SLBS ENGINEERING COLLEGE

DEPARTMENT OF PETROLEUM ENGINEERING

MANUAL

HEALTH SAFETY & ENVIRONMENT LABORATORY

List of Experiment

1.Toxicity, Physiological, Asphyxiation, respiratory and skin effect of Petroleum Hydrocarbons (including mixtures), sour gases (e.g. Hydrogen sulphide and carbon monoxide etc) with their thresh-hold limits.

2. Effect of corrosive atmosphere and additives during acidizing, sand control and fracturing jobs etc.

Safety System:

1. Hazards analysis, developing a safe process, failure mode analysis, safety analysis (API-14C) safety analysis function evaluation chart (synergic approach).
2. Manual & atmospheric shut down system, blow down systems.
3. Gas detection system
4. Fire detection and suppression systems.
5. Personal protection systems & measures.
6. HSE Policies, standards & specifications
7. Disaster & crisis management.

Environment:

1. Environment concepts, impact on eco-system, air, water and soil.
2. The impact of drilling & production operations on environment, Environmental transport of petroleum wastes.
3. Offshore environmental studies, offshore oil spill and oil spill control.
4. Oil mines regulations and other environmental legislations.

EXPERIMENT 1

OBJECT - Toxicity, Physiological, Asphyxiation, respiratory and skin effect of Petroleum Hydrocarbons (including mixtures), sour gases (e.g. Hydrogen sulphide and carbon monoxide etc) with their thresh-hold limits.

EFFECT OF PETROLEUM HYDROCARBONS (INCLUDING MIXTURES)

Exposure to oil and oil products either directly or indirectly causes severe health issues in humans, and the effects are principally dependent on the nature of contact with the oil spill. Direct exposures include breathing contaminated air (volatile fractions which are emitted as gases) and direct contact with the skin (while walking in contaminated areas). Indirect exposures to oil are due to bathing in contaminated water and eating contaminated food. Human health is badly affected by the contamination of total petroleum hydrocarbons (TPHs), and the effects depend largely on the type of site (land, river, and ocean) of oil spilled. Other contributing factors that affect the human health upon oil exposure include the kind and extent of exposure. Cleaning workers at the oil spill site are at greater risk. Health disorders include skin and eye irritation, breathing and neurologic problems, and stress. TPHs have a strong impact on mental health and induce physical/physiological effects, and they are potentially toxic to genetic, immune, and endocrine systems. Even though the long-term effects of TPHs in humans are not fully understood yet, certain symptoms may persist for some years of post-exposure period. Thus, health protection in TPHs-exposed individuals is a matter of serious concern. Health risk assessments have the greatest impact in enabling the detection of any potential exposure-related harmful effects either at the time of exposure or for prolonged periods following the exposure. In this direction, the present chapter provides comprehensive insights into understanding the effects of TPHs on human health.

The unfavorable impacts of petroleum contamination on such necessary part of oceanic biological systems might be of extraordinary noteworthiness. Since the lethality of oil to biota is brought about by unsaturated hydrocarbons, naphthenic acids and another compound containing fragrant gatherings and nitrogen, the genuine harmful impacts portion is firmly identified with the measure of broke down non-unstable material. The crude oil spills influence human well-being through their exposure to the intrinsic risky synthetics, for example, paraphenols and unpredictable benzene. The anticipated courses of introduction to synthetic compounds from the oil spill are inward breath, dermal contact, sustenance and water ingestion, and contact with the shoreline sand. This chronic exposure leads to affect physiological function such as hematologic, hepatic, respiratory, renal, and neurological functions.

THRESHOLD LIMIT VALUES FOR HYDROCARBONS -

Substance	TLV® (8 h TWA) (ppm)
Gasoline	300
Possible constituent chemicals	
Benzene	0.5
Cumene (isopropylbenzene)	50
Cyclohexane	100
Cyclopentane	600
Ethylbenzene	20
Heptane (all isomers)	400
n-Hexane	50
Hexane (other isomers)	500
Nonane (all isomers)	200
Octane (all isomers)	300
Pentane (all isomers)	600
Toluene	20
Xylene (all isomers)	100

EFFECT OF H2S GAS –

- Hydrogen sulfide is a mucous membrane and respiratory tract irritant; pulmonary edema, which may be immediate or delayed, can occur after exposure to high concentrations.
- Symptoms of acute exposure include nausea, headaches, delirium, disturbed equilibrium, tremors, convulsions, and skin and eye irritation.
- Inhalation of high concentrations of hydrogen sulfide can produce extremely rapid unconsciousness and death. Exposure to the liquified gas can cause frostbite injury.

Hydrogen sulfide can cause inhibition of the cytochrome oxidase enzyme system resulting in lack of oxygen use in the cells. Anaerobic metabolism causes accumulation of lactic acid leading to an acid-base imbalance. The nervous system and cardiac tissues are particularly vulnerable to the disruption of oxidative metabolism and death is often the result of respiratory arrest. Hydrogen sulfide also irritates skin, eyes, mucous membranes, and the respiratory tract. Pulmonary effects may not be apparent for up to 72 hours after exposure.

CNS

CNS injury is immediate and significant after exposure to hydrogen sulfide. At high concentrations, only a few breaths can lead to immediate loss of consciousness, coma, respiratory paralysis, seizures, and death. CNS stimulation may precede CNS depression. Stimulation manifests as excitation, rapid breathing, and headache; depression manifests as impaired gait, dizziness, and coma, possibly progressing to respiratory paralysis and death. In addition, decreased ability to smell hydrogen sulfide occurs at concentrations greater than 100 ppm.

Respiratory

Inhaled hydrogen sulfide initially affects the nose and throat. Low concentrations (50 ppm) can rapidly produce irritation of the nose, throat, and lower respiratory tract. Pulmonary manifestations include cough, shortness of breath, and bronchial or lung hemorrhage. Higher concentrations can provoke bronchitis and cause accumulation of fluid in the lungs, which may be immediate or delayed for up to 72 hours. Lack of oxygen may result in blue skin color.

Children may be more vulnerable to corrosive agents than adults because of the relatively smaller diameter of their airways. Children may also be more vulnerable to gas exposure because of increased minute ventilation per kg and failure to evacuate an area promptly when exposed.

Cardiovascular

High-dose exposures may cause insufficient cardiac output, irregular heartbeat, and conduction abnormalities.

Renal

Transient renal effects include blood, casts, and protein in the urine. Renal failure as a direct result of hydrogen sulfide toxicity has not been described, although it may occur secondary to cardiovascular compromise.

Gastrointestinal

Symptoms may include nausea and vomiting.

Dermal

Prolonged or massive exposure may cause burning, itching, redness, and painful inflammation of the skin. Exposure to the liquified gas can cause frostbite injury.

Ocular

Eye irritation may result in inflammation (i.e., keratoconjunctivitis) and clouding of the eye surface. Symptoms include blurred vision, sensitivity to light, and spasmodic blinking or involuntary closing of the eyelid.

THRESHOLD LIMIT VALUES FOR H_2S –

OSHA ceiling = 20 ppm

OSHA maximum peak = 50 ppm (10 minutes, once, no other exposure)

NIOSH IDLH (immediately dangerous to life or health) = 100 ppm

AIHA ERPC-2 (emergency response planning guideline) (maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action) = 30 ppm.

EFFECTS OF CARBON MONOXIDE –

The most common symptoms of CO poisoning are headache, dizziness, weakness, upset stomach, vomiting, chest pain, and confusion. CO symptoms are often described as "flulike." If you breathe in a lot of CO it can make you pass out or kill you. People who are sleeping or drunk can die from CO poisoning before they have symptoms.

THRESHOLD LIMIT VALUE FOR CO

The OSHA personal **exposure limit** (PEL) for **CO** is 50 parts per million (ppm). OSHA standards prohibit worker **exposure** to more than 50 parts of **CO** gas per million parts of air averaged during an 8-hour time period.

EXPERIMENT 2

OBJECT - Effect of corrosive atmosphere and additives during acidizing, sand control and fracturing jobs etc.

THEORY:

One of the main pollutants released in the fracking process is methane.

In addition to fracking's global impact, there are harmful effects to those living near extraction sites. A host of ancillary components released at well sites can lead to health problems such as irritation of the eyes, nose, mouth and throat. Local air pollution can aggravate asthma and other respiratory conditions. Regionally, fracking-related processes release nitrogen oxides and volatile organic compounds, forming smog that can deprive workers and local residents of clean air.

The byproduct of fracking's water consumption is billions of gallons of wastewater, only small portions of which are re-used in the fracking process. The majority of wastewater is injected into underground wells, and what isn't injected is transported for treatment. The EPA highlights potential leakage from wastewater storage pits, or accidental releases during transport, as risks to drinking water supplies.

In addition to air and water pollution, fracking can have long-term effects on the soil and surrounding vegetation. The high salinity of wastewater spills can reduce the soil's ability to support plant life. In addition, the injection wells used in the storage of hydraulic fracturing wastewater can cause earthquakes.

Chemicals used in gravel packing and acidizing can cause air pollution and health risks, which is why regional air regulators expressed interest in tracking them.

Crystalline silica is a cement additive also known as “frac sand.” It's used to hold open cracks in underground rock formation so that gas and oil can travel into the well. While crystalline silica is naturally-occurring, respiration of the fine sand can cause silicosis, an incurable lung disease.

Nitrogen oxides and volatile organic compounds form ground-level ozone in the presence of sunlight, which can cause: Respiratory problems, including coughs, shortness of breath, airway and lung inflammation, decreased lung function, worsening of asthma and other respiratory diseases, increased hospital admissions, and premature mortality Cardiovascular effects, including cardiac arrhythmia, increased risk of heart disease, heart attacks, and stroke.

Exposure to diesel particulate matter, hydrogen sulfide, toxics, including benzene, toluene, ethylbenzene, and xylene, and other volatile hydrocarbons can lead to: Eye, nose, and throat irritation Respiratory problems, including cough, difficulty breathing, and worsening of asthma and other respiratory diseases , cardiovascular problems, including high blood pressure, heart attacks, and worsening of cardiac diseases , brain and nervous system problems, including headaches, lightheadedness and disorientation, damage to the blood and bone marrow leading to anemia and immunological problems

Diesel emissions originate from the combustion engines of heavy trucks and machinery used during well site preparation, drilling, and production. Exhaust from diesel engines contains hundreds of toxic chemicals. Of greatest concern is the fine diesel soot particles, which can lodge deep within the lungs, increasing health risks including: emergency room visits, hospital admissions, asthma attacks, cardiopulmonary disease (including heart attack and stroke), respiratory disease, adverse birth outcomes, and premature death (from pneumonia, heart attack, stroke and lung cancer)

Toxic air pollutants originate from direct and fugitive emissions of hydrocarbons at the well and from associated infrastructure such as condensate tanks, dehydrators, wastewater impoundment pits, and pipelines. The fracking process involves dozens of chemicals and the process returns oil, gas, fracking chemicals, formation brines, and mobilized compounds, including heavy metals and naturally occurring radioactive materials (NORM) to the surface.

Benzene, toluene, ethylbenzene, and xylene (BTEX) and other toxic hydrocarbons, such as formaldehyde, released from oil and gas operations and equipment can lead to health impacts ranging from irritation of eyes, nose, mouth, and throat to aggravated asthma and other respiratory conditions, blood disorders, harm to the developing fetus, immune systemrelated diseases, and cancer (e.g., leukemia, nonHodgkins lymphoma).

Silica—the main component of 'frac sand'—is used widely and in large quantities to hold open the fractures created during the fracking process. Inhalation of respirable silica can cause silicosis, an irreversible lung disease,30 as well as lung cancer in miners, sandblasters, and foundry workers. Silica inhalation is now also recognized as an occupational health hazard among oil and gas workers.

Fracking-related processes and other stages of the oil and gas production process release nitrogen oxides and VOCs, which react in the presence of sunlight to form ozone ('smog'). Exposure to ozone is associated with a variety of respiratory and cardiovascular effects, including shortness of breath, reduced lung function, aggravated asthma and chronic respiratory disease symptoms, inflammatory processes, and premature death

EXPERIMENT 3

OBJECT - Hazard analysis and safety analysis

HAZARD ANALYSIS –

<u>HAZARD IDENTIFICATION:</u>

1. Take a look back into the past at what accidents have already happened.
2. Talk to the workers doing the jobs to find out what they consider are safety issues.
3. Take a walk around the work area to see and hear what is happening now.
4. Review any information you may have on a particular piece of equipment (manufacturers manual) or chemical Material Safety Data Sheets (MSDS) to see what it says about safety precautions.
5. Think creatively into the future about what could happen if something went wrong. Most incidents occur when something does go wrong.

<u>Decide Who Might be Harmed:</u>

Requires the assessor to decide who might be harmed and how. Generally it will be staff and workers occupying the workplace but attention must also paid to:

- Contractors.
- Inexperienced staff.
- Visitors.

<u>Risk:</u>

For each hazard identified, evaluate the consequence and probability to gauge the level of risk. From there, action to reduce the risk can be planned.

	Consequence		
Probability	Slightly Harmful (1)	Harmful (2)	Extremely Harmful (3)
Highly Unlikely (1)	1	2	3
Unlikely (2)	2	4	6
Likely (3)	3	6	9

Control:

Any risks identified in your assessment should be eliminated or reduced "as far as reasonably practicable" and certainly must meet legal requirements, comply with industry standards and be in line with "best practice".

If the assessment finds that there are unacceptable levels of risk, controls must be implemented. Certain control measures are considered to be more effective than others – consider the following options in order of priority:

- Elimination - Don't do the task/use the chemical etc.
- Substitution - use a different method/chemical etc.
- Engineering Controls - enclose the area to avoid human contact, guard machinery, ventilation, etc.
- Work Organization - reduce number affected/duration of exposure set safe systems of work etc.
- PPE - use as a last resort as it relies on correct use, timely replacement etc.

Note: Combinations of measures can of course be used.

The implementation of control measures should be planned. A timescale for completion should be agreed and a person should be assigned responsibility for ensuring implementation.

To help interpret risk and to help priorities control measures, the following table should be used:

Risk Level	Action and Timescale
1	○ No action is required and no documentary records need to be kept
2	○ No additional controls are required. ○ Consideration may be given to a more cost-effective solution or improvement that imposes no additional cost burden. ○ Monitoring is required to ensure that the controls are maintained.
3	○ Efforts should be made to reduce the risk, but the costs of prevention should be carefully measured and limited. ○ Risk prevention measures should be implemented within a defined time period. ○ Where the risk is associated with extremely harmful consequences, further assessment may be necessary to establish more precisely the likelihood of harm as a basis for determining the need for improved control measures.
4	○ Work should not be started until the risk has been reduced. ○ Considerable resources may have to be allocated to reduce the risk. ○ Where the risk involves work in progress, urgent action should be taken.
5	○ Work should not be started or continued until the risk has been reduced. ○ If it is not possible to reduce risk even with unlimited resources, work has to remain prohibited.

SAFETY ANALYSIS –

Job safety analysis, or JSA, is a systematic process designed to keep your employees and workplace safe. It breaks down each job into training sequences, identifies key safety risks, and teaches the employee how to avoid those hazards. It breaks a job down into individual steps and then finds the safest way for an employee to complete each step.

The Process

The JSA process can be broken down into the following steps:

1. Selecting the job to be analyzed
2. Breaking down the job into a sequence of steps required to complete it
3. Identifying potential hazards in each step
4. Developing preventative measures to overcome these hazards

WHAT HAPPENS IN JSA?

Job Selection and Task Breakdown

The first step is selecting the job to be analyzed. Every individual job in your company should receive a JSA, but there are some jobs that are higher on the priority list than others.

High-priority jobs include those at high risk of accidents, brand new jobs, jobs that have few (but severe) accidents, jobs whose procedures have recently changed, non-routine or periodic jobs, and jobs where catastrophic accidents could reasonably occur but haven't happened yet.

Basically, you're looking for jobs that pose the most risk for your employees. The more dangerous the job, the more urgently it requires a JSA. Once you've selected an individual job, break that job down into individual tasks. The goal is to be specific and realistic – break it into the tasks that an employee would actually do in an ordinary day in order to complete this job. Make a spreadsheet or use JSA software and be systematic about it.

Identifying Hazards

Once you've broken a job into tasks, you have to identify potential hazards associated with individual tasks. Note that you're not looking for ways your workers could create a hazard. You're not looking for random accidents either. You're looking for potential areas of risk.

For example, worn-out tools are an easy risk area. Slipping or falling hazards are also incredibly common, as is poor lighting and extreme noise, temperatures, or vibrations.

The goal of identifying these hazards is figuring out where you can fix them. You're also looking for ways that your employees could complete the job more safely to avoid these hazards. From there, you can train your employees in the proper safety procedures so that they can reasonably avoid the risks you've identified.

EXPERIMENT 4

OBJECT – Blow down systems and shut down systems

BLOWDOWN SYSTEMS-

The term gas blow down is referred to venting of gas accumulated in equipment's, process facilities, oil production wells etc. The gas which is to be blown down is not desired to be used for production of a variety of possible reasons and is usually vented through a flare. The flare burns the hydrocarbons before venting product gases to atmosphere.

The purpose of blowdown valves is to depressurize the equipment by sending the unwanted gases to flare. Blowdown valves are emergency on-off valves activated by a signal from the Emergency Shut Down (ESD) system, rather than direct activation by overpressure in the protected equipment. Blowdown valves are on-off valves, often installed in a parallel configuration to pressure relief valves on equipment. This depressurization is different than equipment protection performed by pressure relief valves. Certain on-off valves are closed on emergency shutdown (ESD) of a system. Closing of these valves can lead to overpressure in some process equipments. At the same time, ESD system sends signal to open up the blowdown valves and to release the excess gas to flare, thus preventing an overpressure scenario.

Since blowdown valves are simply on-off valves, they cannot restrict the gas flow. The blowdown lines are often equipped with restriction orifices downstream of blowdown valves to restrict the gas flow being sent to the flare to a certain limit.

Oil production wells which have been shut in for a period, can develop a gas cap at the wellbore by accumulation of the gases percolating through the formation. It is desirable to remove this gas cap by flaring the accumulated gases before starting **well intervention.** This flaring of gases is referred to as **casing blowdown.**

SHUT DOWN SYSTEMS-

Emergency shutdown capability is to be provided all petroleum facilities be it manual, remotely operated or automatic. Inherent safety practices rely on emergency shutdown capability as a prime facet in achieving a low risk facility. Without adequate shutdown capabilities a facility cannot be controlled during a major incident.

DEFINITION AND OBJECTIVE - An Emergency Shutdown (ESD) system is a method to rapidly cease the operation of the process and isolate it from incoming or going connections or flows to reduce the likelihood of an unwanted event from occurring, continuing, or escalating. The aim of an ESD system is to protect personnel, afford protection to the facility, and prevention of an environmental impact from a process event.

DESIGN PHILOSOPHY

The ESD system is distinguished from other facility safety systems in that it responds to a hazard situation which may affect the overall safety of the entire facility. It is therefore considered one of the prime safety systems that can be provided for any facility. Without an ESD system, an incident at a hydrocarbon facility may be provided with "unlimited" fuel supplies that can destroy the entire facility. Such situations are amply demonstrated by wellhead blowouts that can be fed from underground reservoirs and destruction of pipeline connections at offshore installations affecting the availability of further isolation means, e.g., "Piper Alpha". Facilities that do not have the capability to immediately provide an emergency shutdown should be considered high risks. Similarly, if the reliability of an ESD system is very poor the facility might be considered without adequate protection and therefore also a high risk.

ACTIVATION MECHANISMS

Most ESD systems are designed so that several mechanisms can initiate a facility shutdown. These mechanisms are provided by both manual and automatic means.

They may include the following:
Manual activation from a main facility control point.
Manual activation from strategically located initiation stations within the facility.
Automatic activation from fire or gas detection systems.
Automatic activation from process instrumentation set points.

EXPERIMENT 5

OBJECT: GAS DETECTION SYSTEMS

Many industrial processes produce flammable gases and vapours which can burn when mixed with air, sometimes violently. Typical examples include:

- removal of flammable materials from tanks and pipes in preparation for entry, line breaking, cleaning, or hot work such as welding;
- evaporation of flammable solvents in a drying oven;
- spraying, spreading and coating of articles with paint, adhesives or other substances containing flammable solvents;
- manufacture of flammable gases;
- manufacture and mixing of flammable liquids;
- storage of flammable substances;
- solvent extraction processes;
- combustion of gas or oil;
- combined heat and power plants;
- heat treatment furnaces in which flammable atmospheres are used;
- battery charging

Flammable gas detectors can make a valuable contribution to the safety of these processes. They can be used to trigger alarms if a specified concentration of the gas or vapour is exceeded. This can provide an early warning of a problem and help to ensure people's safety. However, a detector does not prevent leaks occurring or indicate what action should be taken. It is not a substitute for safe working practices and maintenance.

Point detectors measure the concentration of the gas at the sampling point of the instrument. The unit of measurement can be:

- % volume ratio;
- % lower explosion limit (LEL) for a flammable gas;
- ppm or mg/m3 for low level concentrations (primarily used for toxic gases).

Open-path detectors, also called beam detectors, typically consist of a radiation source and a physically separate, remote detector. The detector measures the average concentration of gas along the path of the beam. The unit of measurement is concentration multiplied by path length, % LEL x m or ppm x m. Systems can be designed with path lengths of 100 m or more. However, it is impossible to distinguish whether a reading is due to a high concentration along a small part of the beam or a lower concentration distributed over a longer length. Also, they are not specific to a particular gas, for example steam or water vapour can produce false readings and alarms.

Portable and transportable detectors are always point detectors. Fixed gas detectors can be point detectors or open-path detectors.

TYPE OF SENSOR

There are a number of different types of sensors used for gas detection. The choice of sensor depends on:

- the gas to be detected;
- the expected range of concentration;
- whether the detector is fixed or portable;
- whether the detector is point or open path;
- the presence of other gases that may affect readings or damage the sensor.

SAMPLING METHOD –

In many fixed gas detection systems, the sensor units are designed to use natural diffusion as the sampling method. The sensors are located at or near points where there is the possibility of a gas release.

However, natural diffusion as a sampling method can be slow. In many cases a faster response is needed, and the sample is transported to the sensor using a sampling pump. This is called aspirated or extractive sampling.

Sampling lines are often used in fixed detector installations to transport the sample to the sensor. A possible disadvantage is that it takes a finite time for the sample to travel the length of the sampling line. This delay could be unacceptable in situations where an explosive atmosphere could develop quickly, such as in a solvent-evaporating oven. In multi-point sampling, there may be a number of sampling lines connected to one sensor. The detector processes the samples from each line in a set sequence. This can introduce further delay in the time taken to detect a leak.

The materials used for the sampling line should be selected carefully to prevent dilution or contamination of the sample by leakage, diffusion or sorption of the vapours, corrosion, or the ingress of air. The path and location of the line should be chosen carefully to avoid any mechanical damage.

Care should be taken to avoid blockages in the sampling line. These can be caused by particulates, water condensation or liquids with a high boiling point. To minimise this effect, a filter may be needed to remove particulates and a trap to remove entrained liquid. It may also be necessary to heat the sampling line.

Portable detectors can be used in diffusion or aspirated mode. They can be fitted with probes for leak seeking or testing inside confined spaces beyond the normal reach of the user. Probes are normally rigid and about 1 m in length, although they may be telescopic and may be connected to the apparatus by a flexible tube.

ALARM

If a specified gas concentration or set point is exceeded, the detector system should trigger an alarm. The alarm should not stop or reset unless deliberate action is taken. The alarm should be audible or visible or preferably both. The requirements for alarms are specified in performance standards such as BS EN 61779.3 22 For a portable gas detector, the alarm is part of the instrument itself. If the instrument is put down for some reason, for example to carry out a task, then it is important that the operator should be able to see or hear the alarm from the work position.

In determining the required alarm levels for fixed gas detection systems, the following should be taken into account:

■ any industry standards and recommendations;
■ the lower explosion limit of the gas or vapour;
■ the size of the potential leak and the time to reach a hazardous situation;
■ whether the area is occupied;
■ the time required to respond to the alarm;
■ the actions to be taken following the alarm;
■ the toxicity of the gas or vapour.

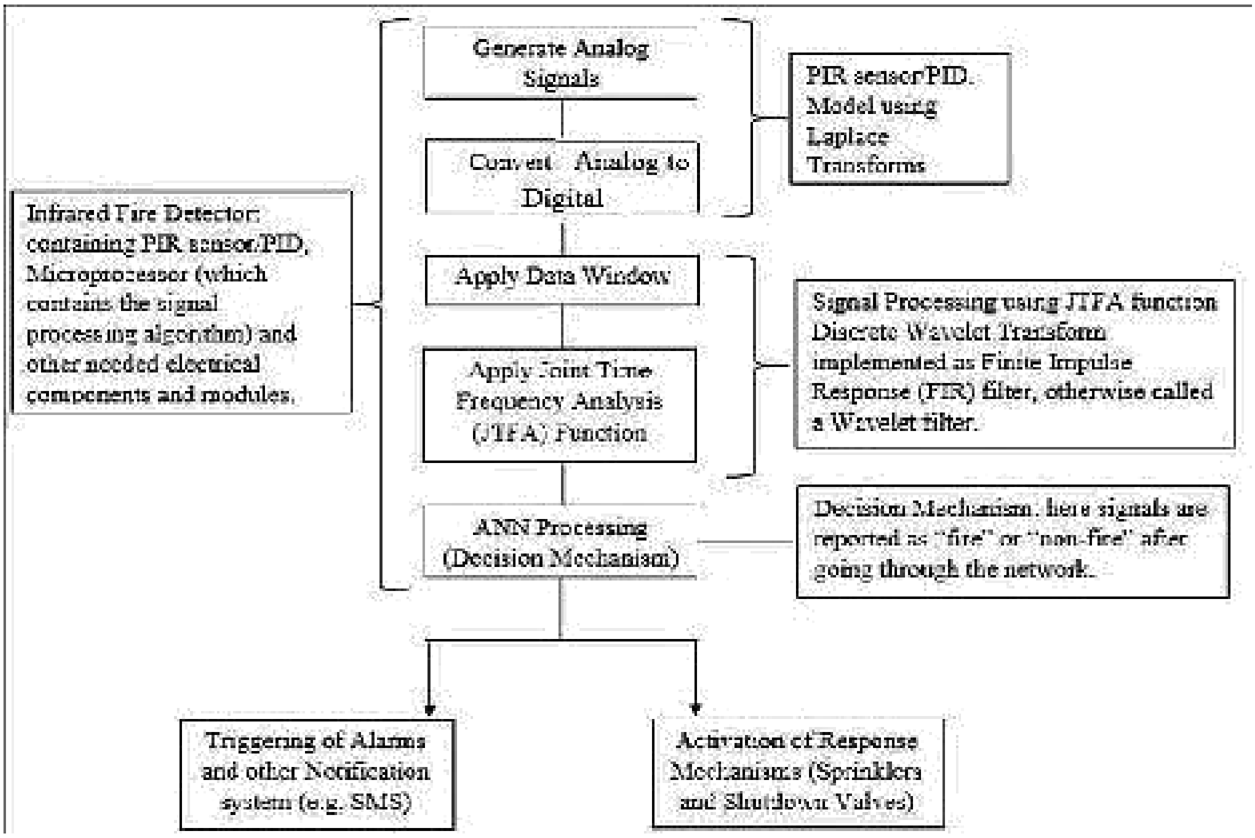
EXPERIMENT 6

OBJECT- FIRE DETECTION AND SUPPRESSION SYSTEM

INTRODUCTION –

Petroleum facilities, also known as oil and gas storage facilities are sites where combustible/flammable liquids are received from shipping vessels, pipelines, tankers etc. These products can be stored or blended in bulk for the purpose of distribution by tankers, pipelines and other methods of transfer and transportation. From this definition, one expects the observation of very high safety standards on such sites to prevent loss of any kind especially by fire. Despite the progress made in the design and installation of safety facilities for oil storage sites, they remain one of the most hazardous places on earth. Late detection and/or suppression of fires are among the primary reasons why little fire outbreaks leads to major oil storage site fire disasters.

Some of the most prominent suppression systems include fire water distribution systems, sprinkler systems, water spray and deluge systems, water flooding systems, fire water control and isolation valves



The Pyro-Electric Infrared Sensor (PIR)/Passive Infrared Detector (PID)

A PIR sensor/PID is comprised of three main parts, namely the Fresnel lens (which focuses the IR radiation to the sensor), the PIR sensor which senses the IR radiation and an amplifier/comparator or amplifier/ analog to digital converter (ADC) circuitry depending on the generation of the PID (Emin, 2009). The Fresnel lens offers a field of view (FOV) of 110o over a distance of 11m. This work simulated the third generation PID, where the comparator circuitry is replaced by analog to digital converter (ADC). Hence, after amplification, we have the ADC. The ADC gains were then fed into a microprocessor containing the detection algorithm for further signal processing and categorisation decision (if the model is to be implemented).

Such a sensor/detector can be modeled as a capacitor with capacitance Cd with a PolyVinylidene Fluoride (PVDF) film as the dielectric with thickness d and surface area A

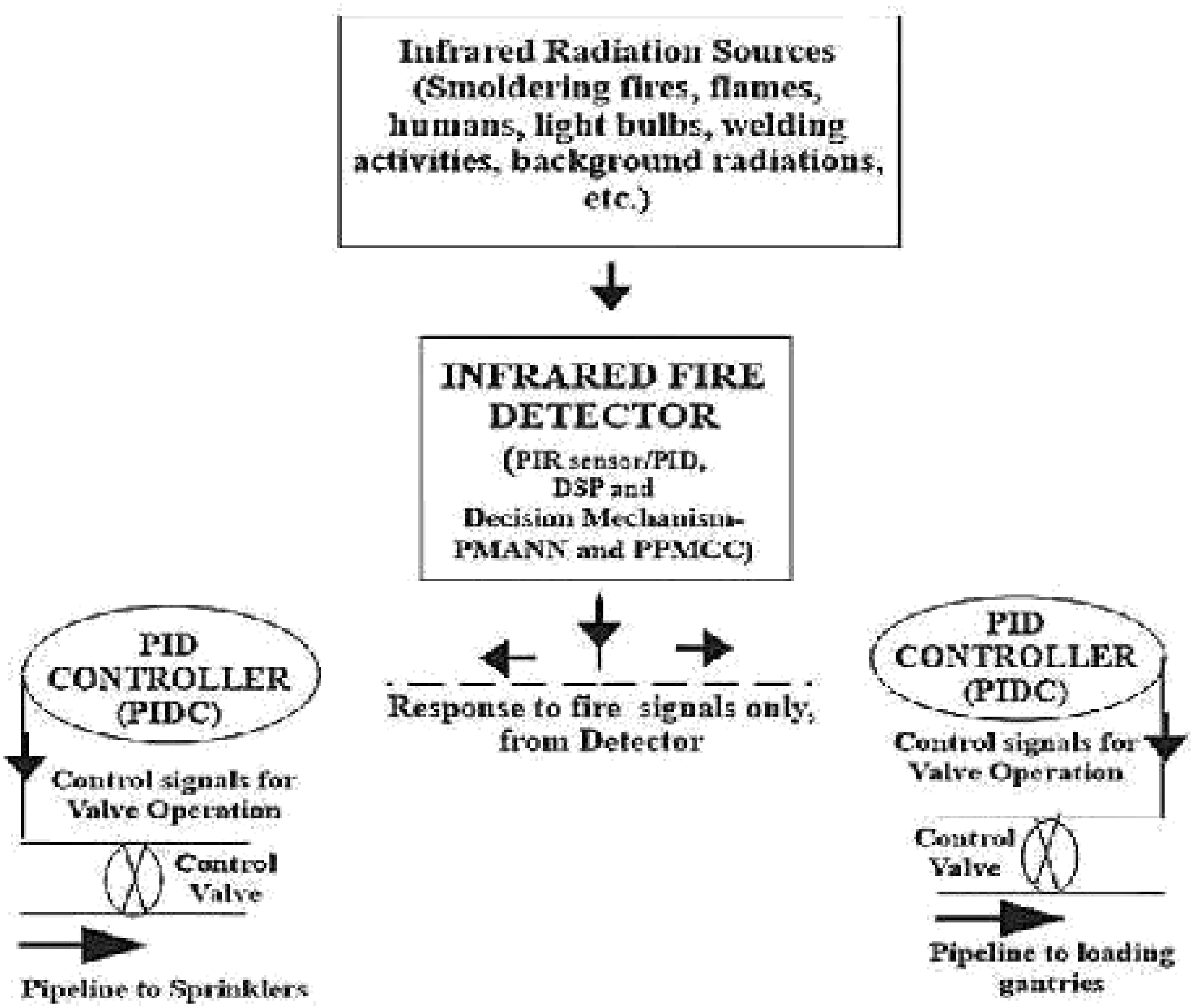
(Odon, 2010). When IR radiation of power Φ(t), varying in time is incident on the active surface of the PIR sensor, an electric charge q(t) is generated. This is transferred as a signal with information content either as voltage V(t) on the detector electrodes or current Ip(t) flowing through the low load resistance of the detector output. Converting IR radiation into an electric signal is done in 3 stages: converting radiation power Φ(t) to thermal change on the sensor surface i.e. temperature ΔT(t), the second stage is the thermal to electric conversion i.e. ΔT(t) to Ip(t), and the last stage is the current to voltage signal conversion i.e. Ip(t) to V(t). The PID detects infrared radiations from several sources within its range or field of view.

From automatic control theory, the procedures for the creation of block diagrams for simulation involves connecting the block transfer function in series, where series connection implies multiplication.

Suppression Mechanism

The fire suppression response mechanism involved the modeling of control valves. The aim was to come up with a model that could be able to control (open/close) fire suppression systems (foam injection lines, water deluge lines, and water sprinkler lines, etc.), pipelines and also active pumps. By using Proportional, Integral and Derivative Controllers (PIDCs), we simulated the control of an Active Hydraulic Device (ADH) such as hydraulic proportional valves (Yong, 2009).

Under normal system operations in these sites, pumps used for loading and unloading of petroleum products are always running to keep business moving. Also, fire pipelines for suppression systems are always pressurised for emergency cases. These valves can be connected at key places along these pipelines, such that immediately this model detector senses fire, signals are sent to these valves for prompt control as the case may demand.



SIGNAL FLOW MODEL FOR WHOLE PROCESS

EXPERIMENT 7

OBJECT – PERSONAL PROTECTION SYSTEMS AND MEASURES

INTRODUCTION

Workers in the oil and gas industry face a wide variety of hazards in their daily job duties. Oil and gas products and chemicals can be irritating, corrosive, flammable and worse. To help prevent workers from coming into contact with these hazards, employers will provide them with **personal protective equipment** (PPE).

On oil and gas sites, required **PPE** usually includes eye protection, hearing protection, hand and foot protection, and flame-resistant clothing (FRC). Many workers are also required to wear portable monitors that detect hydrogen sulfide (H_2S) or other gases.

Hazards Unique to the Oil and Gas Industry

Oil and gas wells can expose workers to hydrogen sulfide gas. If your workplace uses sand for any process, such as hydraulic fracturing, workers may be exposed to crystalline silica. Crystalline silica is a known lung carcinogen, and can cause silicosis, which can be debilitating and even fatal. Oil-and-gas-related flash fires can reach up to 1900 degrees Fahrenheit and can last up to five seconds. These fires most commonly occur in well drilling, servicing, and production-related operations. Fortunately, there are many different types of **personal protective equipment (PPE)** to protect against these hazards.

Head, Face and Eye PPE

The Occupational Safety and Health Administration (OSHA) requires employers to provide their workers with eye protection if their job will expose them to flying particles; molten metal; hazardous, acidic, or caustic liquids, gases, or vapors; or potentially harmful light radiation. Safety glasses with side shields are effective at protecting against flying objects. Impermeable goggles can be worn while working around liquid, gas or vapor hazards. Face shields can protect the entire face from both flying objects and chemicals. Face shields aren’t a replacement for goggles or safety glasses, because they aren’t as good at protecting the eyes. Welders use special filtered helmets to protect their eyes from radiant light, sparks, flying particles and glare.

If there’s a danger of falling objects, overhead electrical hazards or fixed objects that workers could bump into, they’ll need to wear head protection. All classes of hard hats provide impact and penetration protection. Class G hard hats also provide protection against up to 2,200 volts of electricity. Class E hard hats protect against up to 20,000 volts. Class C hard hats provide no electrical protection, so they aren’t usually worn on oil and gas sites.

Body PPE

OSHA recommends that employers and employees choose gloves based on the employee’s job duties, work environment and the performance and construction characteristics of glove materials. Leather, canvas and fabric gloves can protect hands from dirt, splinters, abrasions, cuts and heat, but they can’t fully protect against liquids or strong chemicals. Neoprene, nitrile, vinyl and rubber gloves can protect against liquid and chemical hazards, but each material is only rated to protect against certain types of chemicals. Many of these types of gloves are only intended for a single use and are vulnerable to tears. Specialty gloves can be worn to protect against crushing injuries, heavy vibrations, and situations where multiple hazards are present.

Workers may step on sharp objects, have their feet crushed by heavy objects, be exposed to excessive heat or cold, and be exposed to slip, trip, and fall hazards. Depending on your worksites’ job duties, workers may also be susceptible to electrical hazards, caustic chemicals and acids, and even molten metal. Safety boots with steel or impact-resistant toes are common and should have slip-resistant soles with a strong grip. Boots made of neoprene or nitrile can protect against chemicals or petroleum products. Insulated rubber boots help protect against electric shock. For welders, leather leggings can be worn above or over boots to protect from sparks and molten metal.

Respiratory PPE

If a workplace has unsafe atmospheric conditions, employers must provide employees with respirators. Before wearing a respirator, all employees must undergo a medical examination and fit test to ensure that they can safely use a respirator. Finally, all employees must receive extensive training on their respirator, including how to maintain and inspect it, before using it in the workplace. Air-purifying respirators have cartridges designed to filter airborne particles and/or chemicals, such as organic vapors or acid gases. In circumstances where the air cannot be made safe through filtering, such as in oxygen-deficient atmospheres, atmosphere-supplying respirators can provide clean breathing air from a tank or generator.

EXPERIMENT 8

OBJECT – HSE POLICIES AND STANDARDS

POLICIES-

- Maintain a strong, integrated HSE Management System to identify and manage risks;
- Accept responsibility and accountability for providing leadership, visible commitment and direction to meet our HSE performance targets;
- Continuously evaluate and improve policies and operating practices;
- Integrate HSE into business objectives;
- Provide every employee and contractor with a safe and healthy workplace;
- Make a positive contribution to the protection of the environment and seek improvements in the efficient use of natural resources;
- Respond promptly, responsibly and effectively to emergencies;
- Focus on continual improvement of HSE performance;
- Ensure open and timely HSE communication with all stakeholders;
- Ensure the resources necessary to support this policy are provided.

HSE STANDARDS –

HSE Compliance Standards will:

- Formalise HSE Policy development and planning processes;
- Improve consistency in HSE management and performance;
- Improve health, safety and environmental risks and hazards management;
- Increase corporate HSE capacity and memory;
- Drive compliance to HSE statutory and other obligations.

Minimum Standard

The CEO is accountable for developing and communicating the Health and Safety and Environmental (HSE) Policies and holding management accountable for implementing the Policies.

The (HSE) Policies shall:

- include a commitment to continual improvement of HSE management systems and performance;
- include a commitment to comply, as a minimum, with the host country's HSE legal obligations and voluntary commitments;
- be documented, implemented and communicated;
- be available to third parties on request; and
- be reviewed and endorsed every 2 years by the CEO (as a minimum).

Each Business Unit will utilise the Statement of Commitment template to document its Commitment to the Policies.

The Business Unit General Manager will endorse the Business Unit's Statement of Commitment and ensure it is displayed alongside the Policies. Business Units shall ensure that Corporate Vision and Values, Policies and Statement of Commitment to the Policies is communicated to all employees and contractors, as well as appropriate third parties.

Business Units shall ensure that a local language version of the Corporate Vision and Values, Policies and Statement of Commitment to the Policies is communicated throughout the Site as appropriate.

EXPERIMENT 9

OBJECT: DISASTER AND CRISIS MANAGEMENT

OBJECTIVES OF DISASTER MANAGEMENT PLAN

The Disaster Management Plan (DMP) is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operations in this same order of priorities. For effective implementation of the Disaster Management Plan, it will be widely circulated and personnel training through rehearsals/drills. The Disaster Management Plan would reflect the probable consequential severalties of the undesired event due to deteriorating conditions or through 'Knock on' effects. Further the management will be able to demonstrate that their assessment of the consequences uses good supporting evidence and is based on currently available and reliable information, incident data from internal and external sources and if necessary the reports of outside agencies. To tackle the consequences of a major emergency within or in immediate vicinity of the project site, a Disaster Management Plan has been formulated.

The objective of the Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;
- Identify any dead;
- Provide for the needs of relatives;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of affected area;

- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the Emergency.

Disaster Management Plan: Key Elements

Following are the key elements of any Disaster Management Plan:

- Basis of the plan
- Accident prevention procedures/measures
- Accident/emergency response planning procedures
- Recovery procedure

Basis of the Plan

Identification and assessment of hazards is crucial for emergency planning and it is therefore necessary to identify what emergencies could arise during the production of Oil and Natural Gas. Hazard analysis and the consequence analysis are, therefore, considered as the basis of DMP.

Major hazards/accidents are categorized into the following events involving flammable materials:

- Hazards from spread of fire, explosion or release of flammable substances from the wells, platforms and storage tank
- Hazards from high levels of thermal radiation for limited duration
- External interference such as excavation resulting in blow out of well. Ignition of the released gas from well blow out can cause heat radiation at some distance from the well.

Accident Prevention Procedures / Measures

OISD standard 174 gives the codes for well control and standard 189 sets out engineering requirement for firefighting equipment for drilling rigs. Standard Industry practice is to be adopted. A separate plan is provided to deal with the situations, which necessitate emergency action. The emergency response plan includes details of the organizational response to emergencies and the safety precautions to be observed in preventing loss of life and damage to property.

In case of emergency – Onsite and Offsite following Disaster Management Plan will immediately come into force

Disaster Management Organization will assume control and responsibility in case of any emergency situation. The function and responsibilities of various functionaries of the organization are discussed below.

Following are the members of Contingency team constituted at CBM- Development Project to meet any emergency situation:

a) Controller of the disaster management committee (DMC)

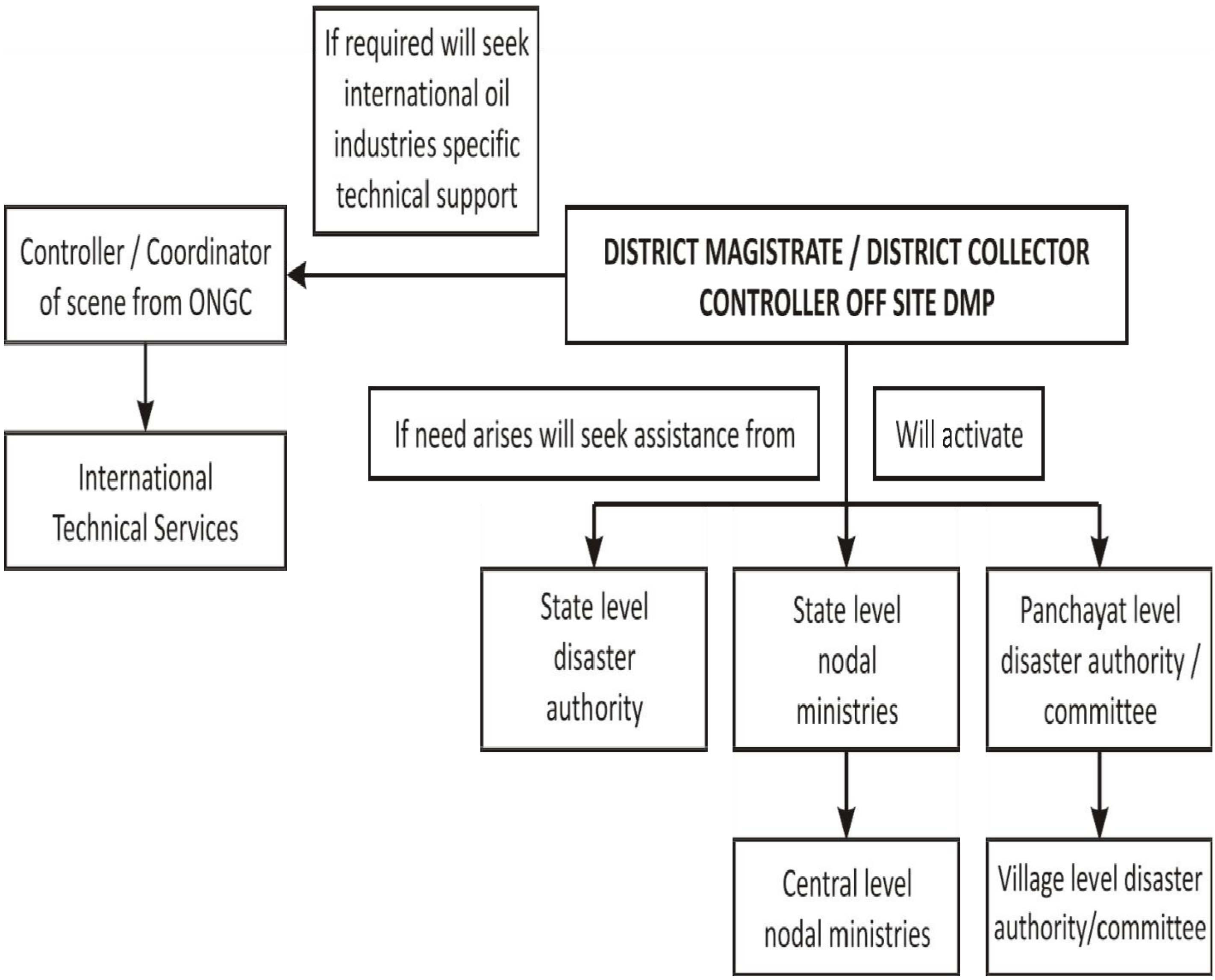
- Project Manager

b) Dy. Controller of disaster management committee

- Head Surface Team
- Head Drilling/Workover Services
- Head Engineering Services
- Location Manager drilling Services
- Head –HR-ER
- Head Sub-Surface Team
- Head –F&A

c) Co-ordinators

- Head-HSE
- Head of the Medical Section
- Head Security
- Head HR-ER - Welfare and Public Relation



If required will seek international oil industries specific technical support
Controller / Coordinator of scene from ONGC
DISTRICT MAGISTRATE / DISTRICT COLLECTOR CONTROLLER OFF SITE DMP
International Technical Services
If need arises will seek assistance from
Will activate
State level disaster authority
State level nodal ministries
Panchayat level disaster authority / committee
Central level nodal ministries
Village level disaster authority/committee

Disaster & crisis management

A disaster management plan shall have typically following elements

DISASTER MANAGEMENT PLAN

FOR

ONGC RAJASTHAN

- Disaster management plan is given for ONGC as an example. The DMP however shall have site specific plan.

PREFACE

Disaster Management Plan is dynamic plan for emergency control. Since the process of command and control is dynamic, changes need to be captured instantaneously. However, standard guidelines to combat the known emergencies are incorporated in the Disaster Management Plan.

Due to change in the phone numbers and induction of mobile phones to contact the concerned authority, a new revised DMP of Jodhpur has been prepared.

The plan clearly defines the role and responsibilities of concerned executives of asset to combat the disaster and emergency situation.

The plan contains separate chapters on fire control at different locations, plan to combat blow out at drilling rigs, environment hazards.

This will help the employees to be in readiness to fight out the situation to avoid panic situation at the time of disaster / emergency.

The plan also deals to control the situation at the time of natural calamities like floods, earthquake etc.

Address and contact numbers of statutory bodies like DGMS, RPCB and Civil authorities are also given in the plan for fast and better communications / co-ordination.

This DMP will be very much helpful while taking prompt actions at the time of emergencies.

Sl. No.	Description
1	Important Telephone nos.
2	Brief about Industry (ONGC) , Jodhpur
3	Introduction
4	On site Emergency Plan
5	Contingency plan to combat Fire
6	Emergency Procedures for Drilling Rig
7	Contingency Plan for Emergency Situations due to Natural Calamities or Enemy Air Raids during war
8	Emergency Response plan in case of Gas leakage at GCS
9	Contingency flow chart showing inter distances

BRIEF ABOUT ONGC RAJASTHAN

The Oil and Natural Gas Corporation, a pioneer in oil industry, started its exploration activities in and around Jaisalmer of Rajasthan in the year 1964. The important commercially producing field of the Forward Base is Manherra Tibba (West of Jaisalmer) .At present one GCS (Gas collecting station) at Gamnewala is situated deep inside desert, 100 kms from Jaisalmer and 400 kms from Jodhpur. GCS started supplying gas in 1994 to the tune of 50,000 CUB.M average daily gas and supplying to Rajasthan State Electricity Board Power Plant at Ramgarh.

ONGC has drilled about 80 wells since its inception and have made nearly Rs 650 crores of expenditure on drilling. Recently the efforts of ONGC bore fruit when gas was struck in Cinnewala Tibba (South Khartar area) which showed promise in terms of quality and quantity.

As part of its corporate social responsibility ONGC has taken up project '**Saraswati**' to augment water availability in the remote areas of desert. ONGC has started drilling of tube wells ranging 500Mts to 1000Mts and has a plan to drill 40 such wells in near future.

Map of Rajasthan

INTRODUCTION

OBJECTIVE

TO INITIALLY CONTAIN AND ULTIMATELY CONTROL THE SITUATION AND BRING IT TO NORMAL.

2. TO REDUCE OR MINIMISE DAMAGE TO MEN, MACHINERY, MATERIAL AND ENVIRONMENT.

3. TO CHECK RECURRENCE OF ABNORMAL SITUATION.

The inflammable nature of oil and gas and availability of these in the reservoirs at high pressure make the ONGC operations highly hazardous. The incidence of emergency situation-such as blowouts, fire accidents, environmental hazards, social disturbances and other abnormal situations arises during ONGC operations. It has been observed that during such situations, actions at various levels have not been timely and well-directed. Often there is a state of confusion as to what a person has to do or when he has to contact for different facilities to over come and manage the situation. This contingency plan has been drawn keeping in view all these factors. The purpose of this plan is to identify, as far as possible, various actions to be taken in order of priority and to specify the personnel responsible for taking various actions in the event of different types of emergency situation with a view to overcome the crisis in the least possible time with no or minimum injury to persons, damage to equipment, reservoir and environment. Keeping these factors in view, this contingency plan is drawn.

To make this plan really useful, every concerned officers and employee must read it as a part of their routine duty to make themselves well conversant with it. This will help them in taking timely decision and appropriate action in an event of real emergency.

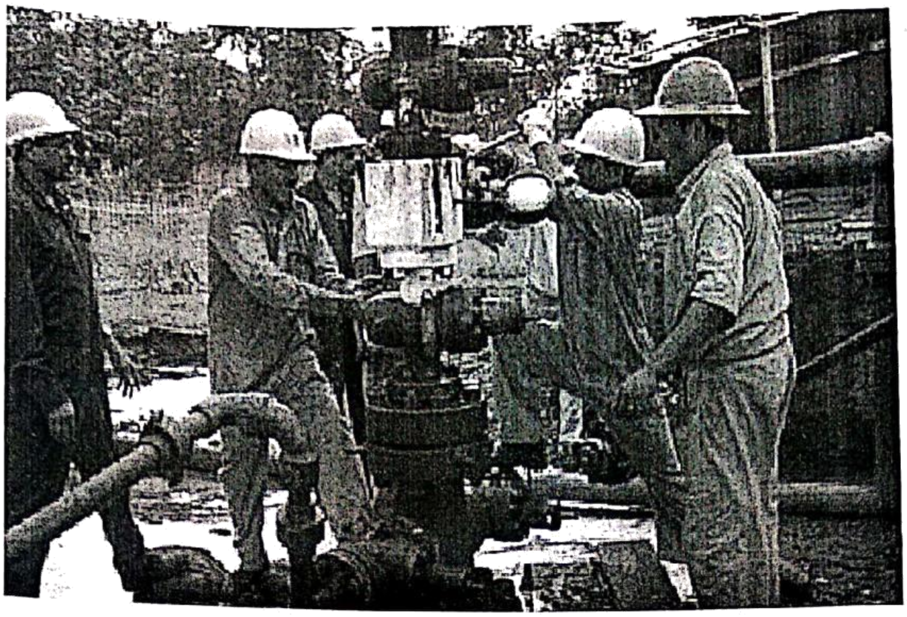
Regular rehearsals & mock exercises at regular intervals will generate confidence in the minds of participants, which will make it easy for them to fact the real situation of an emergency.

Hence the contingency plan is meant to assist in taking emergency situations by taking immediate action in order to control abnormal situation in an effective and systematic manner.

ONSITE

EMERGENCY

PLAN



OBJECTIVES:

1. Safeguarding lives both at installations and in neighborhood.
2. Containing the incident & bringing it under control.
3. Minimizing damage to property & Environment.
4. Resuscitation & treatment of causalities.
5. Evacuating people to safe area.
6. Identifying persons and to extend necessary welfare assistance to causalities.

7. Finally when situation is controlled, efforts are to be made to return to normal or near normal conditions

1. SCOPE OF DISASTER MANAGEMENT PLAN:

Oil Mine Operation of ONGC is vulnerable to various kinds of natural and operational disasters. It has been our endeavor to cover all possible types of emergency situations, which can occur during operations at the oil mine of the Asset. For all disastrous situations, action plans have been drawn for overall command, control and communication within the organization setup. The emphasis is on specifying the personnel at different levels of taking various actions, which have been identified as necessary for these emergency situations. Thus, this Disaster Management Plan may help in minimizing the losses in terms of human lives and properties and at the same times enable normal operations to be resumed as soon as possible

In addition, the details of Blowout Preventers and Fire Extinguishers, Breathing Apparatus available at various work points of the Asset have been included in this plan. The Phone Nos. and address of key personnel at Head Quarters and other places have been given for immediate communication in the event of emergency..

Finally, since every emergency situation is unique in characteristics, the exact plan would be decided by the competent authorities. This plan would, at best, serve as guide for drawing the exact plan.

2 CLASSIFICATION OF HAZARDS:

There are two major classes of hazard.

I On site emergency within the plant of ONGC and primarily can be mitigated by using its own resources but outside help cannot be ruled out.

II On site and offsite emergency.

This class includes emergency likely to endanger human lives, plants and equipments within the installations and its vicinity areas.

Control of such events may require combined resources of ONGC and out side agency like civil and defense services etc.

BASED ON GRAVITY OF HAZARD

(These are further classified as follows)

A. Hazards which may be controlled with the resources available within the work points

B. Hazards which may require assistance from other departments like Logistics, Medical, Fire, etc.

C. Hazard, which will demand assistance from regional office and corporate office and other specialized agencies.

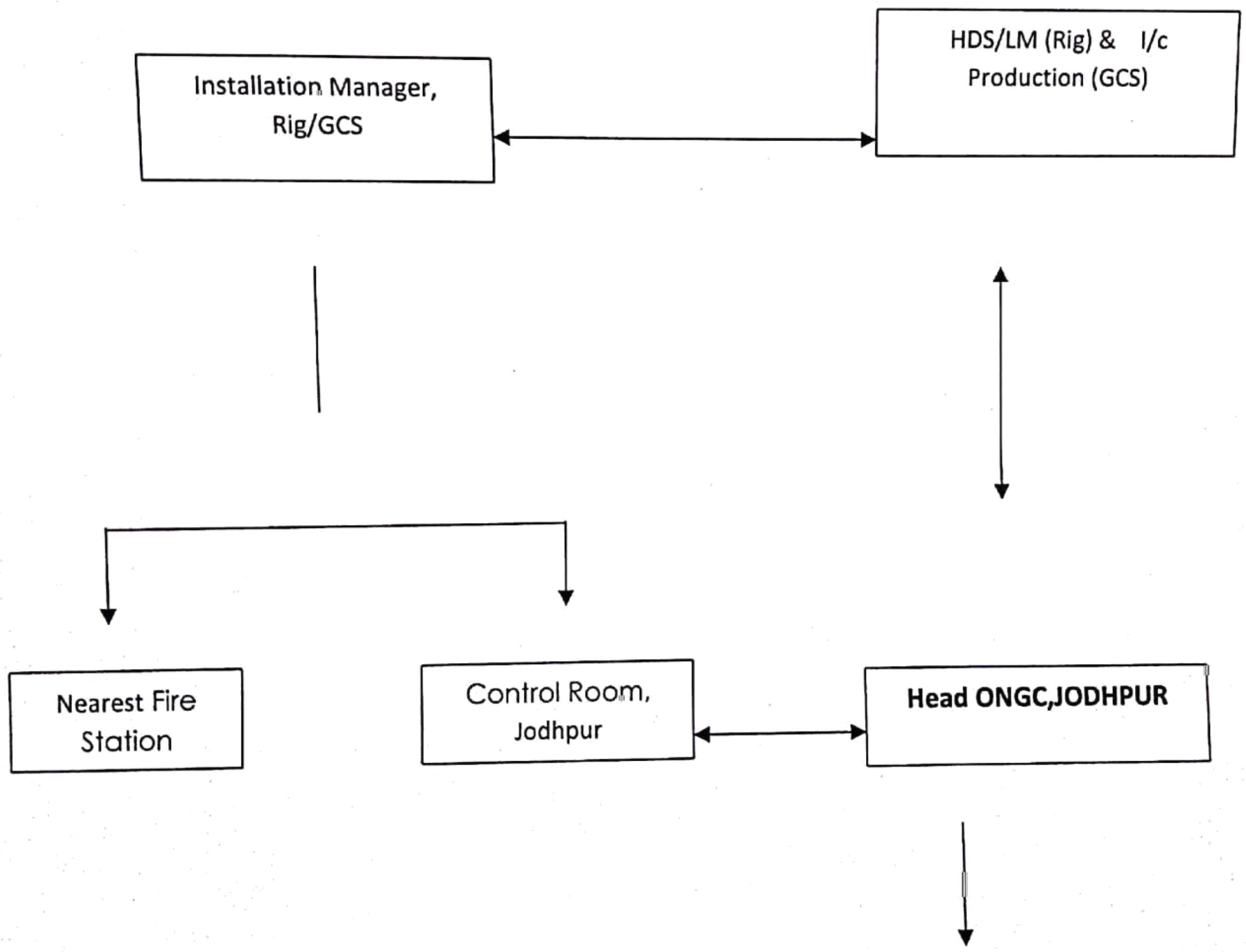
D. Hazard which will require help of local civil administration for safe evacuation, rehabilitation etc.

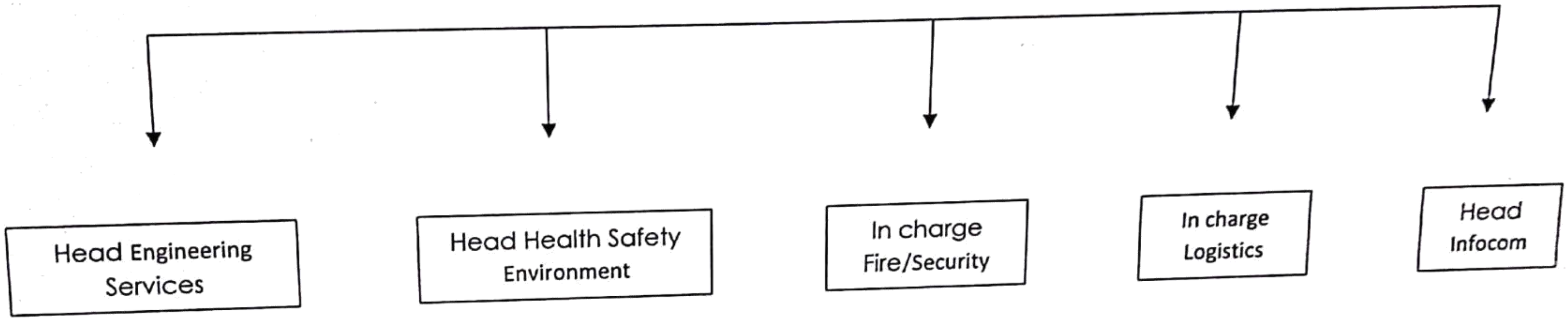
4.0 ORGANOGRAM FOR ON-SITE EMERGENCY PLAN:

Co-ordinated efforts involving all the disciplines are required to control major on-site emergency. Hence for the purpose of making an Emergency Committee, members of different disciplines and from senior management are identified.

At times, Emergency Committee may have to undertake the execution of the decision taken by Base /Head Quarter.

ON SITE EMERGENCY PLAN




Head Engineering Services
Head Health Safety Environment
In charge Fire/Security
In charge Logistics
Head Infocom

CONTIGENCY PLAN TO COMBAT FIRE

FIRE

Operation in field areas involve mainly Drilling operations, work over operations, compressor applications and bottom hole study operations etc.

Fire is the one of the most common causes for development of grave situation in the operational as well as non operational areas of ONGC. All dangerous situations ultimately turn into or have the tendency to change into fire.

	Classification of fire medium	Extinguishing agent
A	Involving combustibles like wood, cotton waste, paper rubberized spare parts etc.	Water
B	Involving flammable liquids like crude oil solvents, petrol, diesel, kerosene etc.	Foam. Carbon-di-oxide and chemical powder.
C	Involving gaseous substance under pressure	Carbon-di-oxide and dry chemical powder
D	Fire in reactive chemicals/active metals etc.	Special dry powder extinguishers.

Keeping in view the type of fire suitable extinguishers should be used to extinguish fire

EXPERIMENT 10

OBJECT- ENVIRONMENT CONCEPTS, IMPACT ON ECO-SYSTEM, AIR, WATER AND SOIL

Toxicity:

- ☐ Crude oil is a mixture of many different kinds of organic compounds, many of which are highly toxic and cancer causing (carcinogenic).
- ☐ Oil is "acutely lethal" to fish - that is, it kills fish quickly, at a concentration of parts per million (ppm) (0.4%).
- ☐ Crude oil and petroleum distillates cause birth defects.

Toxicity of Benzene

- ☐ Benzene is present in both crude oil and gasoline and is known to cause leukaemia in humans.
- ☐ The compound is also known to lower the white blood cell count in humans, which would leave people exposed to it more susceptible to infections.

"Studies have linked benzene exposure in the mere parts per billion (ppb) range to terminal leukemia, Hodgkin's lymphoma, and other blood and immune system diseases within 5-15 years of exposure

Exhaust Gases:

- ☐ When oil or petroleum distillates are burned (see combustion), usually the combustion is not complete.
- ☐ This means that incompletely burned compounds are created in addition to just water and carbon dioxide.
- ☐ The other compounds are often toxic to life. Examples are carbon monoxide and methanol. Also, fine particulates of soot blacken humans' and other animals' lungs and cause heart problems or death.
- ☐ Soot is cancer causing (carcinogenic).

Volatile organic compounds:

- ☐ Volatile organic compounds (VOCs) are gases or vapours emitted by various solids and liquids, many of which have short- and long-term adverse effects on human health and the environment.

- VOCs from petroleum are toxic and foul the air, and some like benzene are extremely toxic, carcinogenic and cause DNA damage.
- Benzene often makes up about 1% of crude oil and gasoline. Benzene is present in automobile exhaust
- More important for vapors from spills of diesel and crude oil are aliphatic, volatile compounds.
- Although "less toxic" than compounds like benzene, their overwhelming abundance can still cause health concerns even when benzene levels in the air are relatively low.
- The compounds are sometimes collectively measured as "total petroleum hydrocarbons" or "TPH.“
- Petroleum hydrocarbons such as gasoline, diesel, or jet fuel intruding into indoor spaces from underground storage tanks or brown-fields threaten safety (e.g., explosive potential) and causes adverse health effects from inhalation.
-

EXPERIMENT 11

OJECT- THE IMPACT OF DRILLING AND PRODUCTION OPERATIONS ON ENVIRONMENT, ENVIRONMENT TRANSPORT OF PETROLEUM WASTES.

The exploration & exploitation activities of petroleum industry often causes environmental degradation that have significant impact on :

quality of air, water, soil, vegetation and on health unless adequate preventive measures are planned.

Environmental Pollution:

It may be defined as " the introduction by man into the environment substances or energy liable to :

cause hazards to human health, harm to living resources & ecological systems,

damage to structures or interference with legitimate uses of the environment.

Pollution due to drilling activity:

Drilling contributes to air, water and soil pollution because of diverse nature of activity.

Sources of Air pollution:

Exhaust from engines, generators , motors, cranes –they contribute to levels of co2.co; NOx; So2

Sources of Water Pollution:

Water washings of drill cuttings; spillage of diesel oil, crude oil contaminates ground water table.

Production operations contributes to air, water and soil pollution:

Sources of Air pollution

Venting of gas lines , engines, generators, flaring of hydrocarbons to atmosphere

Sources of Water Pollution:

Spillage of oil, Brines co-produced along with oil, overflow of oils, Effluent generation due to various processes

Petroleum Waste oil:

- Waste oil contains not only breakdown products but also impurities from use.
- Some examples of waste oil are used oils such as hydraulic oil, transmission oil, brake fluids, motor oil, crankcase oil, gear box oil and synthetic oil.
- Many of the same problems associated with natural petroleum exist with waste oil.
- When waste oil from vehicles drips out engines over streets and roads, the oil travels into the water table bringing with it such toxins as benzene.
- This poisons both soil and drinking water. Runoff from storms carries waste oil into rivers and oceans, poisoning them as well.

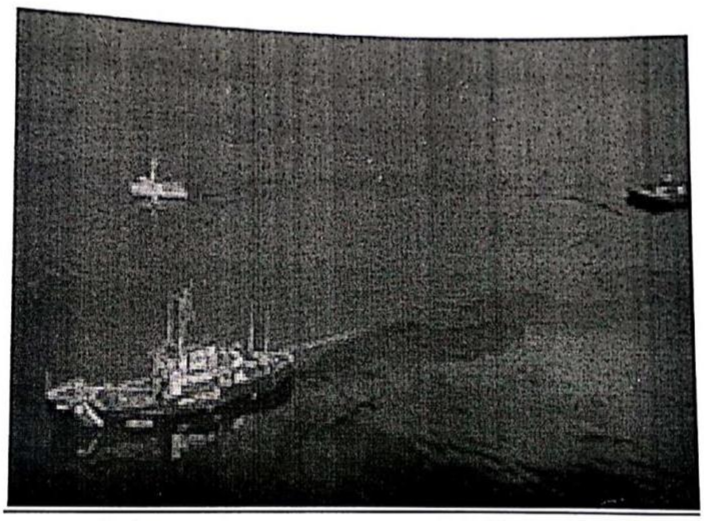
EXPERIMENT 12

OBJECT- OFFSHORE ENVIRONMENTAL STUDIES, OFFSHORE OIL SPILL AND SPILL CONTROL.

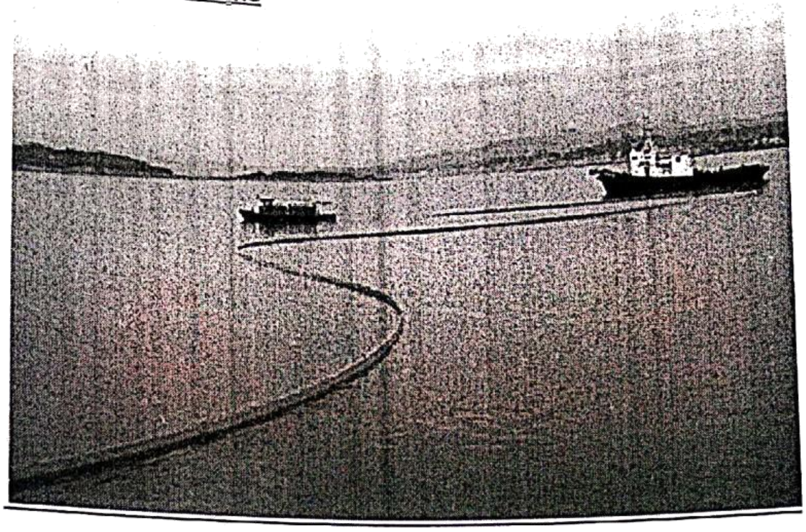
OIL SPILLS:

Oil spills are one of the most visible signs of pollution to our environment.

Sometimes the environment is able to take care of an oil spill by natural processes. However, when a large oil spill occurs, nature needs some assistance in the clean-up process.



Cleanup Methods: Booms

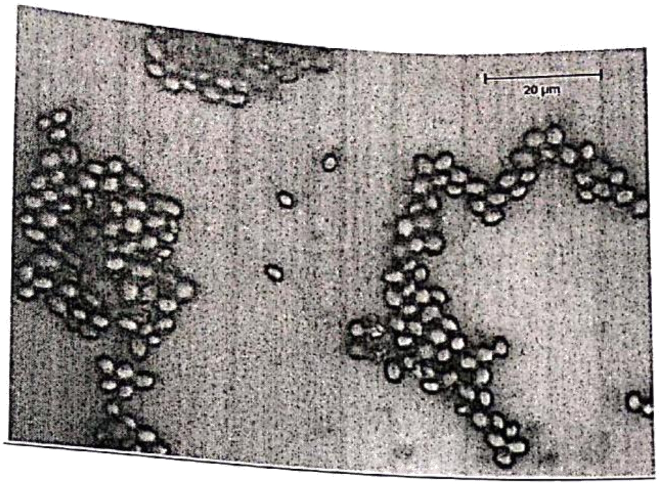
- 

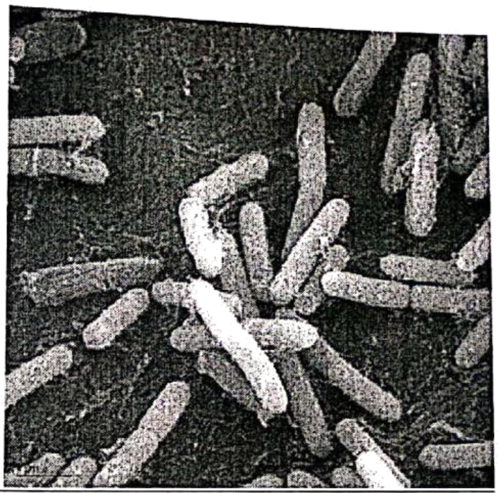
- **What are booms?**

- Definition: used to hold oil in one place so that it is easier to clean.
- Once the spread of oil is controlled, environmental scientists can choose from three major methods for oil clean-up:
  - **Biological**
  - **Chemical**
  - **Physical/Mechanical**

Biological Methods:

- How is it used: to break down oil into a harmless substance.
- Examples: fungi, microorganisms
- They have the potential to provide clean-up in sensitive areas such as shorelines and wetlands without further harming the environment.





Chemical Methods of oil spill clean up:

- How is it used: to break up or dissolve oil.
- Examples: soap
- **Use of Surfactants:**
- Surfactants engage or hold the oil droplets and help in removing he oil spill.

Another chemical method is simply burning the oil off of the surface. However, because burning and special chemicals might hurt the environment and living organisms, these methods are not the best choice along coastlines or populated areas.

Physical/Mechanical methods of oil spill clean up:

- How is it used: to physically remove the oil from the water.

Examples: large vacuums, skimmers, and substances to soak up or absorb oil.

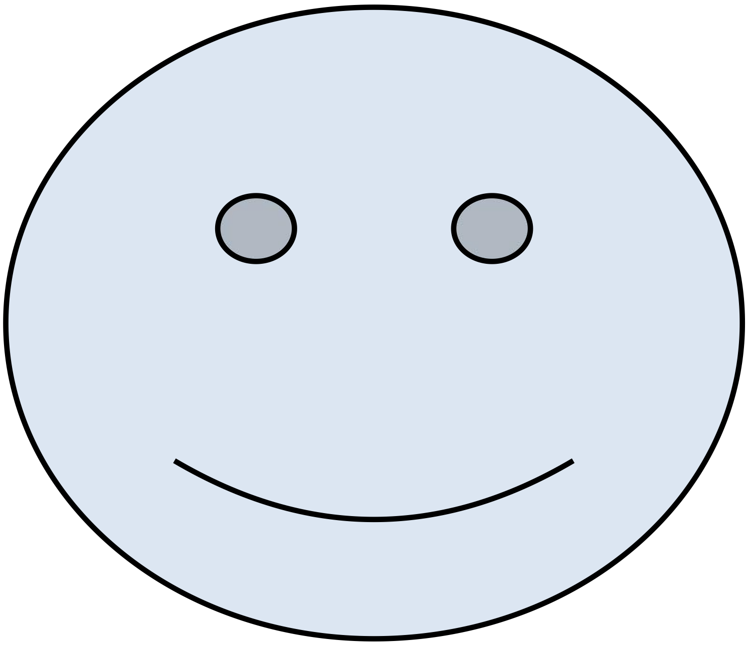
EXPERIMENT 13

OBJECT- OIL MINES REGULATIONS AND OTHER ENVIRONMENTAL LEGISLATIONS.

Oil Mines Regulations-1984

Oil Mines Regulations-1984 (OMR 1984) replaces the Oil Mines Regulations-1933, with effect from October-1984 to deal with matters for the prevention of possible dangers in oil mines in India.

OMR 1984 was Published in 1986 by Directorate General of Mines Safety, Ministry of Labour in Dhanbad, Bihar.



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