A.7	Land filling including Padding	Increase in turbidity of nearby water-bodies	• Use of appropriate sediment filtration devices in the form of silt fence or straw barriers Stockpiled topsoil should be maintained & protected from pilferage.
		Temporary impact on air quality	• Dry, unpaved areas and roads to be sprinkled with water to prevent fugitive emission. • Vehicle transporting material will not be over loaded. • Covering of loose materials during transportation. • Preventive maintenance of machinery to be undertaken as per manufactures schedule.
		Temporary adverse impact on noise quality of areas adjoining transport routes	• Preventive maintenance of vehicles to be undertaken as & when required. • All vehicles movements for hauling materials to be undertaken during daytime only. • Vehicle & machinery should have appropriate engineering controls at source.
		Loss of vegetation & habitat	• Minimize felling of trees & mature shrubs in those areas. • To adopt adequate mitigation measures and follow best practices.
A.8	Storage & Handling of materials & Spoils	Temporary impact on air quality especially increase in fugitive dust emissions	• All loading and unloading activities to be carried out as close as possible to the storage facilities.

			• Proper handling of materials to ensure minimal emission of dust.
		Potential contamination surface water body resulting impact on aquatic ecosystem	• All spills to be reported and contained to prevent entry of spilled chemicals/fuels to any surface water body or drainage channel.
		Potential impact on soil quality	• All spills to be reported and remedial measures to be taken for cleanup of the spill.
A.9	Transport of Materials, Spoils and Machinery	Temporary deterioration on air quality along transport route	• Preventive maintenance of machinery to be undertaken as per manufacturer's schedule.
		Temporary deterioration in ambient noise along the transportation route	• Preventive maintenance of Vehicles to be undertaken as & when required • All vehicular movements for hauling materials to be undertaken during daytime only.
B : DRILLING AND TESTING ACTIVITY			
B.1	Operation & maintenance of rig and associated and machinery	Temporary impact on air quality due to increase in concentration of gaseous pollutants	• Preventive maintenance of DG sets to be undertaken as per manufacturer's schedule. • Automatic H_2S and CO gas detection kits at drilling sites and sensitive areas • These gas detection monitors sets to activate warning signals whenever concentration of H2S and CO exceed the approved level for continuous exposure • Contingency plan for H_2S release events including all

			necessary aspects from evaluation to evacuation • Workers in locations of high risk exposure will be provided with self contained breathing apparatus and emergency oxygen supplies that is conveniently located to enable • Provision of adequate ventilation will be provided to occupied to void accumulation of hydrogen sulfide gas
		Temporary increase of ambient as well as work place noise level	• All workers working near high noise generating equipment to be provided with Personal Protective equipments. • Preventive maintenance of machinery to be undertaken as per manufacturers schedule
		Depletion of ground water resources	• Optimize use of water during drilling operations.
		Potential impact on surface water quality and aquatic ecosystem	• All spill to be contained so that it does not reach any surface water body or drainage channels.
		Potential safety concerns for drill site workers	• All machineries with moving parts shall be guarded.
B.2	Operation & maintenance of Vehicles	Temporary increase of noise level in areas abutting transport route	• Preventive maintenance of vehicles to be undertaken as and when required.
		Temporary deterioration air quality in areas abutting transport routes	• Same as above
		Contamination of soil	• All spills to be reported and

		resulting loss of soil living organism	remedial measures to be taken for cleanup of spill.
		Impact on surface water quality and aquatic ecosystem	• All spills to be contained so that it does not reach any surface water body or drainage channels.
B.3	Casing & cementing of well	Temporary increase of ambient noise level	• Preventive maintenance of machinery to be undertaken as per manufacturer's schedule.
		Temporary localized deterioration of air quality due to increased SPM levels	• Dry cement handling should be enclosed to the extent possible.
		Potential contamination of ground water aquifer	• Proper engineering controls during cementing operation to prevent migration of drilling mud and cement slurry into ground water aquifer.
B.4	Temporary storage, handling & disposal of process waste	Potential for contamination of soil and ground water in & around disposal site	• Adequate engineering control at the landfill site in form geo-textile liners and leach-ate collection systems.
		Contamination of surface water resulting in deterioration of surface water quality and aquatic ecosystem	• Disposal site to be selected away from surface water body • Garland drains to be constructed along the disposal site to collect the runoff. • Ensure run-off from such on-site storage is channelized into waste water pit for treatment. • All accidental spills of oil and lubricant to be reported and measures to be taken to clean up the spill.

		Potential health hazards of local recyclers	• Ensure recycle of wastes such as scrap metal, etc which causes visual impacts to authorized waste recycler
		Localized visual impacts	• Same as above
B.5	Testing & Flaring of natural gas	Temporary localized deterioration air quality (NO_X& SO_X)	• Proper engineering controls to ensure complete combustion of gas • Minimize flaring of gas • Knockout drums will be used to on flares to prevent condensate emission

Chapter 6
Environmental Monitoring Program

6.0 POLLUTION MONITORING AND SURVEILLANCE SYSTEMS

Regular monitoring of important parameters is of immense importance to assess the status of environment during exploratory drilling operation. With the knowledge of baseline conditions, a properly planned monitoring program can serve as an indicator for assessment of any deterioration in environmental conditions. This will facilitate undertaking suitable measures to mitigate adverse impacts during the operation of the plant and further help to protect the environment in the area.

Environmental monitoring programme for exploratory drilling will be planned considering the temporary nature of the activity. No post project monitoring schedule will be envisaged at the exploratory drilling phase. Post project monitoring programme will depend upon the techno commercial viability of hydro carbon production from the exploratory well. If the economic viable quantities of hydrocarbon are not found then the drilled well will be plugged and abandoned after reinstating the drilling site to its near original state before handing over to the owner.

Onshore exploratory drilling activity follows the analysis of seismic data to verify and quantify the amount of and extent of oil and gas resources from potentially productive geological formation. The enteractivity will be depend up on the geological formation beneath the earth at drilling location and depth of the reservoir. The span of the activity will vary from 30-60 days at each site.

Monitoring frequency will be selected to provide representative data for the parameter being monitored. Monitoring will be conducted through the reputed Consultant organization or environmental labs with NABET accreditation / MoEF recognitions.

Monitoring data will be analyzed and reviewed at regular intervals and compared with operating guidelines so that any necessary corrections can be taken.

The main attributes for which monitoring shall be carried out are:

- Ambient air Quality
- Drill cuttings and Drill fluid
- Noise Level

6.1 AMBIENT AIR QUALITY MONITORING:

The ambient air quality with respect to NOx, SO_2, H_2S, Suspended particulate matter (PM_{10} and $PM_{2.5}$), CO, Methane and VOC shallbe monitored at drilling locations site and in 1 location in the adjoining village.

The selected monitoring stations shall be monitored for a period 24 hours, once in a week

6.2 STACK MONITORING:

All the stacks attached to the DG sets monitoredonce in amonth, with respect to temperature, oxides of nitrogen (NO_x), Suspended Particulate Matter (SPM), Carbon monoxide (CO) level.

6.2.1 Automatic Gas Detection:

Automatic Hydrogen Sulphide (H_2S) gas detection kits will be installed in all strategic locations of the drilling site. These installed monitors will be set to activate warning signals when ever detected concentration of H_2S exceeds10ppm.

Automatic Carbon monoxide (CO) detection kit will be installed near the DG sets for early detection and warning.

6.3 NOISE ENVIRONMENT

Monitoring of the noise levels is essential to assess the effectiveness of Environmental Management Plan implemented to reduce noise levels. A good quality sound level meter and noise exposure meter may be procured for the same. Audiometric tests shall be conducted periodically for the employees working close to the high noise sources. The noise levels due to rigs, machines/equipments, compressors, diesel generator, shall be monitored regularly.

6.4 DRILL CUTTING AND DRILL FLUIDS

Regular Analysis of waste streams from the drillpit collecting drill cutting and drill fluids is recommended.

Table 6.1: Monitoring schedule

Area of monitoring	Number of sampling	Frequency of Sampling	Parameters to be analysed
Ambient air Quality	Onsite –one Villages-One	Once in a week During the exploratory	SPM(PM10and PM 2.5) NOx, SO2, CO,H_2S, Methane and VOC
Automatic gas detection	On site	Continuous	H_2S and CO
Stack Monitoring	All the stacks attached to DG sets	Once in a month During the exploratory	Temperature, NO_X, SO2, SPM

Noise	Near all the sound generating devices and near the project site boundary	Daily (day time and night time)	Sound pressure level (Leq)
Liquid effluents streams	From Drill cutting and Drill fluid storage pit	Once in day-Composite sample from the individual steams	pH. Conductivity, TDS, TSS, Chloride, , Oil and grease, Phenolic compounds , Hydrocarbon and Heavy

6.5 Budgetary Allocation for Environment management and Environmental monitoring:

3.80 lacs Rupees is earmarked for the environmental management plan and environment monitoring during exploratory drilling operation of each well.

Table 6.2: Budgetary Allocation for Environmental Management plan and Environment Monitoring

Sr no.	Head	Approximate cost per well (RS in lacs)	Approximate cost for 7 wells (RS in lacs)	Basis for cost estimates
1.	Air pollution control	Not estimated	Not estimated	Flare stack provided at drill site as OMR. No pollution control equipment is required to install with flare stack at the drilling site hence capital & recurring cost is nil. Drilling is temporary.
2.	Water pollution control	2	14	Capital cost would include construction cost for HDPE lined pit for disposal of wastewater and septic tank for disposal of domestic waste.
3.	Solid and Hazardous	1.0	7	Capital cost would include

	waste Management			cost of providing storage space for hazardous waste and membership of TSDF fee.
4.	Environment monitoring and management	0.80	5.6	The cost would be incurred on hiring of consultants and payments of various fees and environmental monitoring cost
	Total	3.80	26.6	

7.0 INTRODUCTION

A risk assessment is a careful examination of consequences resulting from the undesired events that could cause harm to people or property, so that sufficient precautions can be taken. Workers and others have a right to be protected from harm caused by a failure to take reasonable control measures.

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 these. Fire, explosion, hazardous release or a combination of these are the hazards associated with hydrocarbon operations. These have resulted in the development of more comprehensive, systematic and sophisticated methods of Safety Engineering, such as, Hazard Analysis and Risk Assessment to improve upon the integrity, reliability and safety of hydrocarbon operations

7.1 OBJECTIVES OF THE RISK ASSESSMENT:

As per the requirements stated in the Terms of Reference of the EIA study, the risk assessment study has been undertaken to address the following aspects:

- To identify and assess those fire and explosion hazards arising from drilling and production testing operations in order to comply with regulatory requirements, company policy and business requirements.
- To eliminate or reduce to as low as reasonably practical in terms of risk to human health, risk of injury, risk of damage to plant, equipment and environment, business interruption or loss etc.

7.2 IDENTIFICATION OF HAZARDS IN DRILLING AND PRODUCTION TESTING OPERATIONS

Various hazards associated with drilling and testing operations of hydrocarbons are briefly described as below.

7.2.1 Minor Oil Spill

A minor oil spill is confined within the well site area. The conditions which can result in minor oil spill are as follows:

- **Diesel Fuel Storage System:**

  Oil spillage from tanker unloading, leaking valves, lines and storage tank.

- **Exploration or Testing Well Site:**

Drill stem testing leading to an oil spillage from lines, valves, separator and tank failure. During the well testing operation, there exists a possibility of hydrocarbon gases being released from a failure upstream of crude stabilization facilities at the exploratory drilling location. Once the flow of oil from well is stopped, then on-site access for clean-up is possible. If flow from well cannot be stopped, a blowout situation exists.

7.2.2 Major Oil Spill

Significant hydrocarbon inventories will not be maintained at a well site since only exploratory production testing is involved at present for 10 to 15 days at each well site. A major spill can, therefore, only arise as a result of an uncontrolled flow from a well either during drilling or exploratory production test resulting from a failure of the surface equipment.

For this to occur would require a combination of mechanical damage, such as, ruptured flow line coupled with failure of the emergency shutdown (ESD) system. Oil is produced with some associated gas; therefore, an oil spill arising from a failure of the surface equipment upstream of the crude stabilization facilities will result in the release to atmosphere of hydrocarbon vapors together with oil droplets in the form of a mist.

Provided that ignition does not take place and the well head is not obstructed the well can be shut in manually at the wellhead. If ignition occurs or other damage prevents access to the wellhead then a blowout situation exists and appropriate measures must be implemented.

7.2.3 Blowout

Blowout means uncontrolled violent escape of hydrocarbon fluids 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 cement bond around casing.

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

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

7.2.4 Hydrogen Sulphide (H_2S)

Hydrogen sulphide gas (H_2S) is extremely toxic, even very low concentrations can be lethal depending upon the duration of exposure. Without any warning, H_2S may render victims unconscious and death can follow shortly afterwards. In addition, it is corrosive and can lead to failure of the drill string or other tubular components in a well. Fortunately, crude oil and natural gas is likely to be sweet, that is, without any sulphur compounds including H_2S in the block area. However, following safety measures may become necessary as and when H_2S is detected while drilling and testing the exploratory wells in the block area and these are presented.

The Occupational Safety and Health Act (OSHA regulations) has set a 10 ppm ceiling for an eight hourly continuous exposure (TWA limit), a 15 ppm concentration for short term exposure limit for 15 minutes (STEL) and a peak exposure of 50 ppm for 10 minutes for H2S.

7.3 Control measures for above Hazards

Out of above mention hazards blowout and Hydrogen sulphide gas are two major hazards. Control measures for occurrence of blowout and H2S gas are discussed in following sub-sections:

7.3.1 Precautions against blowout

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

7.3.1.1 Precautions against blowout

1. The following control equipments for drilling mud system shall be installed and kept in use during drilling operations to prevent the blowout:

- A pit 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 explosimeter at 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.

2. Blowout prevention drill shall be carried out once every week near the well during drilling.
3. Suitable control valves shall be kept available near the well which can be used in case of emergency to control the well.
4. When running in or pulling out tubing, gate valve and tubing hanger shall be pre-assembled and kept readily available at the well.

7.3.1.2 Precautions 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:

1. A competent person shall be present on the spot throughout.

2. An area within the 500 meters of the well in 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.

1. 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.
2. 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 an emergency.
3. Adequate fire-fighting equipment shall be kept readily available for immediate use.

7.3.1.3 Blowout preventer assembly

To prevent the blow out during drilling operations following steps are taken:

1. After the surface casing is set in a well no drilling shall be carried out unless blowout preventer assembly is securely installed and maintained.
2. Blowout preventer assembly shall consist of :

- On bag type of preventer for closing regardless whether drilling equipment is in the hole or not.
- One blind ram preventer closing against an open hole.
- One pipe ram preventer closing against drill pipe in use in the hole.

3. In blow out preventer assembly, there shall be provided two seamless steel pipes at least 50 mm of diameter connected below each set of blow out preventer one for bleeding off pressure and the other for killing the well. These pipes shall be straight and lead directly in the well.
4. Each pipeline shall consist of component having a working pressure equal to that of the blowout preventer.

7.3.1.4 Blowout preventer (BOP) Control unit: Location and condition

1. BOP control units shall be located at a distance of nearly 30 m from well center.
2. Status of following shall be checked and maintained in good condition:

- Pressure Gauges;
- Pressure steel lines/fire resistant hoses;
- Level of hydraulic oil;
- Charging of unit; and
- Availability of sufficient number of charged bottles.

7.3.1.5 Control system for blowout preventer

1. All manual control for manually operated blowout preventer shall be located at least 0.60 meters out side the derrick substructures. Instructions for operating the controls shall be posted prominently near the control wheel.
2. A control of power operated blowout preventer shall be located within easy reach of driller floor:
3. A remote control panel for blowout preventers shall also be installed around floor level at a safe distance from the derrick floor.

4. All control for blow out preventers shall be clearly identified with suitable markers.

7.3.2 Control measures for H2S drilling

The following control measures for H2S will become necessary if presence of H2S is detected at an exploratory well.

7.3.2.1 Hydrogen Sulphide detection system presence

A four channels H2S gas detection system shall be provided. Sensors shall be positioned at optimum points for detection, actual locations being decided on site but are likely to be:

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

The detection system shall be connected to an audio visual (siren and lights) alarm system. This system will be set to be activated at a concentration of 15 ppm H2S.

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 H2S as suggested in the Drilling and Production Safety Code for Onshore Operators issued by The Institute of Petroleum.

A stock of H2S scavenger will be kept ready at drilling site for emergency use.

7.3.2.2 Low level of Hydrogen Sulphide

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.

H2S will cause a sudden drop of mud pH.

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

- Add H2S scavenger to mud.
- Check H2S levels at regular intervals for possible increase.
- Inform all personnel of the rig about the presence of H2S and current wind direction.
- Commence operations in pairs.
- Render sub base and cellar out-of-bounds without further checking levels in this area.

7.3.2.3 High level of Hydrogen Sulphide

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 H2S 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:

- One pre-assigned roughneck will go to doghouse and put on breathing apparatus. All other rig personnel will evacuate the rig and move in up-wind direction to designated muster point.
- Driller and roughneck will return to the rig floor and commence circulating H2S scavenger slowly.
- 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 hydrogen peroxide (H_2O_2) solution will neutralize H_2S gas in the mud at 20 gallons of H_2O_2 per 100 barrels of mud.

7.3.2.4 Control measures for Hydrogen Sulphide during production testing

H_2S scavenging chemicals (caustic soda solution, calcium hydroxide or iron oxide slurry) are to be continuously injected in the recovered gas/oil/formation water after pressure reduction through choke before sending the same to separator, if H_2S is detected during drilling of any exploratory well.

7.4 IDENTIFICATION OF HAZARDS BY FIRE AND EXPLOSION INDEX & TOXICITY INDEX

Fire and Explosion Index (F&EI) is an important technique employed for hazards identification process. Consequence analysis then quantifies the vulnerable zone for a conceived incident. Once vulnerable zone is identified for an incident, measures can be formulated to eliminate or reduce damage to plant and potential injury to personnel.

Rapid ranking of hazard of an entire installation, if it is small, or a portion of it, if it is large, is often done to obtain a quick assessment of degree of the risk involved. The Dow Fire and Explosion Index (F&EI) and Toxicity Index (TI) are the most popular methods for Rapid Hazard Ranking. These are based on a formal systematized approach, mostly independent of judgmental factors, for determining the relative magnitude of the hazards in an installation using hazardous (inflammable, explosive and toxic) materials.

The steps involved in the determination of the F & EI and TI are:

Selection of a pertinent process unit

Determination of the Material Factor (MF)

- Determination of the Toxicity Factor (Th)
- Determination of the Supplement to Maximum Allowable Concentration (Ts)
- Determination of the General Process Hazard Factor (GPH)
- Determination of the Special Process Hazard Factor (SPH)
- Determination of the F&EI value
- Determination of the TI value
- Determination of the Exposure Area

7.4.1 Hazardous material identification methodology

From the preliminary appraisal of Material Safety Data Sheet, it is observed that high speed diesel, natural gas and crude oil are hazardous. F&EI and TI values have been computed for three phase separator of crude oil and natural gas as well as HSD storage tank.

In general, the higher is the value of material factor (MF), the more inflammable and explosive is the material. Similarly, higher values of toxicity factor (Th) and supplement to maximum allowable concentration (Ts) indicate higher toxicity of the material. The tabulated values of MF, Th and Ts are given in Dows Fire and Explosion Index Hazard Classification Guide. For compounds not listed in Dow reference, MF can be computed from the knowledge of flammability and reactivity classification, Th can be computed from the knowledge of the National Fire Protection Association (NFPA) Index and Ts can be obtained from the knowledge of maximum allowable concentration (MAC) values. The MF, Th and Ts values are respectively 16, 0 and 50 for crude oil, 21, 0 and 50 for natural gas, and 10, 0 and 50 for HSD.

General process hazards (GPH) are computed by adding the penalties applied for the various process factors.

Special process hazards (SPH) are computed by adding the penalties applied for the process and natural factors.

Both General process hazards and Special process hazards corresponding to various process and natural factors are used with MF to compute F&EI value and with Th and Ts to compute TI value.

7.4.2 F&EI Computation

F&EI value computed for TPS and CTT from GPH and SPH values using the following formula

F&EI = MF x [1 + GPH (total)] x [1 + SPH (total)]

7.4.3 Toxicity Index (TI)

Toxicity index (TI) is computed from toxicity factor (Th) and supplement to maximum allowable concentrations (Ts) using the following relationship:

TI = (Th + Ts) x [1 + GPH (total) + SPH (total)]/100

Calculation for F&EI as well as TI is given in table shown below for Natural gas, crude oil and HSD.

Table 7.1: Fire and Explosion Index for Natural Gas / crude oil

Material Factor			21 / 16	Nf=4, Nr=0
1	**GPH**	**Penalty factor range**	**Penalty factor used**	**Remark**
	Base factor	1.00	1.00	Base factor
A	Exothermic reaction	0.3-1.25	0.00	No reaction
B	Endothermic process	0.2-0.4	0.00	NA
C	Material handling and transfer	0.2-1.05	0.5	For class I flammable material transfer through pipeline
D	Enclosed or Indoor process unit	0.25-0.9	0.00	Not Enclosed
E	Access	0.2-0.35	0.00	Two side easy access so NA
F	Drainage & spill control	0.25-0.5	0.00	Proper dike design so NA
	General process Hazard factor F1		**1.5**	
2	**SPH**	**Penalty factor range**	**Penalty factor used**	
	Base factor	1.00	1.00	
A	Toxic material	0.2-0.8	0.20	Nh=1
B	Sub atmospheric pressure(<500 mm hg)	0.5	0.00	NA

C	Operation in or near flammable range			
1	Tank farm storage flammable liquid	0.5		
2	Process upset or purge failure	0.3		
3	Always in flammable range	0.8	0.8	
D	Dust Explosion	0.25-2.0	0	NA
E	Pressure	0.86-1.5	0	Above normal pressure
F	Low temperature	0.2-0.3	0	NA
G	Quantity of flammable / unstable material			
1	Liquid or gases in process	0.2-3	0.2	
2	Liquid or gases in storage	0.1-1.6		
3	Combustible solid in storage, dust in process	0.2-4		
H	Corrosion & Erosion	0.1-0.75	0.1	<0.005 in per year
I	Leakage joint and packing	0.1-1.5	0.1	possibility of minor leakage
J	Use of fired equipment	0.1-1	0	NA
K	Hot oil heat exchange system	0.15-1.15	0	NA
L	Rotating equipment	0.5	0	NA
	Special process Hazard F2		**2.4**	
	Process unit hazard factor(F1×F2)=F3		3.6	
	Fire and Explosion Index(F3×MF)		**75.6**	
TOXICITY INDEX				
	Toxicity number Th		50	Nh=1
	Penalty factor Ts		50	TLV 0.5 ppm

	Toxicity Index		**4.9**	

Table 7.2: Fire and Explosion Index for HSD

FIRE AND EXPLOSION INDEX FOR HSD				
Material Factor			10	Nf=2, Nr=0
1	**GPH**	**Penalty factor range**	**Penalty factor used**	**Remark**
	Base factor	1.00	1.00	Base factor
A	Exothermic reaction	0.3-1.25	0.00	No reaction
B	Endothermic process	0.2-0.4	0.00	NA
C	Material handling and transfer	0.2-1.05	0.40	NFPA 2
D	Enclosed or Indoor process unit	0.25-0.9	0.00	Not Enclosed
E	Access	0.2-0.35	0.00	Two side easy access so NA
F	Drainage & spill control	0.25-0.5	0.00	Proper dike design so NA
	General process Hazard factor F1		**1.40**	
2	**SPH**	**Penalty factor range**	**Penalty factor used**	
	Base factor	1.00	1.00	
A	Toxic material	0.2-0.8	0.40	0.2×2
B	Sub atmospheric pressure(<500 mm hg)	0.5	0.00	NA
C	Operation in or near flammable range			
1	Tank farm storage flammable liquid	0.5	0.5	
2	Process upset or purge failure	0.3		
3	Always in flammable range	0.8		

D	Dust Explosion	0.25-2.0	0	NA
E	Pressure	0.86-1.5	0	NA
F	Low temperature	0.2-0.3	0	NA
G	Quantity of flammable / unstable material			
1	Liquid or gases in process	0.2-3	0	NA
2	Liquid or gases in storage	0.1-1.6	0.5	
3	Combustible solid in storage, dust in process	0.2-4		
H	Corrosion & Erosion	0.1-0.75	0.1	<0.005 in per year
I	Leakage joint and packing	0.1-1.5	0.1	possibility of minor leakage
J	Use of fired equipment	0.1-1	0	NA
K	Hot oil heat exchange system	0.15-1.15	0	NA
L	Rotating equipment	0.5	0	NA
	Special process Hazard F2		**2.60**	
	Process unit hazard factor(F1×F2)=F3		3.6	
	Fire and Explosion Index(F3×MF)		**36**	
TOXICITY INDEX				
	Toxicity number Th		50	Nh=1
	Penalty factor Ts		50	TLV more than 50 ppm
	Toxicity Index		**5**	

Table 7.3: Conclusion for Fire, Explosion & toxicity Index

Applicable Fire and Explosion index range	1-60	Light
	61-96	Moderate
	97-127	Intermediate

	128-158	Heavy
	>159	Sever
CONCLUSION FOR TOXICITY INDEX		
Applicable Toxicity index range	1-5	Light
	6-9	Moderate
	above 10	High

7.4.4 Hazards Ranking

Table 7.4 Hazards Ranking

Substance	F&EI value	TI value	F&EI range	TI range
Natural gas / Crude oil	75.6	4.9	Moderate	Light
HSD	36	5	Light	Light

From the above various hazards identified from the proposed project activities are as under:

- Fire and explosion hazard due to use of natural gas / crude oil.
- Fire hazard due to handling and storage HSD

Other hazards are:

- Occupational health hazards
- Other hazards

Consequences of hazards also depend on prevailing meteorological conditions and density of population in surrounding areas.

7.5 CONSEQUENCE ANALYSIS

Consequence analysis quantifies vulnerable zone for a conceived incident and once the vulnerable zone is identified for an incident, measures can be proposed to eliminate damage to plant and potential injury to personnel. For consequence analysis both units chosen for hazards analysis are considered. The following likely maximum credible scenarios (Primary) considered for hazard analysis

- Catastrophic failure of HSD storage tank

- Bursting / catastrophic rupture of a three phase separator (TPS) at exploratory production testing area.

Damage area from the above scenarios is presented in the model developed with HAMS-GPS software and presented as below.

a) Catastrophic failure of HSD storage tank

From the primary scenario of catastrophic failure of HSD storage tank (50 KL capacity) and immediate release of all quantity in to atmosphere following secondary scenario is considered.

- Liquid Pool fire

1) Liquid pool fire model & Data sheet

Fig: 7.1 Liquid pool fire model

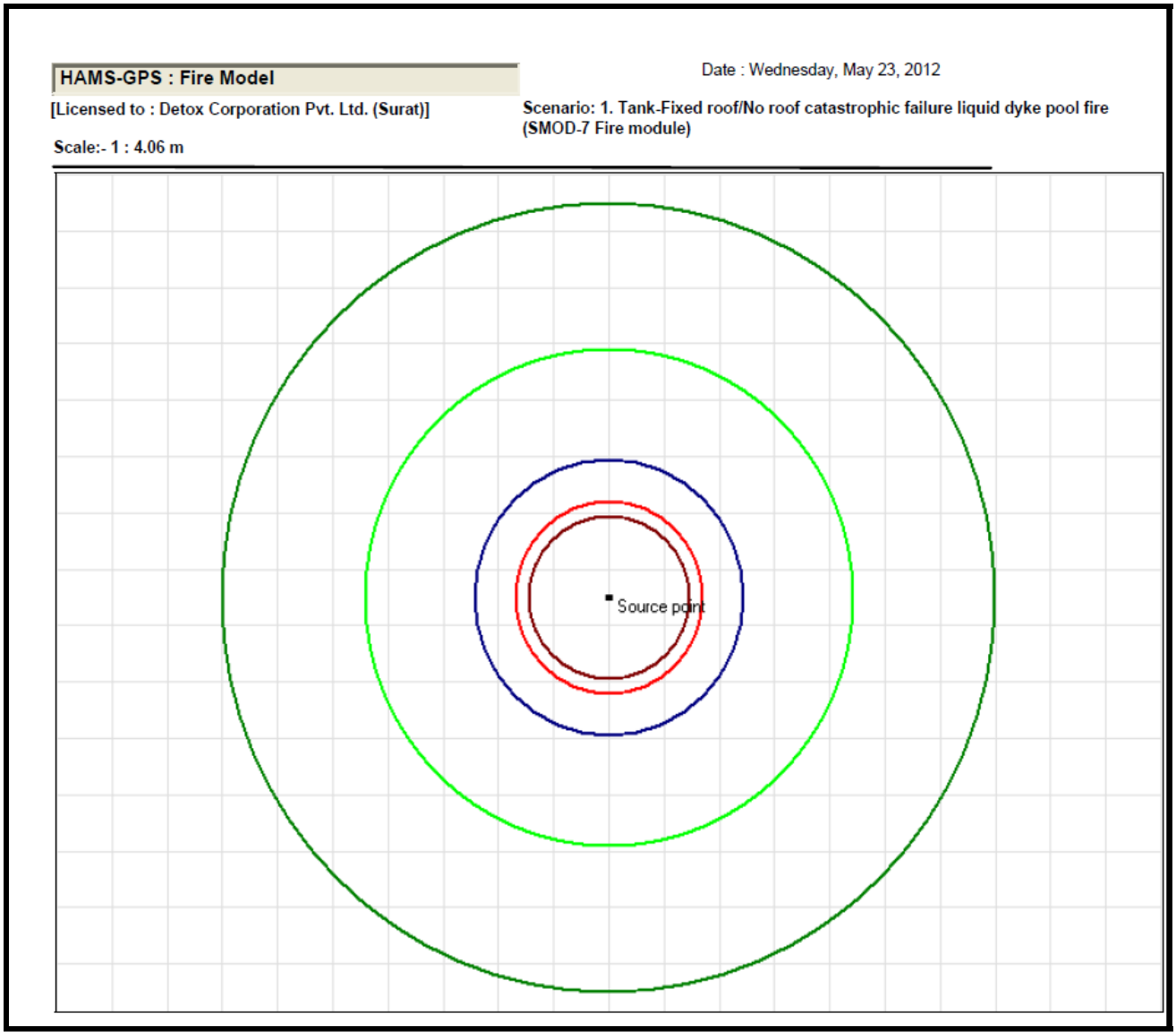
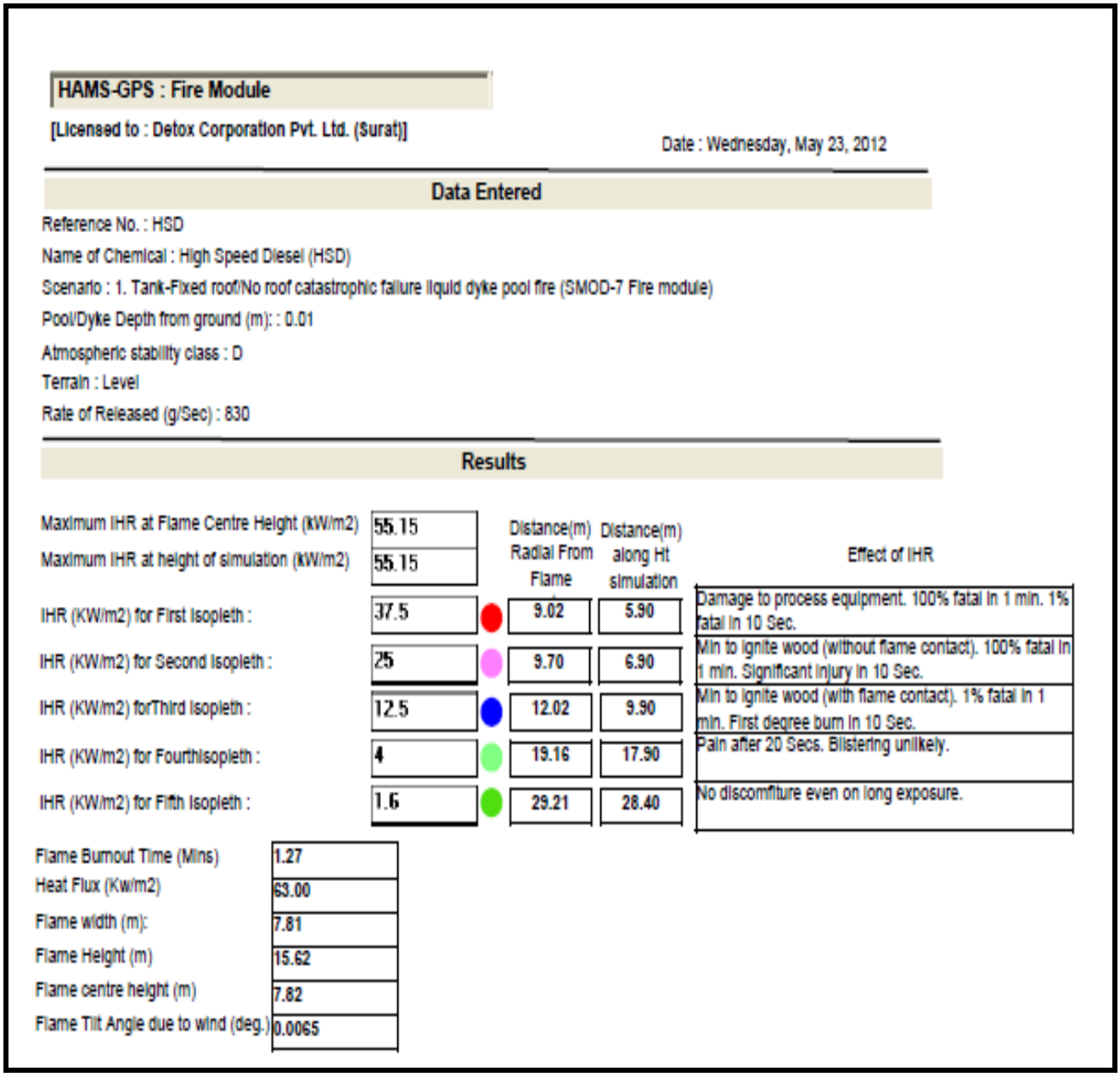


Fig 7.2: Liquid pool fire model data-sheet



HAMS-GPS : Fire Module

[Licensed to : Detox Corporation Pvt. Ltd. (Surat)]

Date : Wednesday, May 23, 2012

Data Entered

Reference No. : HSD

Name of Chemical : High Speed Diesel (HSD)

Scenario : 1. Tank-Fixed roof/No roof catastrophic failure liquid dyke pool fire (SMOD-7 Fire module)

Pool/Dyke Depth from ground (m): : 0.01

Atmospheric stability class : D

Terrain : Level

Rate of Released (g/Sec) : 830

Results

		Distance(m) Radial From Flame	Distance(m) along Ht simulation	Effect of IHR
Maximum IHR at Flame Centre Height (kW/m2)	55.15			
Maximum IHR at height of simulation (kW/m2)	55.15			
IHR (KW/m2) for First Isopleth :	37.5	9.02	5.90	Damage to process equipment. 100% fatal in 1 min. 1% fatal in 10 Sec.
IHR (KW/m2) for Second Isopleth :	25	9.70	6.90	Min to ignite wood (without flame contact). 100% fatal in 1 min. Significant injury in 10 Sec.
IHR (KW/m2) forThird Isopleth :	12.5	12.02	9.90	Min to ignite wood (with flame contact). 1% fatal in 1 min. First degree burn in 10 Sec.
IHR (KW/m2) for Fourthisopleth :	4	19.16	17.50	Pain after 20 Secs. Blistering unlikely.
IHR (KW/m2) for Fifth Isopleth :	1.6	29.21	28.40	No discomfiture even on long exposure.

Flame Burnout Time (Mins)	1.27
Heat Flux (Kw/m2)	63.00
Flame width (m):	7.81
Flame Height (m)	15.62
Flame centre height (m)	7.82
Flame Tilt Angle due to wind (deg.)	0.0065

7.6 RISKS AND FAILURE PROBABILITY

The term Risk involves the quantitative evaluation of likelihood of any undesirable event as well as likelihood of harm of damage being caused to life, property and environment. This harm or damage may only occur due to sudden/ accidental release of any hazardous material from the containment. This sudden/accidental release of hazardous material can occur due to failure of component systems. It is difficult to ascertain the failure probability of any system because it will depend on the components of the system. Even if failure occurs, the probability of fire and the extent of damage will depend on many factors like:

- Quantity and physical properties of material released.
- Source of ignition.
- Wind velocity and direction
- Presence of population, properties etc. nearby.

Frequencies of Loss of Containment (LOCs) for atmospheric tanks as per CPR 18E guidelines are as under:

Installation (part)	G.1a Instantan. release to atmosphere	G.1b Instantan. release to secondary container	G.2a Continuous 10 min release to atmosphere	G.2b Continuous 10 min release to secondary container	G.3a Continuous ∅10 mm release to atmosphere	G.3b Continuous ∅10 mm release to secondary container
single-containment tank	5×10^{-6} y^{-1}		5×10^{-6} y^{-1}		1×10^{-4} y^{-1}	
tank with a protective outer shell	5×10^{-7} y^{-1}	5×10^{-7} y^{-1}	5×10^{-7} y^{-1}	5×10^{-7} y^{-1}		1×10^{-4} y^{-1}
double containment tank	1.25×10^{-8} y^{-1}	5×10^{-8} y^{-1}	1.25×10^{-8} y^{-1}	5×10^{-8} y^{-1}		1×10^{-4} y^{-1}
full containment tank	1×10^{-8} y^{-1}					
membrane tank	see note 7					
in-ground tank		1×10^{-8} y^{-1}				
mounded tank	1×10^{-8} y^{-1}					

Frequencies of Loss of Containment (LOCs) for pressurize tanks as per CPR 18E guidelines are as under:

Installation (part)	G.1 Instantaneous	G.2 Continuous, 10 min	G.3 Continuous, ∅10 mm
pressure vessel	5×10^{-7} y^{-1}	5×10^{-7} y^{-1}	1×10^{-5} y^{-1}
process vessel	5×10^{-6} y^{-1}	5×10^{-6} y^{-1}	1×10^{-4} y^{-1}
reactor vessel	5×10^{-6} y^{-1}	5×10^{-6} y^{-1}	1×10^{-4} y^{-1}

7.7 CONTROL MEASURES FOR HANDLING AND STORAGE OF HSD

- HSD will be used in closed system. Employee handled HSD during unloading of the tankers shall be trained for standard operating procedures.
- HSD will be stored as per supplier's instruction and MSDS will be made available at site.
- Safety shower and Eye wash fountains shall be made available near by the area for flushing in case of exposure.
- Personal Protective Equipments like apron, gloves, safety goggles, etc. shall be provided and ensured to be worn during working. Use of PPE is enforced 100%.
- Typical label, Warning and safety phrases such as 'flammable', etc shall be marked where applicable.
- Movement in HSD storage area will be restricted and smoking will be strictly prohibited.
- Good Housekeeping is maintained at the facility.
- HSD will be stored in a suitable steel tank designed, constructed, and operated according to standards for the prevention and control of fire and explosion hazards.
- The storage tanks shall be secured in the open air, and sited at a distance of 5m from adjacent building and the facility. Tanks are located away from other storages.
- All measures will be taken to prevent potential heat and ignition sources reaching the storage area. Typical label, Warning and safety phrases such as 'flammable', poison', etc are marked where applicable.
- To avoid static electricity build up proper grounding and bonding (including formal procedures for the use and maintenance of grounding connections) will be provided and other safety procedures for loading and unloading of product to transport systems
- Facilities are properly equipped with fire suppression equipment that meets recognized technical specifications for the type and amount of flammable and combustible materials stored at the facility. Portable fire extinguishers are maintained and readily available at the storage site. Fire buckets filled with dry sand will be provided for fire controls. Fire hydrants systems are also installed at the facility. Fires are handled by trained fire fighters.

- Special trainings will be given to the employees regarding fire fighting through demonstration and mock drills and in case of emergency only trained person are permitted to handle the fire.
- Emergency telephone numbers will be posted in a permanent place.

7.8 OCCUPATIONAL HEALTH AND SAFETY

During the project work lot of activities shall be involved such as construction, erection, testing, commissioning, operation and maintenance, the men, materials and machines are the basic inputs. Along with the boons, the industrialization generally brings several problems like occupational health and safety.

The following occupational health and safety issues are specific to proposed plant activities will arise during project work as well as regular operation of plant:

- Physical hazards
- Respiratory hazards
- Electrical hazards
- Noise
- Entrapment hazards
- Fire and explosions

7.8.1 Physical Hazards

Industry specific physical hazards are discussed below.

Potential physical hazards in proposed plant are related to handling heavy mechanical transport (e.g. trucks) and work at heights (e.g. platforms, ladders, and stairs).

Heavy Loads / Rolling during construction phase

Lifting and moving heavy loads at elevated heights using hydraulic platforms and cranes presents a significant occupational safety hazard. Recommended measures to prevent and control potential worker injury include the following;

- Clear signage in all transport corridors and working areas;
- Appropriate design and layout of facilities to avoid crossover of different activities and flow of processes;
- Implementation of specific load handling and lifting procedures, including:
- Description of load to be lifted (dimensions, weight, position of center of gravity)
- Specifications of the lifting crane to be used (maximum lifted load, dimensions)

- Train staff in the handling of lifting equipments and driving mechanical transport devices
- The area of operation of fixed handling equipment (e.g. cranes, elevated platforms) should not cross above worker and pre-assembly areas;
- Material and product handling should remain within restricted zones under supervision;
- Regular maintenance and repair of lifting, electrical, and transport equipment should be conducted.
- Use appropriate PPE (e.g. insulated gloves and shoes, goggles to protect against radiation, and clothing to protect against heat radiation and liquid metal splashes);
- Install cooling ventilation to control extreme temperatures;
- Implement work rotations providing regular work breaks, access to a cool rest area, and drinking water.

7.8.2 Respiratory Hazards

Gas

During transfer of gas workers may be exposed to gas inhalation hazards.

Recommendations to prevent exposure to gas are as follows:

- Design facility ventilation to maximize air circulation. Outlet air shall be filtered before discharge to the atmosphere;
- Exhaust ventilation will be installed at the significant point sources of gas emissions;
- Sealed cabin with filtered air conditioning will be provided
- Separated eating facilities shall be provided that allow for washing before eating;
- Facilities that allow work clothes to be separated from personal clothes, and for
- washing / showering after work;
- Periodic health checks will be implemented.

Recommendations for respiratory protection include the following:

- Use of filter respirators when exposed to dust;

7.8.3 Electrical Hazards

Workers may be exposed to electrical hazards due to the presence of heavy-duty electrical equipment in plant.

7.8.4 Noise

Noise level will be high at gas compressors and gas engine. Proper environment management plan has been formulated to control the same

7.8.5 Explosion and Fire Hazards

Fire fighting system to control the hazard is discussed in previous sections

7.9 OTHER HAZARDS AND ITS CONTROLS

The other hazards possible at site are as given below:

Table 7.5: Other Hazards and Its Controls

Name of possible hazard or emergency	Its source & reason	Its effects on person, property & environment	Place of effect	Control measures provided
Building collapse Earthquake	• Any natural Calamities • Week structure • Over loading	• Injuries & Fatalities • Building damage.	• All building & sheds of the company as given in the Fac. layout	• Structure stability is by competent person for all structure. • No overloading of structures and building.
Electrical Installation failure like Transformer, PCC etc.	• Overload Loose contacts Short circuit	• Fire • Suffocation of persons inside the plant	• Electrical transformer switch yard • Electrical MCC rooms • Power plant	• Installation as per electricity rules. • Other Controls provided • Rubber mat provided • Earthing provision

7.10 AUTOMATIC FIRE DETECTION AND CONTROL MEASURES

7.10.1 General

The fire fighting system shall be designed as per Oil Industry Safety Directorate (OISD) Standard, August 2000, for the drilling rigs and well testing. The plant's fire protection shall consist of structural solutions, fire extinguishing systems and fire alarm systems.

The fire extinguishing system shall consist of the fire water system with fire pumps distribution pipelines, hydrant valves and fire hoses and the portable fire extinguishers.

The fire alarm system is a part of the primary systems and shall take care of the places which are unmanned or do not have any fixed fire extinguishing system.

7.10.2 Fire Water system

Separate fire water tank is proposed for firefighting system. Water will be taken the nearest available resources and stored in a 100 m^3 capacity fire storage pit and from there water require for firefighting will be taken to fire water tank for firefighting system.

Details of fire water reservoir are as under:

Table 7.6: Fire tank capacity details

Sr no	Proposed	Volume m^3
1	Fire hydrant tank	100
	Total	100

7.10.3 Fire Water / Hydrant System

Fire pumps

There shall be two fire pumps, diesel engine driven. The pumps supply water for the fire line and the fixed fire extinguishing systems. Either of these centrifugal pumps can alone deliver the required amount of water. At the rated flow, the pressure produced by the pumps shall be adequate, at least 6 bar by the rated flow, and at a zero flow not exceed 10 bar.

Jockey Pumps

Jockey pump will maintain automatically system pressure in the fire line. In case of emergency main pump will be turned on manually.

Pressure switches located in the fire water main shall sense sudden drop of pressure below set point, due to opening of any hydrant valves, which shall provide the starting signal to the jokey pumps. For stopping of the pumps only manual arrangement shall be provided.

The run and fault alarms from the fire pumps are led to the control room. The pumps will be located in pump house which shall be constructed by purchaser based on input from supplier.

Details of fire fighting main pumps and jokey pump for fire hydrant and sprinkler system are as under:

Table 7.7: Control logic of system in kg/cm^2

SYSTEM	Pump set	Start	Stop
HYDRANT	Jockey pump	6.00	7.00
	Main pump	5.00	Manual
	Stand by pump	4.00	manual

Diesel Engine

Diesel engine shall be equipped with an approved automatic auxiliary starting device having a sufficient capacity for at least six starts of fire pump. The diesel pump shall have a fuel tank containing sufficient fuel to enable the pump to run on full load for at least three hours.

Gas Detector

Gas leakage detectors will be installed at different locations in the premises.

Water distribution system

Fire piping shall be of MS Class "C" with supports for above ground lines. For underground piping GI class "C" pipes with necessary fittings will be used. The piping will be externally painted. The codes IS1239/IS 3589 will be followed. All underground pipes shall have cathodic protection. Sufficient no of isolation valve shall be provided to Isolate the area in case of maintenance. The diameter of the fire pipes shall be sufficient for the effective use of at least two fire hoses. The pipes and hydrants will be so placed that the fire hoses may be easily coupled to them.

Hydrants

Hydrant type Fire Protection System essentially shall consist of a network of piping and hydrant valves- both indoor & outdoor. The distance between any two hydrants shall not be more than 45 meters. Each hydrant shall be provided with a hose cabinet (mounted along side the hydrant on a steel column, lockable type) containing two nos. of 15 M long hoses and branch pipes/nozzles. For multi-stored office building located alongside engine hall, a wet riser tapped off from the hydrant main, shall be provided for each stair case inside the stair case and on this riser hydrant outlet with first aid hose reel connection shall be provided on each floor. Each hydrant shall be provided with a

wall/column mounted on hose cabinet containing two nos. of hose and branch pipe/nozzle.

The number and position of the hydrants shall be such that spray from at least two hoses with combined jet and water fog nozzles may reach any part of the engine hall or auxiliary room and spray from one combined jet and water fog nozzles may reach any part of other places. A hydrant unit inside the power house shall consist of two hose couplings of size DN50, both equipped with a shutoff valve. There will be two couplings beside each other to make it possible to use the water hose and mobile foam unit simultaneously. Some hydrants shall also to be installed on an external wall, to allow the use of hoses outside a building.

Following fire hydrant accessories will be installed:

Table 7.8: Hydrant Accessories proposed

SL. No.	DESCRIPTION	QTY.
O1	SINGLE HEADED HYDRANT VALVES	30
O2	FIRE ESCAPE HYDRANT VALVES	30
O3	WATER MONITOR (32 NB)	O3
	GRAND TOTAL	

Fire hoses shall be cotton and nylon jacket seamless woven and rot proofed material equipped with quick couplings and adjustable water fog nozzles. Hose couplings and nozzles throughout the fire line shall be completely interchangeable. Hose couplings shall be made of a copper alloy or other approved material.

Hose length : 15 m

Hose diameter : 63 mm

Busting pressure test : 32 kg/cm^2

Fire department connections

The fire water line will be provided with a fire department connection to allow additional water supply from fire department. It consist of a check valve, a pipe between the fire water line after the fire pump and outside wall and 3 inches hose connections on the outside wall.

7.10.4 Fire Alarm and Detection System

The fire alarm and detection centre shall be located in the control room. Manual call points shall be installed at critical points and escape routes. Manual alarms shall set off by breaking a glass disk and pressing a button.

The fire detection system shall comprise of smoke and heat detectors. The fire detection system shall be installed throughout the area and shall at least cover the following areas: Rig, Bulk storage area, Generator area, office etc.

Siren

A siren with minimum range of 300 m in addition to flashing lights & alarm bells shall be provided.

7.10.5 Fire Extinguishing Equipment

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 provided as per the following:

Table 7.9 Quantity of Fire extinguishers

Sr. No.	Type of Area	Qty Nos.	Portable fire Extinguisher
1	Rig area	2	10 kg DCP type extinguisher
2	Main Engine Area	1	10 kg DCP type extinguisher for each engine
3	Electric motor / pumps for water and mud circulation	1	10 kg DCP type extinguisher
4	Mud pump	1	10 kg DCP type extinguisher
5	Electrical control room	1	6.8 kg CO2 type extinguisher for each unit
6	Mud mixing tank area	1	10 kg DCP type extinguisher
7	Diesel storage area	1	50 lit mechanical foam 1 no. 50 kg DCP type extinguisher 2 nos. 10 kg DCP type extinguisher 2 nos. sand bucket or ½ sand drum with spade
8	Lube Storage Area	1	10 kg DCP type extinguisher

9	Air Compressor area	1	10 kg DCP type extinguisher
10	Fire pump area	1	10 kg DCP type extinguisher
11	Near Office	3	10 kg DCP type extinguisher 2 nos. sand bucket or ½ sand drum with spade

7.11 GAS DETECTION SYSTEM

Gas detection system shall be provided gas receiving area. In addition one hand held gas detector (portable type) shall also be supplied. Gas detection system shall be also provided in the area of reactive material storage.

7.12 MEDICAL CENTRE

Even though negligible accident occurs during drilling and production testing at the well site since observation of necessary safety requirements has to be strictly followed. However, first aid should be made available at the drilling site For quick transfer of any injured personnel in case an accident occurs and medical emergency arises to the nearest hospital vehicle (ambulance) will be made available at the well site on contract basis,.

Tie up with nearby hospitals and ambulance facilities should be made and their contact numbers should be displayed.

7.13 SAFETY ORGANIZATION AND ITS ACTIVITIES

7.13.1 Construction and Erection Phase

A qualified and experienced safety officer will be appointed. The responsibilities of the safety officer includes identification of the hazardous conditions and unsafe acts of workers and advise on corrective actions, conduct safety audit, organize training programs and provide professional expert advice on various issues related to occupational safety and health. He is also responsible to ensure compliance of Safety Rules/ Statutory Provisions. In addition to employment of safety officer by Plant, every contractor, who employs more than 250 workers, will also employ one safety officer to ensure safety of the worker, in accordance with the conditions of contract.

7.13.2 Operation and Maintenance Phase

The posting of safety officers shall be in accordance with the requirement of Factories Act and their duties and responsibilities shall be as defined thereof.

7.13.3 Strengthening of HSE and Meeting by Safety and quality circle

In order to fully develop the capabilities of the employees in identification of hazardous processes and improving safety and health, safety and quality circles shall be constituted in area of work. The circle normally will meet for about an hour fortnight.

7.13.4 Safety Training

Safety training will be provided by the Safety Officers with the assistance of faculty members called from Corporate Center, Professional Safety Institutions and Universities. In addition to regular employees, limited contractor labors will also be provided safety training. To create safety awareness safety films would be shown to workers and leaflets would be distributed.

Chapter-8
Disaster Management

8.0 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.

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.

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 contained 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 operation as soon as possible.

8.1 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 inside the premise or immediate vicinity of the premise, a Disaster Management Plan has been formulated and this planned emergency document is called "Disaster Management Plan".

The objective of the Industrial 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.

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy.

8.2 DISASTER MANAGEMENT TEAM

On site and off site emergency plans will require developing and implementing. These plans will consider linkages with local administration, local communities, Forest and Wildlife Departments and other operators in the area to provide necessary support to manage the emergency and also to disseminate information on the hazards associated with the emergency.

Competent and well trained Crisis Management Team will be require to develop and the same can take control of the situation at site, if necessary, soon after receiving the information from site for emergency. Contact person and telephone number for any emergency will be require to display so that contact can be established immediately in case of emergency.

Even well trained staff, all safety guidelines and emergency procedures as per regulations followed, it is still considered appropriate to provide a brief outline of a desirable on-site Disaster Management Plan (DMP) to augment the procedures. Proposed on site DMP is discussed in the following sub-sections.

8.3 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:

8.3.1 Level 1 Emergency

Level 1 emergency lies in case of 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 building/area where accident occurred and utmost the adjacent building/area.

8.3.2 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.

8.3.3 Level 3 Emergency

An accident involving a very serious hazard and with likely impact area extending beyond 500 m from the operational area, that is, drilling area limits, such as, major fire, very large release of inflammable material. Major fires will usually have the triggering effect resulting in the propagation of explosion. In a level 3 emergency, evacuation of population in villages, if any, adjoining the operational area may sometime become necessary if threatened area extend to populated village area adjoining the site of the primary accident in a direction of maximum impact.

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.

8.4 DISASTER MANAGEMENT PLAN

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. Plant may seek the assistance of other agencies, namely, fire brigade, police and health authorities, if considered necessary. The Off-site DMP is normally administered by the District Magistrate with the assistance of other relevant authorities.

Luckily the maximum vulnerable zone may not extend much beyond exploratory drilling and testing area due to VCE around TPS area and fire around HSD storage area in a sparsely populated area around chosen drilling locations. Therefore, Level 3 Emergency requiring evacuation of surrounding village population is not applicable in case of drilling and testing area. Even the Level 2 emergency is likely to be confined within a limited distance from the TPS area and HSD storage area, the evacuation of personnel only from affected area will be required. Even under the worst accident scenario, evacuation of less than 40 persons may be involved and damage, if any, to nearby installations is expected to remain confined within the operational area.

8.5 ON SITE DISASTER MANAGEMENT PLAN

In order to effectively deal with emergencies, the organizational chart for on-site emergencies should be periodically reviewed and updated. Usually, for Oil and Gas facilities, following co-ordinators are required to co-ordinate for various activities during the emergency:

Incident Controller (IC) **:** Installation Manager

Operations Co-ordinator (IC)	: Production Manager
Fire Fighting & Safety Co-ordinator	: Fire & Safety Incharge
Medical Incharge	: Medical Officer / Paramedic
Communications Co-ordinator	: Electrical/Instrumentation Incharge
Services Co-ordinator	: Maintenance Incharge
Logistics Co-ordinator	: Administrative Incharge

8.5.1 Role of Incident controller

He shall be the main guiding force in directing the emergency operations and will be in charge of overall control of the disaster. The actions include:

- On hearing the fire siren or on receiving information about the disaster, he will immediately take charge of the emergency control centre
- To declare the category of the emergency after discussing with other team members
- To instruct all the team members/ co-ordinators to make necessary arrangements
- To inform mutual aid partners about the disaster
- Instruct the safe shut down of system in consultation with emergency site incharge and key personnel
- If necessary, arrange for evacuation of population in the neighboring villages
- Carry out search for causalities within the affected area and arrange for first aid/hospitalization of victims, if required
- Ensure not to operate the plant/system unless it is declared safe by the competent person
- Provide local authorities, media and Govt. adequate factual information through in-company modalities.

8.5.2 Role & Responsibility of other coordinators

Table 8.1 Roles & Responsibilities of co-ordinators

Role	Responsibility
Operations coordinator (OC)	- Responsible for control of emergency at site - Liaise with fire and safety co-ordinator in effective

	control of emergency
Fire & Safety Coordinator	- Responsible for carrying out fire fighting and rescue work at the incident site - Co-ordinate with IC and other teams for effective control in minimum possible type
Services Coordinator	- Responsible for upkeep of equipments and facilities
	- Provides necessary support for identifying and rectifying the faults and bring the systems online
Communication Coordinator	- Ensure proper working of the communication facilities during an emergency - Responsible for internal and external communication as instructed by CC - Log the sequence of events and actions taken
Logistics Coordinator	- Responsible for providing support for the transportation of men, material, food etc. - Liaise with chief co-ordinator for mobilizing external emergency services
Medical In charge	- Responsible for treatment of casualties involved in the incident during emergency control operation - Liaise with hospitals for future treatment

8.6 EMERGENCY CONTROL CENTRE

An emergency control centre shall be provided at a safe place from where Chief Emergency Co-coordinator shall function for ON-SITE emergency. The Emergency Control Centre (ECC) shall be provided with following;

- Adequate number personal protective equipment,
- Alarm and communication network (Siren, local as well as P&T Telephone, Public Address system etc.),
- Route map,

- Map of the factory & surrounding areas, evacuation routes, fire hydrant network and other important information
- Copy of detailed Disaster Management Plan, where names, telephone numbers of the response team members and their responsibilities are clearly written as well as names and telephone numbers of key personnel from outside agencies and district authorities, Fire Station, nearby Hospitals and doctors are provided.
- First aid kit,
- Material safety data sheets of chemicals

Medical Services

The doctors in the nearby hospitals should be trained for treatment of personnel affected. Necessary apparatus and drugs should also be available in first aid post and in State Hospitals and also other Nursing Homes nearby. Manager (HR-Welfare) should have good liaison with authorities of nearby hospitals and Nursing Homes as well as doctors outside so that help may be available when required.

Transport and Communication

Ambulance Van will be available inside premises. The disaster management cell will have the contact number of nearby hospitals or nursing home with Ambulance facility to call them in case of emergency.

Assembly Point

Assembly points shall be set up near to the likely hazardous event sites where pre-designated persons from the disaster response team should assemble and meet the Site Incident controller. This may be regarded as Site Incident Control Room where Incident Controller will receive instruction and furnish information to the Chief Emergency Co-ordinator. The site incident control room shall be provided with efficient communication system, adequate personal protective equipment, copy of Disaster Management Manual etc.

Emergency Shelter

Emergency shelter places shall be chosen sufficiently away from likely affected site. Employees who are not in the emergency management team shall be asked to take shelter. The place is chosen such that the employees taking shelter are not affected by fire, explosion and release of toxic gases. More than one emergency shelter shall be designated so that proper shelter point can be chosen depending on wind direction and other factors.

Wind Socks

Windsocks shall be provided on the top of tall buildings to indicate the wind direction.

8.7 FIRE SERVICES PERSONNEL

Fire service shall be manned by trained fire safety personnel. Fire services department shall have adequate number of safety equipment for use during emergency. The list of safety appliances is as follows:

- Gas Mask
- Asbestos Suit
- Fire Proximity Suit
- BA Set
- Electric Gloves (for 15000 volts)
- Hydraulic Tool
- Telephone
- Emergency Ladder, etc.

8.8 SAFETY AND PERSONAL PROTECTIVE APPLIANCES

Safety and personal protective appliances shall be provided in adequate numbers and shall be distributed in different sections according to requirement. A list of such appliances available in the plant is given in the

Table 8.2: List of Proposed Safety Equipment

Sl.No	Equipment	Nos.
GAS MASK		
01.	Carbon Monoxide	Adequate Nos.
	BREATHING APPARATUS	
01.	Compressed Air	Adequate Nos.
02.	Airline respirator	Adequate Nos.
OTHERS		
01.	Pneupac Resuscitator	Adequate Nos.

02.	Combustible gas indicator/explosimeter	Adequate Nos.
03.	Gas Detector (Dragger Pump)	Adequate Nos.
04.	Safety Belts	Do-
05.	Asbestos Suit	Do-
06.	Hand Gloves etc.	Do-
07.	Gum Boots	Do-
08.	Safety Shoes	Do-
09.	Eye Goggles	Do-

8.9 EMERGENCY PLAN INITIATION

Emergency plan initiate with warning system by following manner for different level of emergencies.

Level 1 Emergency – Single beep every five seconds

Level 2 Emergency – Double beep every five seconds

Level 3 Emergency – Continuous wailing of alarm

Emergency response team will immediately take charge of their duties as defined as above. 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.

8.10 EMERGENCY PROCEDURE

8.10.1 Level 1 Emergency

Accident is small and isolated and may not require the shutdown of any installation/unit at the drilling/testing site. Effort shall be made to arrest its propagation. Level 1 fire may be extinguished with water, sand, earth 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.

8.10.2 Level 2 Emergency

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 fire tenders and foam extinguishers. Level 2 hazardous chemical release, if any, will require evacuation of

personnel including those working in downwind direction towards upwind or cross wind direction to minimize the injurious effect of hazardous gas release.

8.10.3 Level 3 Emergency

Level 3 emergencies are not applicable to drilling and testing operational area as indicated in above as their possibilities are very remote.

8.11 ACCIDENT SITE CLEANUP

While cleaning the site after explosion and fire accidents, care shall be taken against the probability of fire of flammable material lying buried in the debris of fire accident. Information regarding the cleaning up of spills of hazardous materials, if used, is available in material safety data sheets.

8.12 EMERGENCY RESPONSE PERSONNEL SAFETY

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

8.13 ALL CLEAR SIGNAL AND PUBLIC STATEMENT

For Level 1 and 2 emergencies Incident 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.

8.14 HEALTH AND SAFETY MONITORING PLAN

All the potential occupational hazardous work places would be monitored regularly. The health of employees working in these areas would be monitored once in a year for early detection of any ailment due to exposure to hazardous chemicals. First aid centres and medical centre should be provided. Transportation arrangement should be provided in case of emergency. Medical centre should have a permanent FMO (Medical officer).

Chapter-9
Summary & Conclusion

9.1 SUMMARY OF IMPACTS

The primary objective of EIA study is to identify the environmental issues related to the project and suggest appropriate mitigation measures so as to minimize the impacts. This ensures that the drilling operations will be conducted in an environmentally accepted and safe manner.

9.2 IMPACT DUE TO SITE SELECTION:

The total land area of block is 165 sq km. The proposed site where the project is to be located has been presented in the Google earth map in chapter 1, Figure 1.3, page 1-8 of the report. As per the baseline study, there will be no negative impact on livelihood of surrounding villages. The area being away from the ecologically sensitive area shall cause no significant negative impact.

9.2.1 Impact due to Waste generation during drilling operations:

The main waste generation during the drilling operations will be drilling fluids and formation cuttings which may contain traces of heavy metals. This might pose some risk to ecosystem in terms of food chain; where traces of contaminants are consumed by aquatic and terrestrial environment and human consumers of these resources might get affected due to Bioaccumulation of heavy metals. The drilling fluid proposed to be used in the process is water based and hence they will contain low levels of heavy metals. Moreover the drilling fluid shall be reused in the process and incase the oil & grease level exceeds 10 mg/kg in the drill cuttings, they will be packed in bags and then disposed off in a recognized TSDF site, alternately the drill cuttings can also be used as road spreading during the construction of the approach roads.

Soil contamination might arise from spills and leakage of chemicals and oils, simple preventive techniques such as segregated and contained drainage system incorporating sumps and oil traps, drip pans will be incorporated to reduce the caches of oil spillage. Thus there will be a minor localized and temporary effect on local environment in terms of exposure.

9.3 MITIGATION MEASURE AND ENVIRONMENTAL MANAGEMENT PLAN:

9.3.1 General:

The mitigation measures to reduce environmental impacts are through proper site planning, preparation and construction as well as testing of the drilling activity.

9.3.2 Drilling operations:

The drilling operation shall be based on standard industrial practice and equipments shall be operated based on specified design parameters during both erection & operation activities. For the operation and maintenance of rigs, automated H_2S and CO gas detection kits (having warning signals in case of increase in concentration) shall be provided. PPE's and ventilators shall be supplied in case of emergency.

9.3.3 Environmental Management Plan

An Environment Management Plan for Construction and operation phases of the project has been prepared. An Environment Management cell shall be created to strengthen and monitoring of the implementation of the environmental management plan for the project.

9.4 MONITORING:

Environmental monitoring programme for exploratory drilling will be planned considering the temporary nature of the activity. Post project monitoring programme will depend upon the techno commercial viability of hydro carbon production from the exploratory well. The main attributes for which monitoring shall be carried out are:

- Ambient air Quality
- Drill cuttings and Drill fluid
- Noise Level

Other parameters which will be duly checked include:

- Periodic check of wastewater parameters with regard to limit mentioned in GPCB.
- Integrity of storage area, protective measures on-site.
- Comprehensive Waste management plan.

9.5 SUMMARY OF RISK ASSESSMENT AND DIASASTER MANAGEMENT PLAN:

Scope of Risk Assessment is restricted to exploratory well testing only. Risk Assessment includes identification of various hazards such as oil spills, blowouts and hydrogen sulphide evolution from the testing of well and suggested mitigation measures. Worst case scenario for catastrophic failure of HSD tanks has been considered to evaluate the distance of damage occurrence. The probability of such scenario is calculated based on reference books.

Possibility of such scenario to occur is remote however report include various mitigation measures to prevent such scenarios to occur and fire fighting system and other facilities to be develop at site to minimize the damages in case such scenario take place. Report also indentified occupational health and safety hazard during construction and testing phase and suggested their mitigation measures. Report also suggested to develop health and safety monitoring plan and their implementation.

Disaster management plan outline onside and offside emergency plan. Onside emergency plan is of major importance as damage distances are limited to drilling and testing area. Onsite emergency plan focuses on important persons their authority and method of communication in case of emergency.

9.6 PROJECT BENEFITS

The major project benefits are as mentioned below:

- Increase in employment opportunity in skilled, semi-skilled and un-skilled categories.
- Increase in employment/ self employment avenues in service sector.
- Development of support infrastructure such as roads improvement in the livelihood and social status of the local people.

The possibility of finding new oil/gas fields in the block will lead to the reduction of India's dependence on the imported crude oil from other nations. The fluctuating crude oil price has affected our economy drastically. Indigenous production of crude oil helps to save the foreign exchange. In the event commercially viable hydrocarbon reserves are discovered during this exploratory drilling, more long term employment opportunities would be created. Besides, production of hydrocarbons shall help in contributing towards the national demand of petroleum resources.

For the proposed project, the project proponent is committed to implement social welfare measures as the part of the proposed project.

9.7 CONCLUSIONS:

Based on the above, it has been concluded that by adopting a robust environmental management plan and risk mitigation measures as presented in the EIA report, the proposed project would exhibit very insignificant environmental impacts. The proposed activities of NTPC would bring significant positive impacts to the region.

Hence it is being requested to consider awarding Environmental Clearance for the project as per the provisions of EIA Notification and its amendments there on.

Chapter 10
Disclosure of Consultants

10.1 GENERAL INFORMATION

Name of Organization	:	Detox Corporation Pvt. Ltd.
Address	:	3rd Floor, K.G. chambers, Udhna Darwaja, Ring road, Surat- 395 002
Telephone Nos.	:	+91-261- 2351248 ,2326181
Fax	:	+91-261- 2354068
Email	:	info@detoxcorp.com

10.2 VISION AND BUSINESS ETHICS

"Company's long established philosophy – to provide QUALITY SERVICES through integrated Environmental Solutions delivered within the client's schedule. "

10.3 KEY FACTS

1995 Laid Foundation Stone of Firm. Activities covered fabrication & equip. supply

1997 Developed Turnkey execution.

1997 Developed core competence for conducting Environment Audits.

1998 Developed a Full Fledged Laboratory

1998 Construction of ETP's & STP's

2000 Developed core competence for preparation of EIA Study Reports

2002 Expansion and Modernization of Lab & Office.

2004 Certified for ISO 9001: 2000 (QMS)

2004 Established First Branch Office at Gandhidham, Kutch

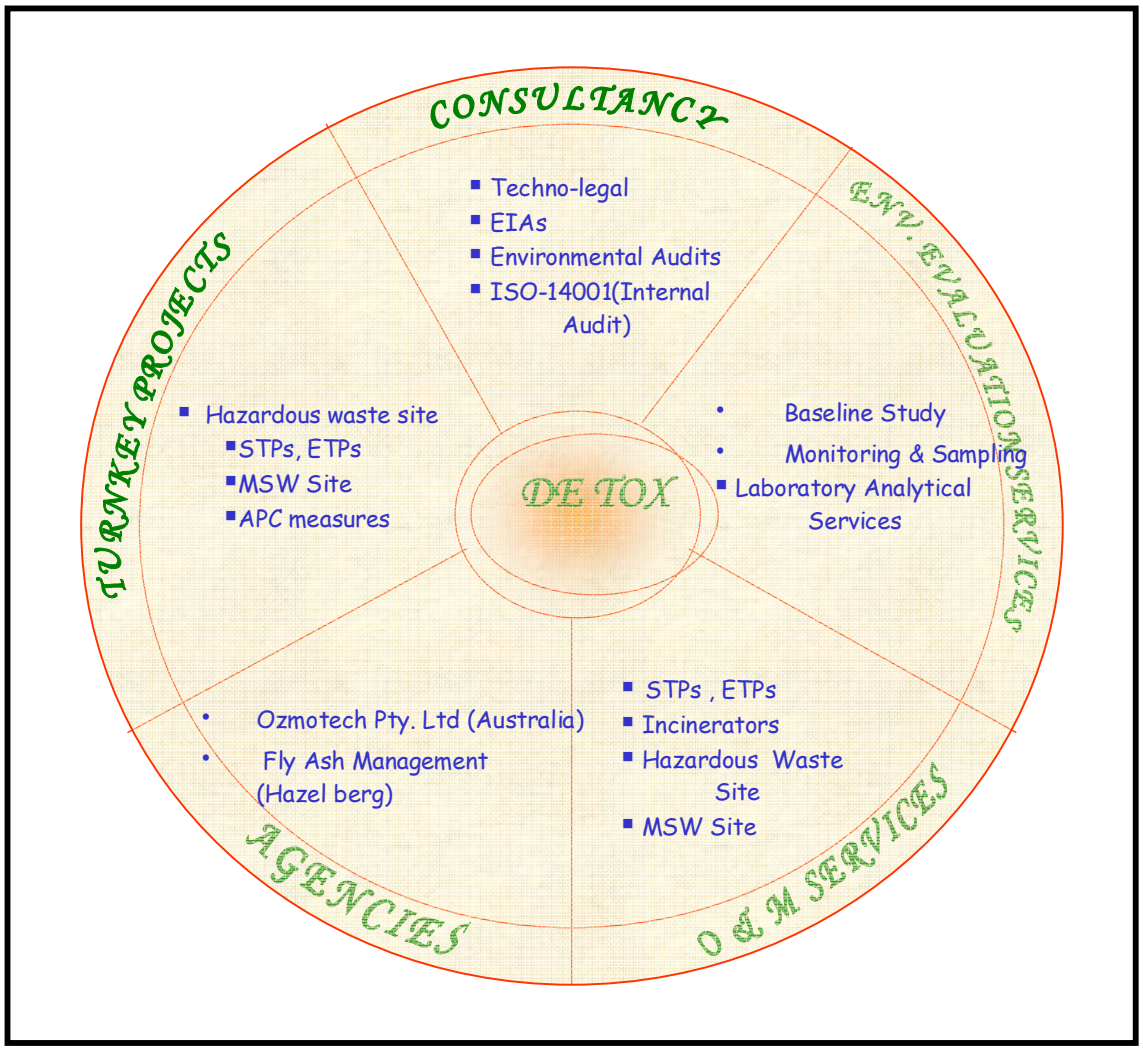
2005 Tie up with Ozmotech, Australia for Converting Waste Plastic to Diesel

2006 Foundation laid for setting up a Total Hazardous Waste Management site at Kutch, Gujarat

10.4 ACCREDITATIONS & REGISTRATIONS

- ISO 9001-2000 certification through DLIQ Certification affiliated to JAZ –ANZ of Australia.
- NABL (National Accreditation Board for Testing & Calibration) Certificate No: T-1635,validity 16/07/2011
- NRBPT (National Registration Board for Personnel & Training) Accreditation No: EIA 92 007 validity May 20, 2012 provided provisional accreditation in 9 sectors
- MoEF registered laboratory
- GPCB enlisted Consultants & Auditors
- NSIC – CRISIL rating

10.5 ACTIVITES



10.6 EIA TEAM

The EIA Team engaged in the preparation of EIA report consist of professionals with multidisciplinary skill and relevant experience required for undertaking this project.. Following are the specific roles and responsibilities of the key team members:

Table 10.1 : EIA team members

EIA COORDINATOR	**MR. PUSHPAK SHAH**
FUNCTIONAL AREA	**NAME OF EXPERT**
Air pollution prevention, monitoring and control	Mr. Pushpak Shah
Water Pollution prevention, control and prediction of impacts	Mr. Pushpak Shah
Solid waste and hazardous waste management	Mr. Amit Renose/ Mr. Pushpak Shah
Ecology and Biodiversity	Dr. Manoj Eledath
Hydrology, Ground water and water conservation	Mr. NB Kavalanekar
Meteorology, Air Quality modeling and prediction	Ms. Anjali Singam
Noise/ Vibration	Mr. D. H Patel
Land use	Dr. Jessica Karia
Risk assessment and hazard management	Mr. D. H Patel/ Mr. Mitesh Desai