7.2. Risk Assessment

Risk Assessment (RA) also known as Hazard Analysis and Vulnerability Assessment is a procedure for identifying hazards and determining their possible effects on a community and environment. Risk or hazard by itself is not an event- it is potential for an event.

Drilling rig floor is the centre stage of all drilling operations and it is most susceptible to accidents. Safety precaution with utmost care is required to be taken during drilling as per the prevailing regulations and practices so that accidents can be avoided. Due to advancement in technology, number of equipments has been developed over a period to cater the need of smooth operation on a rig floor. Various standards are required to be referred to cover the variety of equipments used for safe operation in drilling and it is desirable to use a properly prepared manual for occupational safety while working or drilling over a rig. It may, however, be noted that well testing and production testing of hydrocarbons also require proper analysis of hazards involved in production testing operations and preparation of an appropriate Emergency Control Plan.
Hydrocarbon Operations are generally hazardous in nature by virtue of intrinsic chemical properties of hydrocarbons or their temperature or pressure of operation or a combination of them. Fire, Explosion, Hazardous Release or a combination of these are the hazard associated with Hydrocarbon Operations.

Some of the hazards associated with the drilling are:

- Fires and Explosions:
  - o Non-Process Hydrocarbon Leak (Diesel, Fuel, Oil etc.);
  - o Non-Process Fire;
  - o Control system failure including electrical failure in control room.
- Impact and Collisions:
  - o Accidental Falling of Object from Crown Block.
- Loss of Station Keeping / Loss of Stability:
  - o Structural Failure
  - o Equipment Failure.
- External Hazards:
  - o Failure due to Earthquake, Extreme Weather, Strong Winds, Floods and Sabotage etc.

The primary emphasis in Safety Engineering is to reduce Risk to Human Life and Environment. Some of the more important methods used to achieve this are:

- ***Risk Analysis:*** Provides a relative measure of the likelihood and severity of various possible hazardous events by critically examining the proposed drilling and associated activities.
- ***Work Safety Analysis:*** The technique discerns whether the project site and operating procedures in practice have any inherent infirmities.
- ***Safety Audit:*** Takes a careful look at operating conditions, work practices and work environments to detect unsafe conditions

  Together, these three broad tools attempt to minimize the chances of accidents occurring. Yet, there always exists, no matter how remote, that Small Probability of a Major Accident occurring. If the accident involves hydrocarbon in sufficient large quantities, the consequences may be serious to the project, to the surrounding area and the population therein.

  These have resulted in the development of more comprehensive, systematic and sophisticated methods of Safety Engineering such as Identification and Analysis of Hazards and Risk Assessment to improve upon the Integrity, Reliability and Safety of Hydrocarbon Operations.

7.2.1 Methodology of Risk Assessment

The RA studies are based on Quantitative Risk Assessment Analysis (QRA). QRA aims to provide a systematic analysis of the major risks that may arise as a result of onshore

exploratory development drilling activities. Normally three level " risk assessment" approach is adopted for industrial activities. The brief outline of the three tier approach is given below:

A. Level 1 – Risk Screening

This is Top-Down Review of Worst- Case Potential Hazards/Risks, aimed primarily at identifying Drilling Sites or Areas within Blocks, which pose the Highest Risk. Various screening factors considered, include:

- Inventory of Hazardous Materials;
- Hazardous Materials Properties;
- Storage Conditions (e.g. Temperature and pressure);
- Location Sensitivity (Distance to Residential Areas / Populace).

The Data/Information is obtained from the site. The results provide a relative indication of the extent of hazards and Potential for Risk Exposure.

B. Level 2 – Major Risk Survey (Semi - Quantitative)

The survey approach combines the Site Inspection with established Risk Assessment Techniques applied both Qualitative as well Quantitative Mode. The primary objective is to identify and select major Risks at a specific Location in the Drilling Site considering possible soft spots / weak links during Operation / Maintenance. Aspects covered in the Risk usually include:

- Process Hazards;
- Process Safety Management Systems;
- Fire Protection and Emergency Response Equipments and Programs;
- Security Vulnerability;
- Impacts of Hazards Consequences (Equipments Damage, Business Interruption Injury, Fatalities);
- Qualitative Risk Identification of Scenarios Involving Hazardous Materials.

Risk Reduction Measures

Selection of critical scenarios and their potential of damage provide means of prioritizing Mitigate Measures and allocate the resources to the areas with highest risks.

C. Level 3 – Quantitative Risk Assessment (Deterministic)

This is the stage of Assessment of Risks, associated with all Credible Hazards (scenarios) with potential to cause an undesirable outcome such as Human Injury, Fatality or Destruction of Property. The four basic elements include:

- Hazards Identification utilizing formal approach (Level 2, HAZOP etc.);
- Frequency Analysis: Based on past Safety Data‟s (incidents / accidents), identifying likely pathway of failures and quantifying the toxic / inflammable material release;
- Hazards Analysis to quantify the consequences of various hazards scenarios (Fire, Explosion [due to release of NG/Crude]. Establish minimum value for damage (e.g. IDLH, Over Pressure, Radiation Flux) to assess the Impact on Environment.
- Risk Quantification: Quantitative techniques are used considering effect / impact due to weather data, population data, and frequency of occurrences and likely hood of Ignition / Toxic release. Data are analyzed considering likely Damage (in terms of Injury / Fatality,Property Damage) each scenario is likely to cause.

QRA provides a means to determine the relative significance of each of a number of undesired Events, allowing Analyst and the Team to focus their Risk Reduction Efforts, which will be most beneficial.

7.2.2 Identification of Hazards in Drilling and Production Testing and Processing Plant Operations

Various hazards associated with onshore hydrocarbon drilling and testing operations as well as from gas processing plants are briefly described in the following sub-sections.

(a) Minor Gas Leakage

Testing at Well Site: Drill Stem Testing may lead to Gas leakage from Lines, Valves, or Separator or may also release gases due toTank failure.

During the well testing operation, there exists a possibility of Hydrocarbon (gases / oil) getting released due to some unavoidable incidents.

Hazards in the Gas Processing Facility will be mostly from HC gas leakage and also from chemical spillage. The leakage from process equipment (flange connections/instrument tapings or catastrophic equipment flange failures) can occur. The rate of leakage will depend upon system pressure, depth and opening size.

(b) Major Gas Leakage

Significant hydrocarbon inventories will be maintained at the rig. A major leakage can, therefore, only arise as a result of an uncontrolled flow from a well i.e.Blowout. Provided that ignition does not take place and the well head is not obstructed the well can be shut in at the wellhead.

(c) Blowout

Blowout means uncontrolled violent escape of hydrocarbon from a well. Blowout followed by ignition, which prevents access to the wellhead is a major hazard. Contributors to blowout are:

Primary

- Failure to keep the hole full;
- Mud weight too low;
- Swabbing during trips;
- Lost circulation; and
- Failure of differential fill-up equipment.

Secondary

- Failure to detect and control a kick as quickly as possible;
- Mechanical failure of BOP;
- Failure to test BOP equipment properly;
- Damage to or failure of wellhead equipment;
- Failure of casing; and
- Failure of formation or bond of cementing around casing.

If the hydrostatic head exerted by the column of drilling fluid is allowed to drop below the formation pressure then the hydrocarbon will enter the wellbore (this is known as a kick) and a potential blowout situation might be developed.

Fast and efficient action by operating personnel in recognizing the above situations and taking precautionary measures can avert a blowout.

7.2.3 Project Operations

The proposed project will be located in RJ-ON/6 block of Jaisalmer sub-basin in Jaisalmer District of Rajasthan State. The Geographical coordinates of PML block are given in Table 63

Table 63. Co-ordinates of the RJ-ON/6 block

Points	Latitudes			Longitudes		
	Degree	Minutes	Second	Degree	Minutes	Second
A	27	14	12.77	69	46	13.75
B	26	49	33.87	69	32	35.89
C	26	42	0.15	69	56	50.49
D	27	5	55.39	70	8	1.75
E	27	18	43.44	69	55	11.29
F	27	16	43.61	70	1	4.15
G	27	13	32.55	69	59	0.28
H	27	16	8.78	69	53	58.58

I (PEL Area)	27	20	31.63	69	52	14.61
J (PEL Area)	27	10	21.94	70	22	33.58
K(PEL Area)	26	29	1.89	70	30	34.76
L(PEL Area)	26	24	56.84	70	14	41.37
M(PEL Area)	26	36	0.71	70	14	44.28

The fuel for the drilling rigs, operation of the gas processing facility, DG sets, other machineries and vehicles will be Diesel (HSD with low sulphur <0.05%). Daily fuel requirements for diesel sets & other machineries will be 2500 l/day/well. The HSD storage capacity will be 50000 liters. The exhaust stacks of the DG sets are likely to vent the emissions. The Bulk Hazardous Chemical Storage Facility at Drilling Site is given in Table 64

Table 64. Bulk Hazardous Chemical Storage facility at project site

Compound	**Quantity to be Stored**
HSD (Low Sulphur)	50,000 liters

7.2.4 QRA Approach

Identification of hazards and likely scenarios (based on Level-1 and Level-2 activities) calls for detailed analysis of each scenario for Potential of Damage, Impact Area (may vary with Weather Conditions/Wind Direction) and Safety System in place. Subsequently each incident is classified according to Relative Risk Classifications provided in given below Table 7.3.

Table 65. Risk Classification

Stage	**Description**
High (>1/100)	A failure which could reasonably be expected to occur within the expected lifetime of the plant. Examples of high failure likelihood are process leaks or single instrument or valve failures or a human error which could result in releases of hazardous materials.
Moderate (1/100 to 1/1000)	A failure or sequence of failures which has a low probability of occurrence within the expected lifetime of the plant. Examples of moderate likelihood are dual instrument or valve failures, combination of instrument failures and human errors, or single failures of small process lines or fittings.

Low (<1/1000)	A failure or series of failures which have a very low probability of occurrence within the expected lifetime of plant. Examples of low likelihood are multiple instruments or valve failures or multiple human errors, or single spontaneous failures of tanks
Minor Incidents	Impact limited to the local area of the event with potent for "knock-on-events".
Serious Incident	One that could cause: ● Any serious injury or fatality on/off site; ● Property damage both onsite & offsite
Extensive Incident	One that is five or more times worse than a serious incident.

a) Damage due to Explosion

The explosion of oil or gas (either as a deflagration or detonation) results in a reaction front moving outwards from the ignition source preceded by a shock wave or pressure front. After the combustible material is consumed the reaction front terminates but the pressure wave continues its outward movement.Blast damage is based on the determination of the peak overpressure resulting from the pressure wave impacting on the object or structure. Damage estimates based on overpressure are given in Table 66 below:

Table 66. Damage due to Overpressure

S. No.	Overpressure (bar)	Damage
1.	0.04	Loud Noise/sonic boon glass failure
2.	0.15	Typical pressure for glass failure
3.	0.5-1	Large and small windows usually shattered
4.	0.7	Minor damage to house structure
5.	1	Partial demolition of houses, made uninhabitable
6.	2.3	Lower limit of serious structure damage
7.	5-7	Nearly complete destruction of houses
8.	9	Loaded train box wagons completely demolished
9.	10	Probable total destruction of houses
10.	200	Limits of crater lip

b) Thermal Incidents/ Fire in Storage Area

The diesel storage in the drilling site is limited to 50000 L. Any fire in the tank area if not controlled in time (less chances/ unlikely) may soon spread to the rig site as well as to the gas processing facility. During blow out, Natural Gas coming out with some oil can also catch fire. However its thermal radiation impact (1st degree burn) will be limited (as the fuels are stored in a remote place).

Minor leakage can occur as various scenarios and may also catch fire. If fire is not controlled these can lead to domino effect as major scenarios. During the drilling, crude oil production will be nil or very limited; some well water may come out which can be treated and disposed off or pushed back in the non producing well. The likely impact due to major scenario considered as given below in Table 67.

Table 67. Possible Major Scenarios

S.No.	Scenario	Impact Zone	Remarks
1.	HSD Tank failure, spillage & Fire	~8.5 m	From edge of pool

The impact due to the above scenarios will be within the block having sand dunes and sparse desert shrubs.

7.2.5 Mitigation Measures

Control Measures for Major Hazards

Out of different hazards described in sections 6.2 above, occurrence of Blowout, HSD spillage/ fire, leakage of gases are the major hazards. The first and last possible incident can have built in alarm and preventive measures (as more likely to occur if system fails). The second incident has remote chances and more likely due to some domino effect caused by other incident.

(a) Blowout

The precautionary and control measures used for blowout prevention are discussed below:

A. Precaution against Blowout

(i) The following control equipments for Drilling Mud System shall be installed and kept in use during Drilling Operations to prevent the Blowout:

- A Tank Level Indicator registering increase or reduction in the Drilling Mud Volume and shall include a visual and audio –warning device near the Driller Stand.
- A device to accurately measure the volume of Mud required to keep the well filled at all times.
- A Gas Detector or Explosimeterat the Primary Shale Shaker and connected to audible or visual alarm near the Driller Stand.
- A device to ensure filling of well with Mud when the string is being pulled out.
- A control device near driller stand to close the Mud Pump when well kicks.

(ii) BOP Drill shall be carried out as per OMR & OISD.

(iii) BOP Control Unit shall be kept available near the well which can be used in case of Emergency to control the Well.

(iv) When Running In or PullingOut tubing, Full Opening Safety Valve (FOSV) shall be kept

readily available at rig floor.

B. Precaution after Blowout

On appearance of any sign indicating the Blowout of well, all persons, other than those whose presence is deemed necessary for Controlling Blowout, shall be withdrawn from the Well. During the whole time while any work of Controlling a Blowout is in progress, the following precautions shall be taken:

(i) A competent person shall be present on the spot throughout.

(ii) An area within the 500 meters of the well on the down wind direction shall be demarcated as Danger Zone.

- All Electrical Installations shall be de-energized.
- Approved Safety Lamps or torches shall only be used within the Danger Zone.

- No Naked Light or Vehicular Traffic shall be permitted within the Danger Zone.

(iii) A competent person shall ascertain the condition of ventilation and presence of gases with an approved instrument as far as Safety of persons is concerned.

(iv) There shall be available at or near the place, two approved type of self-containing breathing apparatus or any other breathing apparatus of approved type for use in emergency.

(v) Adequate Firefighting Equipment shall be kept readily available for immediate use.

(b) Leak Detection and Repair Program (LDAR)

The proposed project will use pipelines, vessels, compressors, pumps, valves and other fittings for transfer and processing of gas. To reduce fugitive emissions in the plant, proper Leak, Detection & Repair (LDAR)program is required in the facility.

The proposed LDAR program is as follows:

- Identification of sources: Valves, pipes, joints, pump and compressors seals, flanges etc.
- Monitoring of Gas/VOC is to be carried out regularly through permanent Gas monitors at strategic locations and also portable gas detectors. Monitoring frequency should be once in a quarter is required.
- Focus should be for prevention of fugitive emissions by having preventive maintenance of pumps, valves, pipelines etc. A preventive maintenance schedule should be prepared and it should be strictly adhered to.
- When monitoring results indicate Gas/VOC above permissible limit repairing should be done immediately. The repair should be conducted in such a way that there is no fugitive emission from the particular component.

Fugitive Emission

The following guidelines for fugitive emissions should be strictly followed:

- Fugitive emissions over and around vessels and other machineries transfer areas etc. should be monitored regularly.
- Enclosures to chemical storage area should be provided.
- Vapor balancing, nitrogen blanketing, isolated tanks etc., should be provided. Special care will be taken for odorous chemicals.

(c) Control Measures for H_2S during drilling

Presence of Sour Gas (H_2S) in hydrocarbon during blowout of well can pose immediate dangers to life and health at and around the rig area. On ignition, H_2S is converted to sulfur dioxide (SO_2) which is also highly toxic. Therefore, a safety system should be in place to monitor H_2S.

1. H_2S detection System

A four channel H_2S gas detection system should be provided. Sensors should be positioned
at optimum points for detection, actual locations being decided on site but likely to be at or
near to:

- Well Nipple
- Rig Floor
- Shaker header tank
- Substructure cellar

The detection system should be connected to an audio visual (siren and lights) alarm system. This system should be set to be activated at a concentration of 15 ppm H_2S.
The mud logging will have a completely independent detection system which is connected to an alarm in the cabin. This system will be adjusted to sound an alarm at a concentration level of 10 ppm H_2S as suggested in the Drilling and Production Safety Code for Onshore Operators issued by The Institute of Petroleum.
A stock of H_2S scavenger will be kept at drilling site for emergency use.

2. Small Levels of H_2S

Small levels of H_2S (less than 10 ppm) will not activate the well site alarms. Such levels do not create an immediate safety hazard but could be a first indication of high levels of H_2S to follow.
H_2S will cause a sudden drop of mud pH. The mud man will therefore organize and supervise continuous pH checks while drilling. Checks should be as frequent as required depending on ROP and always made following a formation change.

Following control measures will be taken in case of small level of detection:

- Add H_2S scavenger to mud.
- Check H_2S levels at regular intervals for possible increase.
- Inform all personnel of the rig about the presence of H_2S and current wind direction.
- Commence operations in pairs.
- Render sub base and cellar out-of-bounds without further checking levels in this area.

3.. High Levels of H_2S

Higher levels of H_2S (greater than 10 ppm) do not necessarily cause an immediate safety hazard. However some risk does exist and, therefore, any levels greater than 10 ppm should be treated in the same manner. Occurrence of 10 ppm or greater H_2S concentration will sound an alarm in the mud logging unit.

If higher levels of H_2S greater than 10 ppm are found, following steps will be taken:

- Driller to shut down rotary and pumps, pick-up the string so that drill pipe is in the BOP and chain down the break;
- One pre-assigned roughneck will go to the doghouse and put on the breathing apparatus. All other rig personnel will evacuate the rig and move up wind to designated muster points;
- Driller and roughneck will return to the rig floor and commence circulating H_2S scavenger slowly and reciprocating the pipe string;
- The level of H_2S will be checked in all work areas. H_2S scavenger will be added to the mud and circulated. If H_2S levels drop, drilling will be continued with scavenger in the mud. Approximately 30 % of peroxide (H_2O_2) solution will neutralize H_2S gas in the mud at 20 gallon of H_2O_2 per 100 barrels of mud; etc.

4. Control Measures for H2S During Testing

H_2S scavenging chemicals (caustic soda solution, calcium hydroxide or iron oxide slurry) will be continuously injected in the recovered gas/oil/formation water after pressure reduction through choke before sending the same to separator.

(d) Benzene Emissions

Crude oil and natural gas condensate contain benzene although the concentration varies considerably depending on the geology and location of the well site. Drilling fluids may contain benzene and can also become contaminated with benzene when they are recirculated down the well. Benzene and other hydrocarbons are produced from stacks, flares, hydrocarbon storage facilities, glycol dehydrators and other operations that involve crude oil or fuels. In the upstream oil and gas sector, glycol

dehydrators are the primary source of benzene emissions. Benzene is toxic and a carcinogen.

As per ERCB Directive 39 Revised Program to Reduce Benzene Emissions from Glycol Dehydrators there is a requirement to: inventory glycol dehydrators and submit information to the ERCB annually; reduce emissions; and complete and maintain a DEOS (Dehydrator Engineering and Operations Sheet) at each dehydrator (that must be posted at the dehydrator for use by operations staff and inspection by the ERCB). The purpose of the benzene reduction initiative is a joint effort between the ERCB and Alberta Environment to establish mandatory requirements to reduce potential impact on the public.

This procedure provides the basis for benzene emission management and should be supplemented with a site specific procedure when deemed appropriate. This procedure will provide an overview of the following:

- Worker responsibilities and training requirements;
- Benzene characteristics;
- Benzene exposure limits;
- Glycol dehydrator emissions limits (ERCB);
- Operating procedures.

1. Responsibilities and Training

For each work site where benzene exposure is a hazard (e.g. sites with glycol dehydrators) the work site supervisor will communicate the hazards and follow this operating procedure and/or develop a site specific procedure.

2. Benzene Characteristics

- Benzene is classified as a toxic substance and is a carcinogen.
- Benzene is a clear, colorless liquid with a sweet odour. The odour threshold is around 60ppm but varies from 0.78-160ppm.
- Benzene is extremely flammable (flash point is -11 degrees Celsius).
- The flammable range of benzene is 1.2-7.8 percent.
- Pure vapour is heavier than air.
- The liquid is lighter than water and floats on top of water if mixed.

(e) Fire Fighting Facility

Fixed Fire Fighting System as per Oil Industry Safety Directorate (OISD) Standard 189 should be in place.

Fire Water System

- One water tank/pit of minimum capacity of 40m^3should be located at the Drilling Rig Site and near the gas processing facility.

- For production testing, one additional tank of 40m^3should be provided.
- One diesel engine driven trailer fire pump of capacity 1800 lpm should be placed at the approach area of drilling site.
- One fire water distribution single line with minimum 4 inch size pipe/casing should be installed at a drilling site with a minimum distance of 15 m from the well.

First Aid Fire Fighting Equipments at Drilling Rig

Portable Fire Extinguisher will be installed as per IS: 2190 on the Drilling Rig. The minimum quantities of fire extinguishers at various locations should be provides as per the following.

Table 68. Fire Extinguishers Distribution

S.No.	Type of Area	Portable Fire Extinguishers
1.	Drilling Rig Floor	2 no. 10 kg DCP type Extinguisher
2.	Main Engine Area	1 no. 10 kg DCP type Extinguisher for each engine
3.	Electrical motor/pumps for water circulation for mud pump	1 no. 10 kg DCP type Extinguisher
4.	Mud Gunning Pump	1 no. 10 kg DCP type Extinguisher
5.	Electrical Control Room	1 no. 6.8 kg CO_2 type Extinguisher for each unit
6.	Mud mixing tank area	1 no. 10 kg DCP type Extinguisher
7.	Diesel Storage Area	1 no. 50 liter mechanical foam
		1 no. 50 kg DCP type Extinguisher
		2 no. 10 kg DCP type Extinguisher
		2 nos. Sand bucket or ½ sand drum with spade
8.	Lube Storage Area	1 no. 10 kg DCP type Extinguisher
		1 no. sand bucket
9.	Air Compressor Area	1 no. 10 kg DCP type Extinguisher
10.	Fire Pump Area	1 no. 10 kg DCP type Extinguisher
11.	Near drilling In-charge	One fire extinguisher/shed with 3 nos. 10 kg DCP

	office	type extinguisher and 2 sand buckets
12.	Fire bell near Bunkhouse	1 no. 10 kg DCP type Extinguisher

7.2.6 Occupational Health

Occupational hazards associated with oil and gas projects include exposure to hazardous substances noise, vibrations, heavy manual handling activity at the site etc.

At the project location, qualified doctors will be available 24 hrs on for the Immediate Treatment and First Aid. For serious injuries and diseases patients are evacuated by the Emergency Vehicles exclusively meant for Emergencies to the Nearest Medical Center.

Health Hazard Control is done by adopting following measures:

- Prioritize the health hazards based on their risk potential.
- Identify specific work groups affected by each hazard.
- Determine the controls required to manage these identified hazards. The cost of each identified control versus benefits of its implementation may be evaluated.
- Develop an action plan identifying work to be done.

The health and hygiene of the personnel working at the project location for a long period will be monitored through periodic health checks of the persons. All employees will undergo a periodic medical examination. The record of the health check-up will be maintained centrally off site in a confidential file by the medical section. The medical officer at base recommends appropriate treatment for the persons found to be having any Health Problems requiring attention.

During the proposed operations, inspections of cleanliness will be carried out. First aid boxes will be provided at different strategic locations on the drilling rig as well as the gas processing facility. The medical officer on board shall regularly inspect the First Aid Boxes and ensure that their contents are in order. Majority of the employees on the project site will be trained in First Aid. Regular Drills and

Lectures on First Aid will be carried out. Occupational Health Surveillance Program is summarized in Table 69.

Table 69. Occupational Health Hazard and mitigating measures

Cause of Health Hazard	Risk	Mitigation Measures
Noise (Generators, Cranes, Rig, Movement of vehicles, etc)	Hearing Loss	Use of PPEs in high noise area and written Standards Operating Procedures (SOP) will be followed. Procedures will be followed as per Material safety Data Sheet (MSDS) of all hazardous chemical for safe handling.
Handling of heavy equipment and material (Manual handling of material)	Back Problem	
Handling of chemicals (Chemical stores, Chemical dosing areas, Chemical labs, etc)	Eye problems and chemical ingestion, dermal effect of chemicals	

7.2.7 Frequency of Occurrence of Accident Scenario

Frequency of Occurrence of incident is important in risk analysis. Standards Operating Procedures (SOP), Proper Maintenance and Safety Precaution reduce the Frequency of occurrence of such Incident. The data sources referred for failure frequency is E&P Forum (Oil Industry International Exploration & Production Forum) frequency data base from TNO ("Toegepast Natuurwetenschappelijk Onderzoek", a Netherlands Organisation for Applied Scientific Research) and Failure Frequency Data from the Rijmond Report (COVO Study, "Risk analysis of six potentially hazardous industrial objects in the Rijmond area, a pilot study", prepared and submitted by COVO (Dutch abbreviation for Commission for the Safety of the Pollution at large) Commission report to the Rijmond public authority, Netherlands). The frequency occurrences for various scenarios are given below in Table 70.

Table 70. Frequency occurence for various accidents scenarios

S.No.	Scenarios	Frequency of Occurence
1.	Catastrophic failure of largest nozzle connection in HSD tank	1/1,000,000 per tank per year
	Probability of Ignition	
	• Immediate Ignition	65/1000

	● Delayed Ignition	65/1000
	● No Ignition	87/1000
2.	Catastrophic failure of Tank	67/1,00,00,000 per tank per year

Safety precaution, proper maintenance of equipments and risk mitigation measures adopted in storage and handling of inflammable materials will reduce the probability of occurrence of hazardous incident.

7.2.8 Conclusions

- Hydrocarbon Vapour Concentration Detector should be installed at some critical locations.
  Lower Flammability Limits (LFL) for some gaseous hydrocarbons are as under:

Table 71. LFL for some hydrcarbon gases

Compound	**LFL (% in air)**
Methane	5.0
Ethane	3.0
Propane	2.1
Butane	1.6

- Smoke sensors and thermal detectors are to be installed at Strategic Locations on the Rig and in the Gas processing facility.

7.3. Disaster Management Plan (DMP)

7.3.1 Introduction

For meeting the emergencies caused by major accidents, planning response strategies are termed as Disaster Management Plans (DMPs). DMPs cannot be considered in isolation or act as a substitute for maintaining good safety standards in a plant. The best way to protect against major accidents occurrence is by maintaining very high levels of safety standards.

7.3.2 Statutory Requirements

- Oil Mines Regulation, 1984 of Mines Act 1952: Contingency plan for Fire shall be prepared for any oil installation – OMR 72.
- Environment Protection act and the rules:In exercise of the provisions under the Environment Protection Act 1986, the “Manufacture, Storage and Import of Hazardous Chemicals Rules“ came into force in November 1989. Under these rules, “Preparation of

On-Site Emergency Plan" is covered in Rule No. 13 and "Preparation of Off-Site Emergency Plan" in Rule No. 14.

7.3.3 Emergency Classification

Severity of accident and its likely impact area will determine the level of emergency and the disaster management plan required for appropriate handling of an emergency. Emergency levels and the action needed for each level are indicated below:

Level 1 Emergency

A local accident with a likely impact only to immediate surroundings of accident site such as, local fires and limited release of inflammable material. The impact distance may not be more than 15 m from the site of primary accident and may require evacuation of the drilling area where accident occurred and utmost the adjacent drilling rig/facility.

Level 2 Emergency

A major accident with potential threats to life and property upto 500 m distance requiring the evacuation of all personnel from the threatened area except the emergency response personnel. Larger fires, release of large quantities of inflammable materials may belong to emergency level 2.

Level 3 Emergency

An accident involving a very serious hazard and with likely impact area that extends beyond the operational area limit of drilling rig or the gas processing facility, such as, major fire, very large release of inflammable material and big explosion. Major fires will usually have the triggering effect resulting in the propagation of explosion. In a level 3 emergency, evacuation of all personnel on site is carried out.

On-site Disaster Management Plan (DMP) will meet the hazards created due to all Level 1 emergencies and most of the Level 2 emergencies. In addition to on-site DMP, off-site DMP may also have to be put into operation for some Level 2 and all Level 3 emergencies.

7.3.4 Methodology of DMP Preparation

A DMP is usually prepared in two parts: On-site DMP and Off-site DMP.

The On-site DMP is administered by the owner or occupier of the hazardous plant/installation, Focus Energy Limited in the present case. The management may seek the assistance of other agencies, namely, District authorities and fire brigade, police and health authorities, if considered necessary.

The off-site DMP is normally administered by the statutory authorities / District Magistrate with the assistance of other relevant authorities.

Level 2 Emergency will require evacuation of plant personnel and drilling workers from a limited area on the project site. Level 3 Emergency requiring evacuation of surrounding population may only include onsite workers in this case as there are no habitations within the block area. Even under the worst accident scenario, evacuation of less than 80 persons may

be involved and damage, if any, to nearby installations is expected to remain confined within the project site.

7.3.5 Emergency Response Group

The Emergency Response Group (ERG) is responsible for coordinating the response relative to "Level" of emergencies arising out of exploration activities. The ERG is activated by the DMP leadership and will organize the response accordingly. If assistance is needed from outside the needful action will be initiated.

Emergency Response Centers

The Control centers will be setup both at the Drilling Rig and the Gas Processing Facility locations.

Incident Control center (ICC) will be set up at the well site and the processing plant. It will have direct communication facilities (radio, satellite telephone and also messenger) with the nearby Main Control Room (Base office). Any assistance both in-house and external required will be communicated to the Main Control Center (MCC).

Main Control Center (MCC) will be set up at the base office. It will always be in touch with the drilling site and the processing facility at all times. All supplies and logistics support is provided by the base offices. It becomes all the more important during emergencies. MCC will be in touch with

- Fire and Rescue groups of nearby district authorities/ home guard/ police and other authorities
- Medical groups
- State authorities
- Logistics suppliers
- Other support personnel

MCC will be well equipped with

- Communication equipments (telephones, radio system and also messenger)
- Transport facilities
- List of personnel at barge, their addresses, medical records etc.
- HAZCHEM and storage data of all hazardous chemicals at site and camp.

7.3.6 On-Site Disaster Management Plan

The challenge to a company providing services to Hydrocarbon Industry is to conduct its activities in such a manner that the associated risks are acceptable to the statutory authorities, community and oil company itself. FOCUS ENERGY LIMITED is committed to the idea that:

a) Most accidents are preventable.

b) Creation of safe and healthy working condition at work place is as important as cost, quality, productivity etc.

c) FOCUS ENERGY LIMITED will always strive to reach for superior standards from acceptable standards where so required.

The HSE Management System seeks to achieve the maximum improvement in accident prevention and protection of the environment at all times. The HSE Management system includes more than accident prevention, however. It recognizes the close relationship between personal safety and the protection of damage to rig equipment, of the environment both down hole and at the surface, through fire careless acts, unsafe methods, or a lack of adequate protective measures. Occupational safety and health problems are of concern from top management to the individual worker.

The program recognizes that employee health is important to employee performance and the company feels a serious responsibility in this regard. A major objective of the HSE program is the maintenance of a healthful work environment and the program is concerned with all matters affecting the well being of each person whether the person is an employee, visitor, contractor or member of the community in which FOCUS ENERGY LIMITED operates.

FOCUS ENERGY LIMITED will nominate a person as General Manager, HSE who will be overall in-charge of HSE Management System and will be responsible for implementing the HSE policy of the management.FOCUS ENERGY LIMITED considers accident, fire prevention, good industrial hygiene and protection of the environment through the use of Safe Working Practices to be a vital part of every job and the responsibility of every employee. The actual prevention of on-the-job accidents is the overall responsibility of the Site HSE Engineer.

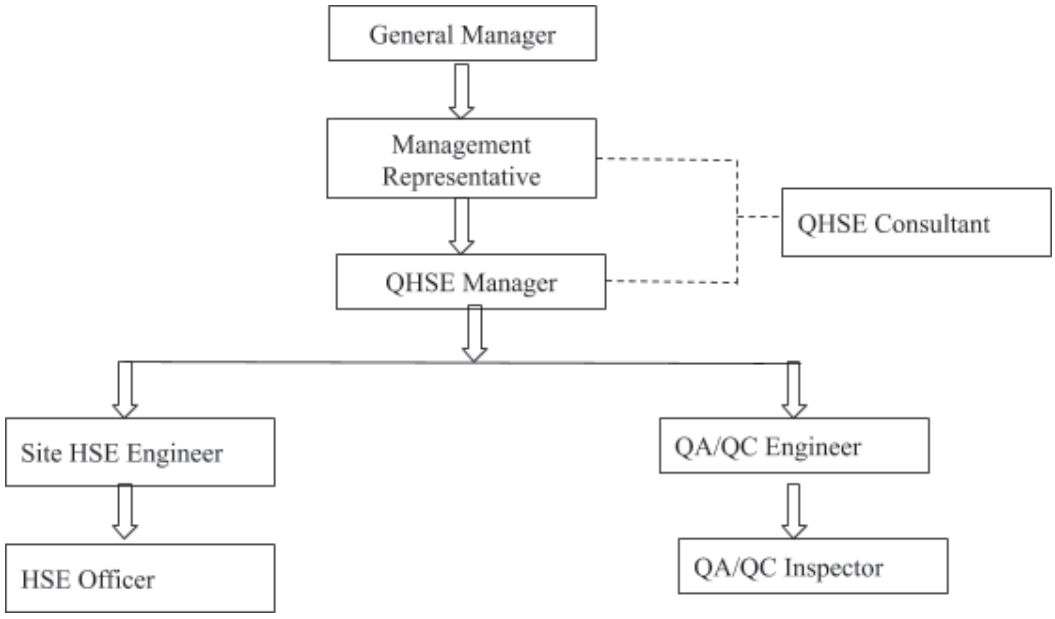

Figure 36. Organizational Set-Up for the On-Site DMP

HSE Program Administration

• It is the responsibility of the Production Manager, in consultation with employees and support from senior management, to coordinate the preparation, implementation and maintenance of the HSE Program. HSE contractors should be used to provide HSE training and support. The following points will guide the administration of the HSE Program:

• The HSE Program will be contained in a binder that is clearly labeled, easy to use, readily available and includes a table of contents. Hard copies of the HSE Program are controlled. Soft copies or electronic copies are considered current as of the date sent.

• The intent of the HSE Program is to outline various procedures that are to be used as a guide to establishing and maintaining a safe work site. The HSE Program procedures are based in part on regulatory requirements and accepted industry practices, but are not intended to be used in substitution of those requirements.

• Employee input is integral to the HSE Program. The opportunity for employees to provide input encourages support of the HSE Program. Employees offer valuable insight because of their skills and hands-on experience with the work. Employee support is necessary because employees will be most greatly affected by the HSE Program.

• Every employee directly involved with field operations will receive and become familiar with the HSE Program. The Acknowledgment forms must be signed upon receipt of the HSE Program and tracked by administrative staff to ensure updates are distributed appropriately.

• The HSE Program is a living document. As regulations, industry standards or FOCUS ENERGY LIMITED operations change, the HSE Program will be revised and updated. Employees are encouraged to submit (verbally or in writing) improvements or changes to the HSE Program that will more accurately reflect work site conditions.

• The date (month and year) will be shown in the footer of each component. Revisions will be sent out with a Revision Log that summarizes the changes and provides insertion instructions. Outdated sections/materials will be disposed of as soon as updates are received.

• An up-to-date list of employees directly involved with field operations and full-time contractors (contract operators or other) will be maintained in the office and each individual will receive a copy of the HSE Program. The list will be used to distribute revisions.

• A HSE Report will be prepared monthly and submitted to all staff directly involved with operations. A quarterly summary will be provided to the Board of Director's.

• Copies of applicable HSE legislation and regulations will be maintained in hardcopy form at the office or should be accessible through the internet.

• Specific oil and gas regulations should be available at field locations in hardcopy or should be accessible through the internet.

Responsibilities of General Manager/Management Representative

The responsibilities of General Manager will be as under:

- Set up an Emergency Control Centre (ECC) to direct emergency operations.
- Inform District Authority, Medical Authority, Mines Authority and OISD.
- Determine the severity of accident; declare appropriate emergency level and changing the emergency level, if considered essential.

- Exercise direct control of units not affected by accident.
- Determine most probable course of events by continuously reviewing and assessing the developments.
- Direct the safe shutting down of the installations in consultation with Site Engineer and other important officers, if necessary.
- Ensure proper evacuation and treatment to injured personnel.
- Liaison with MCC (for all sort of supplies and support).
- Maintain emergency logbook.
- Issue authorized statements to authorities/media.
- Look after safe operation of the project and rehabilitation of affected persons.
- Declare all clear situations after the emergency is cover.

Responsibilities of Site HSE Engineer

The responsibilities of Site HSE Engineer be as under:

- Assess the severity of the accident/incident.
- Initiate emergency actions to ensure the safety of personnel and minimum damage to the installations and material.
- Direct rescue and fire-fighting operation.
- Search for casualties.
- Evacuation of non-essential personnel to the assembly area.
- Give information and advice to external emergency services working at the site.

Responsibilities of HSE Officer

The responsibilities of HSE Officer will be as under:

- Provide all possible services to General Manager so as to enable him to concentrate fully to handle the emergency.
- Provide first aid to injured persons.
- Evacuate seriously injured persons to hospitals.
- Ensure safe shut down of the installations, if necessary.
- Direct precautionary measures to eliminate propagation of accident in unaffected areas.
- Ensure availability of water, power, necessary equipments and materials for tackling emergency.
- Organize an efficient communication system with the base office; between rig or gas processing facility and outside agencies.
- Regulate movement of emergency services in and out of the operational area.

Warning System

A high pitch warning system should be made available within the operational area for announcing the emergency and giving the all clear signal. GM will declare the emergency level and operational personnel will be notified about the nature of the emergency by using alarm system in the following manner:

Level 1 Emergency – Single beep every five seconds
Level 2 Emergency – Double beep every five seconds
Level 3 Emergency – Continuous wailing of alarm

Emergency Plan Initiation

On declaration of emergency,GM, HSE Engineer/Officer and will take charge in their respective control
rooms and confer with one another about the best way to deal with the emergency.
Emergency response personnel will report to their respective control centers and immediately take charge of their duties as enumerated in Sections 7.3.6. It is of paramount importance that the measures to contain and control the accident as well as those for rescue and evacuation are implemented immediately.

7.3.7 Emergency Procedures

Level 1 Emergencies

Accident is small and isolated and does not require the shutdown of any installation/unit of operation/rig. Effort shall be made to arrest its propagation. Level 1 fire may be extinguished with water, sand or fire extinguishers. Level 1 hazardous chemical release, if any, can be contained and controlled quickly without requiring shut down of any installation/unit or the evacuation of persons working in the affected area.

Level 2 Emergencies

The affected unit will be brought to a safe shut down while continuing emergency supplies of water and power. Level 2 fires will be extinguished by mobilizing water and foam extinguishers. Level 2 hazardous chemical release, if any, will require evacuation of personnel working in downwind direction towards upwind or cross wind direction to minimize the injurious effect of hazardous gas release.

Level 3 Emergencies

Level 3 emergencies may not be applicable to this proposed project site.

Assembly point

At every drill site, assembly point is identified as Safe Assembling point during an emergency. People working in the field and who do not have any direct role in Emergency Situation will quickly assemble here and wait for any instructions from the SMC, SIC or ATC.

Accident Site Clean Up

While cleaning the site after explosion and fire accidents, care shall be taken against the probability of leaving any hazardous / or any other materials. Information regarding the cleaning up of spills of hazardous materials, if used, is available in material safety data sheets.

Emergency Response Personnel Safety

All emergency response personnel from in-house and outside agencies shall enter the accident site under instruction of SIC. These persons shall invariably wear appropriate protective gear, such as, fire suits, helmets, boots, respirators and gas masks, before entering the accident site.

All Clear Signal and Public Statement

For Level 1 and 2 emergencies Site Main Controller will authorize an all clear signal in the form of long high pitched alarm with intermittent pauses, say, two minutes alarm followed by

one minute pause repeatedly. Public statements regarding the emergency will be issued only by SMC.

7.3.8 Responding to an Emergency

Generally, the following five phases are involved in an emergency:

- **Discovery and Notification:** An event with an imminent threat of turning into an accident must first be discovered and the discoverer quickly notifies the same to the plant safety officer and the Duty Officer.
- **Evaluation and Accident Control Initiation**: Based on the evaluation of available information, the safety officer makes a rapid assessment of the severity of the likely accident and initiates the best course of action.
- **Containment and Counter Measures:** Action is first taken to contain and control the accident by eliminating the causes which may lead to the spread of accident. Measures are also taken to minimize the damage to personnel, property and environment.
- **Cleanup and Disposal:** After the accident is effectively contained and controlled, the cleanup of the site of the accident and safe disposal of waste generated due to the accident are undertaken.
- **Documentation:** All aspects of accidents, including the way it started and progressed as well as the steps taken to contain and the extent of the damage and injury, must be documented for subsequent analysis of accident for prevention in future, damage estimation, insurance recovery and compensation payment. It may be noted that some aspects of documentation, such as, photographs of the site of accident and main objects involved in the accident, survey for damage estimation, etc. may have to be carried out before the cleanup and disposal phase. However, the effort in all cases is to recommence the production as soon as possible.

  Emergency procedures in the event of blowout

  A blow out situation is a consequence of uncontrolled flow of oil / gas and there is likelihood of fire being triggered off. To tackle such an emergency situation the flow of action can be divided into following two steps.

  Step-I: Action on the spot- On-site.

  Step - II: Action of Asset in co-ordination with Basin.

  The various functions with regard to these steps have been elaborated in the form of action flow sequences and kick control procedures. With a view to avoid overlapping of functions, the various actions required to be taken during a blowout have been identified and the personnel responsible for taking actions have been specified.

The position of blowout well being different in different cases the exact action plan of work to control the blowout spill / blowout fire and for capping of the well would be finalized by competent authorities of the Asset / Basin / Headquarters.

Functions of On-Scene Coordinator (OSC)

Take charge of the situation at the rig and follow the standing instruction given below

- Evacuate all personnel to safe site.
- Switch off engines and generators.
- Remove and secure all well records.
- Avoid and extinguish all naked flames / sparks.
- Pull out all inflammable materials i.e. HSD, Petrol, Gas Cylinders, Chemicals etc. from well premises.
- Pull out all possible equipments to safe distance.
- Start spraying water on well mouth to keep it cool.
- Cordon off the area and do not allow entry of any unauthorized person. Allow only the persons directly involved in operations to go near blowout well and maintain record of such persons.
- Intimate Emergency Control Room at base for deployment of additional manpower, materials, logistics / transport arrangements and technical support if any.
- Keep in touch with ECR through Site Control Room for update, feedback and instructions
  from base.
- Assign responsibilities to the concerned persons to control the situation.
- Evacuate all equipments and materials to safe location if required.

Make record of following information for forwarding to Emergency Control Room at base:

- Well condition.
- Position of drill string / Tubing string in the well.
- Last tubing and annulus pressure recorded.
- Number, Name and Designation of persons at site, measures initiated to meet the
- situation, details of injury / casualty, if any.

Emergency procedure for Control of Kick

A kick during drilling or work over operations is an event preceding a blowout. A blowout situation is never sudden and almost always follows after several indications or pointers. A kick is sudden outflow or upsurge of the drilling mud or work over fluid due to unexpected encountering of a gas zone or high pressure fluids, which throws out the fluids upwards out of the well bore. The kick of the out flowing fluid needs immediate remedial attention lest it assumes a more dangerous form of blowout. The remedial action by the crew and the kick control procedures are elaborated below.

Duty guidelines for Rig operational crew

All operations will be carried out under the control and guidance of the Shift In-charge / Tool Pusher, who then functions as the OSC.
When a kick is detected, the Shift In-charge will give a signal and all members of the crew will take up their respective positions. The signals will be in the form of short sirens in a continuous manner from the driller‟s console.

Table 72. Responsibilities of persons at Site

SHIFT IN-CHARGE (SIC)	● Stand on brake and control as necessary. Supervise all activities to control the situation. ● Ensure functioning of BOP and choke manifold lines. ● Ensure help is provided to Chemist in order to maintain mud parameters as directed by authorities. ● Ensure safe removal of records, men and materials to safe and secure place
ASSISTANT SIC	● Be available at control panel of BOP to operate as per direction of RM / SIC / AE(D) / AEE(D) and the guidelines issued to close BOP, install Kelly cock etc. ● Keep watch on pressure on discharge line, stand pipe and annulus pressure and increase in mud volume in the pit / tanks. ● Help Chemist in preparation of mud and maintaining mud parameters as required. ● Ensure operation of degassing unit, if any. Also keep watch for rise in mud level in the suction tank. ● Work on choke line / kill line of BOP. ● Keep watch on the float in the mud pit for loss or gain of mud and inform SIC the status and request SIC to alert site personnel of impending danger.
TOP MEN	● Both of them will work on choke-line and valves.
RIG MEN	● They will help the SIC in fitting NRV / Kelly etc. and will be available at derrick floor.
RIG ENGINEER (M)	● To be near the engine waiting for directives from SIC.
FITTER	● To be available near the pump and will give pump connection as and when advised by SIC/Chemist.
RIG ENGINEER (E)	● To be available near the BOP panel board and will attend electrical work if needed for charging the accumulators.
CHEMIST	● To liaison with SIC and calculate kill mud weight as per available data and take necessary steps to prepare mud as per requirement. It must be ensured however, it should be checked at the time of kick control and SIC should be informed of the condition.
GEOLOGIST	● To keep contact with the SIC and keep him abreast of possible reservoir condition and convey the data recorded at Mud Logging Unit.
SECURITY GUARD	● To see that no authorized person enters the site. He should remain at the drill site and not allow the villagers to assemble near the gate. He should ensure that there is no open fire nearby.

OTHERS	• To assemble near the bunk house or storehouse within full view of SIC so that any of them is summoned by SIC at the time of need. They should also ensure that there is no open fire at the site and nearby area.

After above mentioned steps are completed, all lines, valves, closed position of BOP are to be inspected by shift In-charge and certified.

Well Kick Shut in procedure for on Land and Jack up Rigs

A well kick shut in procedure for On-land and Jack up rigs as listed below is adopted from OISD STD 174.

i) Shut in procedure while drilling

1. Stop rotary
2. Pick up Kelly to clear tool joint above rotary table.
3. Stop mud pump, check for self-flow. If yes, proceed further to close the well by any of the following methods for shut in the well as shown in Table 73.

Table 73. Shut in Procedure While Drilling

S.No.	Soft Shut-in	Hard Shut-in
1.	Open hydraulic control valve (HCR valve)/ manual valve on choke line	Close Blow out Preventer. (Preferably Annular Preventer)
2.	Close Blowout Preventer	Open HCR/Manual valve on choke line when choke is in fully closed position.
3.	Gradually close adjustable/remotely operated choke, monitoring casing pressure.	Allow pressure to stabilize and record SIDPP, SICP and Pit Gain
4.	Allow the pressure to stabilize and record SIDPP, SICP and Pit gain	---------

SIDPP – Shut In Drill Pipe Pressure
SICP – Shut In Casing Pressure
FOSV - Full Opening Safety Valve

ii) Shut in procedure while tripping

1. Position tool joint above rotary table and set pipe on slips.
2. Install Full Opening Safety Valve (FOSV) in open position on the drill pipe and close it.

Following methods are recommended for shut-in the well as shown in Table 74.

Table 74. Shut in Procedure while Tripping

S.No.	Soft Shut-in	Hard Shut-in
1.	Open hydraulic control valve (HCR valve)/ manual valve on choke line	Close Blow out Preventer. (Preferably Annular Preventer)
2.	Close Blowout Preventer (Preferably Annular Preventer)	Makeup Kelly and open FOSV
3.	Gradually close adjustable/remotely operated choke, monitoring casing pressure.	Open HCR/Manual valve on choke line when choke is in fully closed position.
4.	Makeup Kelly and open FOSV	Allow pressure to stabilize and record SIDPP, SICP and Pit Gain
5.	Allow the pressure to stabilize and record SIDPP, SICP and Pit gain	---------

iii) Shut in procedure when string is out of hole

1. Close blind/shear ram.
2. Close adjustable/remotely operated choke and open HCR valve.
3. Record shut in pressure.

7.3.9 Offsite Emergency Plan

The OFF-SITE Emergency Plan for existing processing/production facilities is a compilation of various emergency scenarios. It also includes the probable impact on "off the site" due to emergency and the action plan to combat / mitigate the consequences of a disaster situation.

7.3.9.1 Assessment of Hazard leading to Off-site Emergency

Fire is the most common hazard in a Natural Gas processing operations and there are also possibilities of explosion and toxic gas dispersion which can arise due to the severe operating and storage conditions. Any incident of the above nature is likely to cause extensive damage to the plant property and personnel.

Disaster situation arising out of the hazards encountered in proposed project installations is normally not expected to affect beyond 200m. An estimated maximum area within 1.0 - 1.5 Km radius can be considered for declaration as emergency or danger zone.

Outside the premises of these installations, environmental hazards are likely to occur due to the leakage / bursting of either trunk pipeline or flow lines from wells and flaring of natural gas.

Hazard in Flow Lines: A pipeline connecting one installation to another installation is termed as a trunk line while a pipeline connecting hydrocarbon well to the installation is called as a flow line.

The trunk pipeline and almost all the well flow lines pass through desert area. The main risk in transportation of gas through pipeline is leakage of gas which may result in fire if source of ignition is present. Once, detected, the emergency procedure will be activated and remedial action will be taken to control the leak, spread of fire etc. Moreover, no major evacuation is required as pipelines are passing through non populated areas.

Hazard in Transportation: During transportation of gas through tankers, there are chances of overturning or collision of tankers. In this case, there are chances of fire. When an emergency arises the nearby police station may be contacted to cordon off the affected area and all sources of ignition are removed to safe distance to avoid fire. Nearby public is instructed not to light any source of ignition.

7.3.9.2 Disaster due to Man-made causes (Terrorist attack)

Other than above technical and operational hazards gas units also poses disasters due to manmade causes such as Terrorist attack, Bomb threats. The action plan for these scenarios is as below:

i) IED Attack

Primary rule

If a suspected device is encountered, it should not be handled and the area should be secured. Improvised explosive devices are very unstable. They are extremely sensitive to shock, friction, impact, and heat, and may detonate without warning. Even the smallest devices can cause serious injury or death.

Secondary rule

- Always assume that there is more than one device present, whether any other bomb or a device has been located.
- Package-type IEDs: Institute security procedures in receipt and dispatch section and instruct employees on how to recognize suspicious packages.
- Luggage-type IEDs: Train security personnel and employees regarding unattended packages of any type. Never pick up or open any suspicious package or piece of luggage. If an IED is discovered, call the police and do not touch the device.
- Vehicle-borne IEDs: Perform a vulnerability/threat assessment for the facility with special attention to this type of explosive delivery mechanism. Consider the use of enhanced security away from your key facilities (such as a vehicle checkpoint) or the use of bollards or barriers to block vehicular access to site entrances.

ii) Chemical Attacks

A chemical emergency occurs when a hazardous chemical has been released and has the possibility of harming people‟s health. Potentially lethal, chemical agents are difficult to deliver in deadly amounts. If released outdoors, the agents often dissipate rapidly. As such, the most lethal area for a chemical release is inside a confined space, such as a building, public place, or subway system.

Industrial chemicals, while not as lethal, can be just as effective if released in sufficient quantities.

Chemical terrorist attacks will most likely be overt because the effects of most chemical agents are immediate and obvious. Your response will have to be thought out and practiced in advance to be effective.

Evacuation

Some types of chemical emergencies will require evacuation from the immediate area. If you are up-wind and in the open then evacuate up-wind and away from the incident. Cover your mouth and nose with a damp cloth. If you have been exposed, you will have to be decontaminated by first responders.

Shelter in Place

If you are already in down-wind, you may be instructed to shelter in place or to make that decision on your own. Most likely you will only need to shelter for a few hours. The procedure includes:

- Go inside as quickly as possible shut and lock all windows and doors; turn off all HVAC equipment and any fans.
- If you have duct tape, tape over door and window cracks, vents, electrical outlets, and any opening to the outside.
- Wait for instructions from first responders before leaving.

iii) Biological Attacks

A bio-terrorist attack could happen in any workplace, yet most company personnel know little about potential bio-toxins or bio-pathogens or how to recognize these agents and respond in the event of an attack.

There are several ways a bio-terrorist event may manifest itself. The biological event may result from a covert attack. A covert attack may be unleashed by the receipt of an object, such as a package or piece of mail, accompanied by a warning or threat. For example, release of a biological agent could occur through delivery of a package contaminated with anthrax spores or another pathogen. Biological agent release also could occur via the ventilation system (HVAC) in a building, where dispersal could take place within a matter of minutes. Because the covert release is not witnessed, the effects of such an event can be widespread and difficult to isolate or recognize.

While terror is intended to produce casualties, disruption, and fear, the use of biological agents is particularly injurious. Biological attacks are delayed events. The sudden appearance of generalized symptoms in victims who present themselves to medical providers may initially disguise the true source of exposure. Only when a trickle of patients turns into a flood or mysterious pathogens quickly make their presence felt does the magnitude of the event reveal itself.

The goal of the medical care community (i.e., hospitals, physicians, and other health care providers) is to recognize and diagnose the disease (which frequently may be unfamiliar to most clinicians) and to provide treatment. The goal of public health authorities is to detect and control the outbreak of the illness. Public health officials will focus on identifying and treating exposed persons and preventing the spread of disease.

In response to a covert release, it is important for health officials to recognize the signs and symptoms of an emerging disease among employees. If an overt release is recognized, take immediate action to isolate the exposed employees and/or area of agent dispersion and to remove others from the area of release. Notify local public health authorities immediately and follow their directions. Decontamination may also be warranted in response to an overt release.

iv) Radiological Attacks

A radiological weapon or "dirty bomb" is a crude device that combines a conventional explosive with highly radioactive material. When detonated, the blast vaporizes the radioactive material and propels it across a wide area.

The main danger from a dirty bomb is the initial blast, which could cause serious injury or property damage. The radioactive materials will likely not be concentrated enough to cause immediate serious illness, except to those very close to the blast site or those who inhale smoke and dust. Dirty bombs are designed to cause tremendous psychological damage by exploiting the public‟s fear of radiation. These are not weapons of mass destruction, but weapons of mass disruption aimed at wreaking economic havoc by making target areas uninhabitable for extended periods.

There are three basic ways to reduce your exposure:

1. Reduce the time near the source of radiation,
2. Increase the distance from the source of radiation,

3. Increase the shielding between person and the source of radiation. Shielding is anything that puts distance and mass between the person and the radiation source.

Evacuation

If a person is outside, evacuate up-wind from the blast site cover the nose and mouth with a wet cloth to reduce the risk of inhaling radioactive smoke or dust. Once out of the immediate area, seek shelter and wait for instructions from first responders. If individual has been exposed to dust or smoke, follow the decontamination procedure.

Shelter in Place

If a person is close to the blast and inside a building/office, stay inside if the building is intact. Move to the basement and turn off all HVAC equipment and fans bringing in outside air it is not necessary to seal doors and windows, but it may be helpful. Wait for instructions from first responders.

7.3.9.3 Action PLan- Reporting of an Off-Site Emergency

The off-site disaster management plan will be put into action in the following situations:

a) In case of an Onsite emergency spreads beyond the boundary of installation and causes damage to the life or property outside the boundary.
b) In case an emergency originated from outside the premises of the installation/Drilling Rig/Work over Rig which is likely to effect the operations of installation.

In case of an off-site emergency, the On-site Chief emergency coordinator will report the matter to the District Collector, who is Chairman of District emergency committee. Further, the Chairman will mobilize other members of District Emergency committee as per the organization Chart for an Off-site emergency management (Figure 7.2).

Communication to Corporate Office

An official communication should also be made to the corporate office in case of an offsite Emergency.

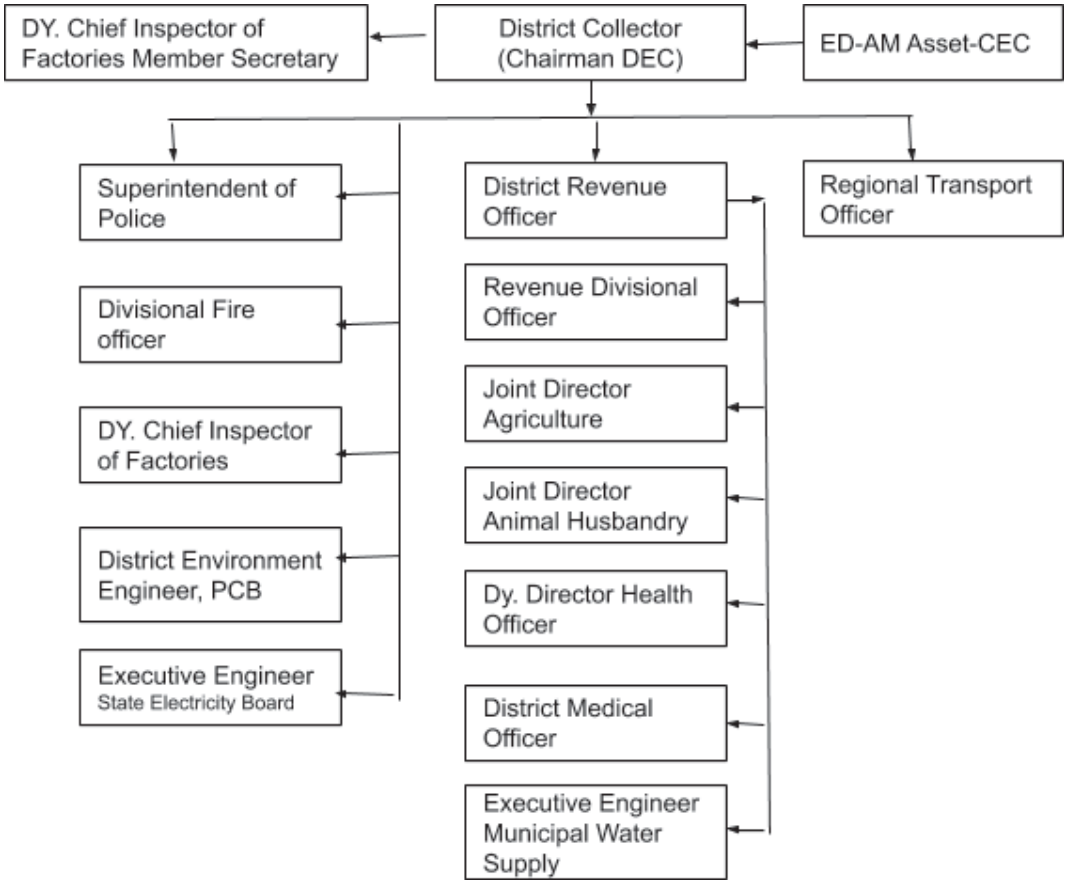

Figure 37. Flowchart for Offsite Emergency Management

Functions and responsibilities of Emergency Committee

When a call is received from On-site Emergency coordinator regarding emergency / disasters, District Collector, who is also chairman of the District Emergency committee, will initiate the district level action plan to combat the emergency.

Responsibilities of Chairman of District Emergency Committee

a) Take overall responsibility for combating the off-site emergency.

b) Declare an area of 500 m or up to 1.5 Kms as felt appropriate around the site as a "Hazardous Zone".
c) Inform the District Police, Fire Personnel to combat the emergency.
d) Inform the team of Doctors headed by District Health & Medical Officer; also help and support from nearby hospitals may be called for.
e) Inform the Regional Transport Officer to arrange for transportation of victims and evacuation of people trapped within the hazardous zone.
f) Inform the Executive Engineer of state electricity department to give uninterrupted power supply or de-energize power supply, as required.
g) Inform the Revenue Divisional Officer (RDO) and District supply officer to provide safe shelter, food and other life-sustaining requirements for the evacuees.

Responsibilities and duties of members of Service group

In the implementation of the Off-site emergency plan a service group will assist the Collector of the respective district. This group consists of the following members from the district area & has responsibilities as indicated.

Table 75. Responsibilities and duties of members of Service group

District Collector	Press and Public Relations
Superintendent of Police	Warning & Advice to the public security measures, Rescue & Evacuation
District Revenue Officer	Coordinates Transport, Civil Supplies, Health, Medical and other services
Revenue Divisional Officer	Rallying post
Regional Transport Officer	Provide transport
Deputy Director Health	To take care of Public Health & Preventive medicines
District Medical Officer	Treatment of affected persons
Divisional Fire Officer	Help in firefighting operations & rescue
District Environmental Engineer	Advice for protection of environment and reduction in environmental losses
Joint Director, Animal Husbandry	Taking care of cattle in the affected area.
Joint Director, Agriculture	Taking care of standing crops

Executive Engineer, State Electricity Department	Ensuring uninterrupted power supplies or de-energies power supply as required.

7.3.10 Mock Drill for Onsite and Off-Site Emergency Management

Mock Drill to check the efficacy of Onsite and Off-site Emergency plan for review and updating in association with Government officials should be conducted.

Once in every year this plan will be practiced on a field mock exercise involving dramatized scenarios to test the communication system, action plan and response of all Key agencies within Focus Energy and Government officials. Such a field mock exercise will be selected from high risk areas and near real approach of actual fire fighting / evacuation operations will be undertaken. An emergency will be alerted through different types of Siren Sound Code example fire, explosion, toxic release etc. Siren codes as per OISD STD 116 reproduced here in Format-I will be followed.

Table 76. Emergency Siren Codes

Emergency Siren Codes	
Scenario	**Siren Sound Code**
Major Fire	A wailing siren for two minutes. Siren should be sounded three times for 30 seconds with an interval of 15 seconds.
Disaster	Same type of siren as in case of Major fire, but the same will be sounded for 3 times at the interval of 02 minutes.
Gas Leak	A wailing sound for 2 min 5 times for 20 sec at 5 sec interval
Blow-out with Fire	Same as Major Fire Siren
Blow-out without Fire	Same as Gas Leak Siren
Air Raid	As per guidelines of Air Defense Dept. of the area
All Clear	Straight run siren for 2 minutes
Test Run	Straight run for 2 minutes

(Reference: OISD-STD 116, page 26)

Note: Sound for Gas situation and blow-out sirens have been devised internally, as it is not mentioned in OISD-116.

During mock drill exercise observers would be appointed in key areas to take note of individual responsibilities, response time and lapses. Every mock exercise will be followed

by "post – mock-drill meeting" to discuss the findings of observers and shortcomings. The lessons learnt from such exercises will be summarized in the form of a report to improve upon the overall preparedness and will also be used as inputs for updating the plan to the extent necessary.

If in any case the exercise cannot be carried out due to operational reasons the same shall be done as the table top exercise to test the communication system, action plan and response of all Key agencies within Focus Energy and Government officials.

Review of the Plan

The off-site emergency plan will be reviewed by Focus Energy Limited and District Emergency Committee as per requirement and updated accordingly.