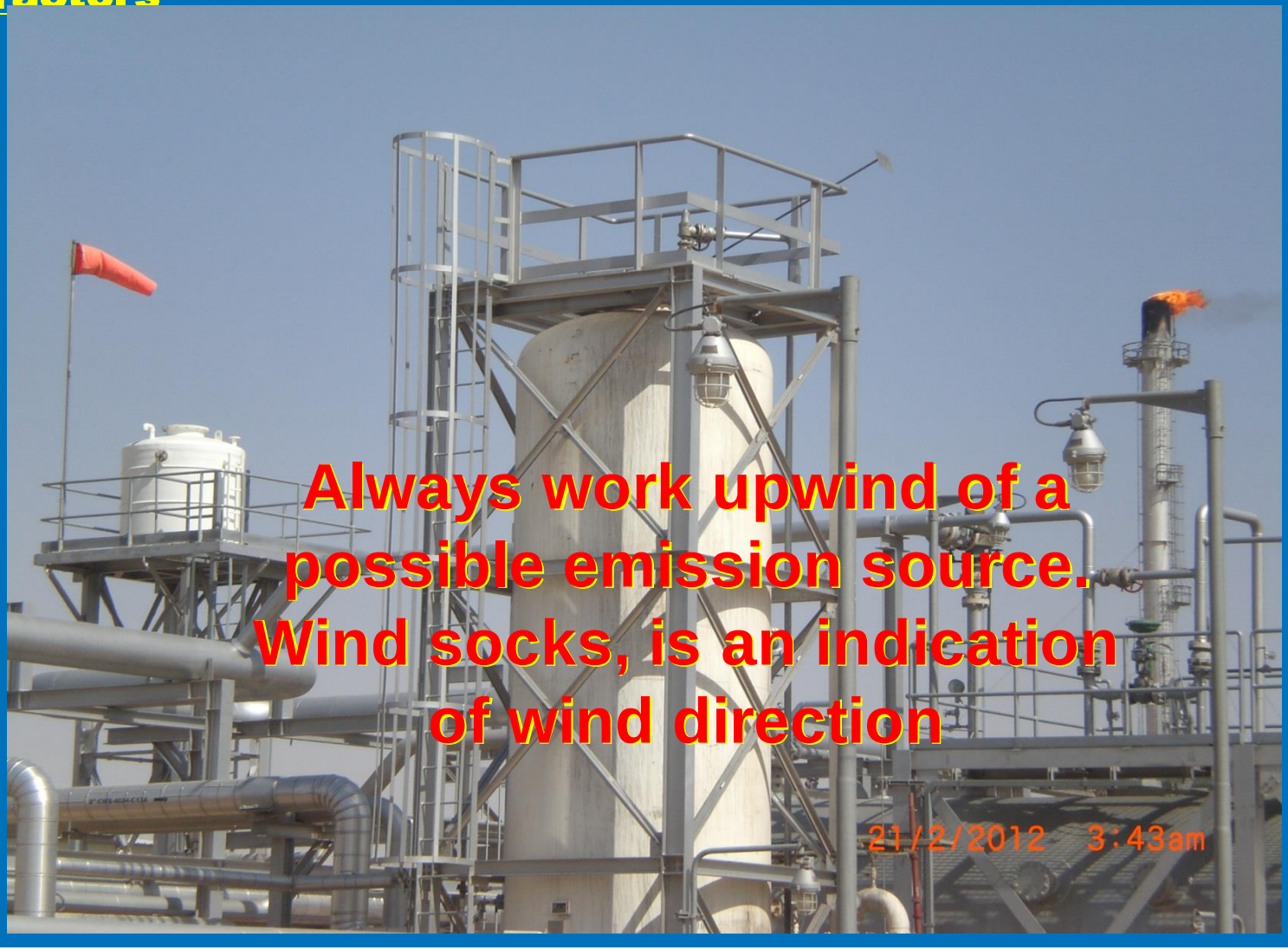
Warning signs are posted to warn the presence of Hydrogen Sulfide.



H2S Authorization Program for WK Fields' Employees & Contractors



H2S Authorization Program for WK Fields' Employees & Contra

Facilities are equipped with H_2S sensors that are designed to detect H_2S concentrations and provide a warning to personnel.

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In process facilities, H2S detectors are placed strategically where H2S is anticipated to exceed 10 ppm.

- Crude storage tanks
- Separators, Accumulator drums, De-salter, Scrubbers
- Heater, Knock out Drum, Flare area
- Gas dehydration area
- CRU Plant area, Water treatment plant
- Drain/Sump pits
- Sample points
- Pig Launcher/Receiver area
- Control Room, Substation etc

Detectors must be tested and calibrated by a competent person. Calibration frequency is

- Fixed H_2S monitors/detectors : 6 months
- Personal monitors : 3 months

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The detectors should be intrinsically safe and have 0-100 ppm range with 2 levels of audio visual alarms.

First alarm is called warning level and set at 10 ppm.
Second alarm is evacuation level and set at 15 ppm.

Take care of personal monitor and ensure it is calibrated periodically and in proper working order.

Your life depends on it!

H2S Authorization Program for WK Fields' Employees & Contractors

When working in areas having more than 10 PPM but less than 100 PPM,

One need to wear an air supplied respirator. He must be trained in respirator selection and use.

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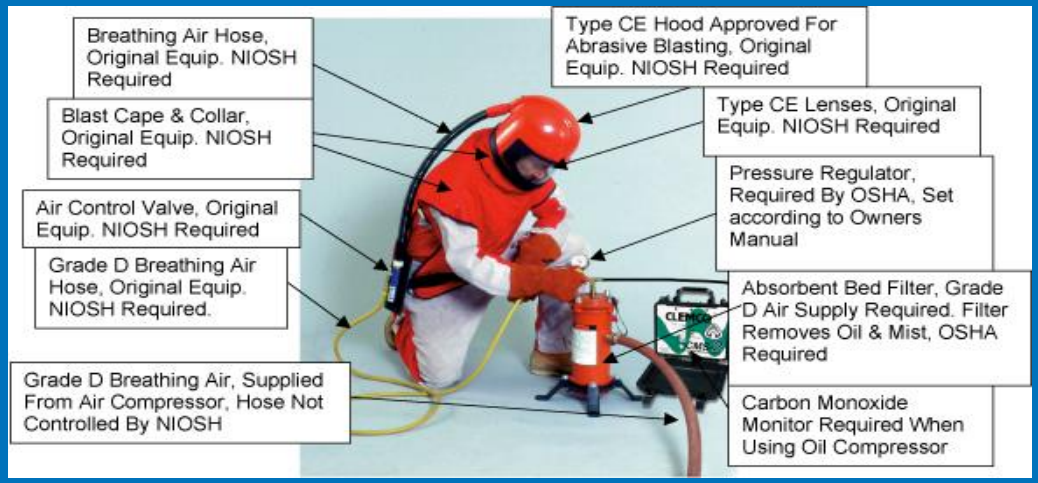
Air supplied respirators can be one of two types.

1) **Air supplied respirator,**

2) **Self-Contained Breathing Apparatus (SCBA)**



Worker rigged with SCBA

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Use the buddy system where H_2S concentrations have the potential of exceeding the Permissible Exposure Limit(PEL). This ensures that one person will be able to assist a co-worker if needed.

What does PEL stand for and what is the PEL limit?

Emergency Response

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Upon receiving the H2S leak notification, the supervisor should act as under:

1. Report the emergency at 160.

2. Identify the leak source and isolate to arrest the leak.

3. Determine the wind direction and Stop all jobs in down wind direction,

4. Evacuate the personnel from downwind direction and ensure all sources of ignition is eliminated.

H2S Authorization Program for WK Fields' Employees & Contractors

5. Ensure all machinery is switched off and no open flame is available.

6. Ensure the area around the H2S leak is barricaded adequately and warning signage posted.

7. Arrange periodic gas test and observe the gas reading. Monitor the wind direction.

8. Ensure everyone use proper PPEs including BA set while responding to emergency.

9. In case the wind direction changes swiftly, stop all hot works, stop machinery and evacuate all personnel.

10. Ensure only skeleton essential staff stay in the plant.
11. Guide Fire & Rescue crew to the scene of emergency and assist in handling the emergency.

If you **discover** or are notified an **individual has been overcome by H_2S….**

NEVER

rush in to attempt rescue without first protecting yourself with the proper respiratory equipment.

Often times the first rescuer becomes the second victim.

The victim should immediately be moved to fresh air. The sooner the victim is moved the better, as it greatly improves their chance of survival.

Immediately begin artificial resuscitation if the victim has ceased breathing. It is vital to get fresh air to the victim's lungs.

Keep the victim warm and treat for shock.

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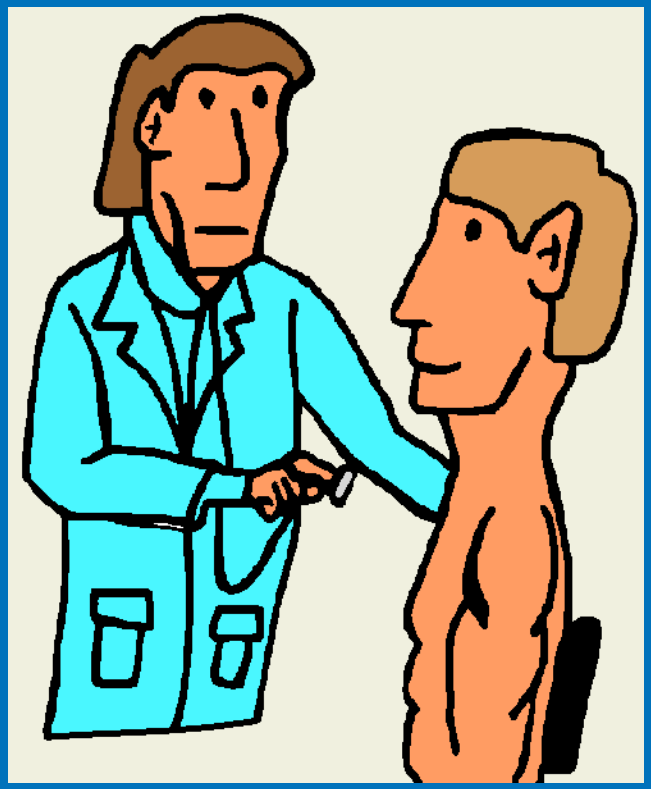
Depending on the length of exposure and concentration of H2S, cardiac arrest may occur within 4-6 minutes.

If the victims heart stops, begin cardiopulmonary resuscitation (CPR) immediately.

while one person initiates artificial resuscitation, another should dial 160 so that the victim can be transported to a hospital immediately for further treatment

Recovery from over-exposure to H_2S is usually complete if first aid is administered promptly.



All victims, regardless of apparent condition, should receive appropriate medical aid as soon as possible.

H2S Authorization Program for WK Fields' Employees & Contractors

Call 160

for emergency medical care and

transportation of victims.

Responsibilities of Personnel

H2S Authorization Program for WK Fields' Employees & Contractors

Operations Team Leader:

1) Safe system of work is developed for safe handling of H2S.
2) Emergency response procedures are established for dealing with the H2S.

Operations Supervisors:

1) Develop emergency procedure for their specific operations involving H2S.
2) Ensures operators are trained on H2S hazards and emergency procedure .
3) Conducting Evacuation drills for facilities involving H2S emissions.
4) Ensuing that facilities are equipped with H2S detectors and PPEs (Mask).
5) Appropriate BA equipment for operators.
6) Sufficient Escape BA sets for operators.

HSE Personnel:

1) Monitoring H2S concentration in the facility.
2) Ensuring that all personnel are briefed on precaution/procedures to be followed during H2S leak.

Thank you