7.2 RISK ASSESSMENT

7.2.1 Scope

The risk assessment process is intended to identify probable hazards in the work environment and all operations to quantify the hazards and to assess the risk levels of those hazards in order to prioritize those that need an immediate attention.

In the unlikely event that an abnormal consequence has occurred, the disaster management kicks in. This includes prescribing the procedures pertaining to a number of issues such as communication, encounter, rescue, rehabilitation and further steps to prevent recurrence of such consequence in future. These issues are addressed in the disaster management plan.

Both, the RA and DMP are living documents and need to be updated whenever there are changes in operations, equipment or procedures.

7.2.2 Methodology

The methodology includes,

- Hazard identification,
- Selection of potential loss scenarios,
- Simulation of release source model on DNV's PHAST 7.1,
- Plotting the damage contour on site map.

These steps undertaken to carry out risk assessment for this project are described in following sections.

7.2.3 Hazard Identification

The project description, and other project related data provided by the client have been comprehensively reviewed to identify the hazardous operations. Also, the information on the hazardous properties (MSDS) of all the chemicals handled at the site has been reviewed to identify the hazards associated with the same.

IOCL would like to establish new plant at Bhadrak. This involves storage of some of the raw material at the site which can lead to uncontrolled release of hazardous material causing hazard. On the basis of this, the important hazards that can lead to accident in the proposed project are described in ***Table 7-3.***

Table 7-3: Important Hazardous Events

Type of Event	Explanation
BLEVE	Boiling Liquid Evaporating Vapor Explosion; may happen due to catastrophic failure of refrigerated or pressurized gases or liquids stored above their boiling points, followed by early ignition of the same, typically leading to a fire ball
Deflagration	Is the same as detonation but with reaction occurring at less than sonic velocity and initiation of the reaction at lower energy levels
Detonation	A propagating chemical reaction of a substance in which the reaction front advances in the unreacted substance at or greater than sonic velocity in the unreacted material
Explosion	A release of large amount of energy that form a blast wave
Fire	Fire
Fireball	The burning of a flammable gas cloud on being immediately ignited at the edge before forming a flammable/explosive mixture.
Flash Fire	A flammable gas release gets ignited at the farthest edge resulting in flash-back fire
Jet Fire	A jet fire occurs when flammable gas releases from the pipeline (or hole) and the released gas ignites immediately. Damage distance depends on the operating pressure and the diameter of the hole or opening flow rate.
Pool Fire	Pool fire is a turbulent diffusion fire burning above a horizontal pool of vaporizing hydrocarbon fuel, where the fuel has zero or low initial momentum

Type of Event	Explanation
Spill Release	'Loss of containment'. Release of fluid or gas to the surroundings from unit's own equipment / tanks causing (potential) pollution and / or risk of explosion and / or fire
Structural Damage	Breakage or fatigue failures (mostly failures caused by weather but not necessarily) of structural support and direct structural failures
Vapor Cloud Explosion	Explosion resulting from vapor clouds formed from flashing liquids or non-flashing liquids and gases

Hazard & Damage Assessment

Toxic, flammable and explosive substances released from sources of storage as a result of failures or catastrophes, can cause losses in the surrounding area in the form of:

- Toxic gas dispersion, resulting in toxic levels in ambient air;
- Fires, fireballs, and flash back fires, resulting in a heat wave (radiation), or;
- Explosions (Vapours Cloud Explosions) resulting in blast waves (overpressure).

Consequences of Fire / Heat Wave

The effect of thermal radiation on people is mainly a function of intensity of radiation and exposure time. The effect is expressed in term of the probability of death and different degree of burn. The consequence effects studied to assess the impact of the events on the receptors are provided in ***Table 7-4.***

Table 7-4: Damage due to Radiation Intensity

Radiation (kW/m^2)	Damage to Equipment	Damage to People
4.0	-	Causes pain if duration is longer than 20 sec. But blistering is unlikely.
12.5	Minimum energy to ignite wood with a flame; melts plastic tubing.	1% lethality in one minute. First degree burns in 10 sec.
37.5	Severe damage to plant	100% lethality in 1 min. 50% lethality in 20 sec. 1% lethality in 10 sec.

Consequences of Overpressure

The effects of the shock wave vary depending on the characteristics of the material, the quantity involved and the degree of confinement of the vapour cloud. The peak pressures in an explosion therefore vary between a slight over-pressure and a few hundred kilopascals (kPa). Whereas dwelling is demolished and windows and doors broken at overpressures as low as 0.03- 0.1 bar. Direct injury to people occurs at greater pressures. The pressure of the shock wave decreases rapidly with the increase in distance from the source of the explosion. The overpressure damage is shown in ***Table 7-5.***

Table 7-5: Overpressure Damage

Overpressure (bar)	Damage
0.02068	Limited minor structural damage
0.21	Corrugated asbestos shattered; corrugated steel or aluminum panels, fastenings fail, followed by buckling, wood panels (standard housing) fastenings fail, panels blown in
1	Fatality

Source: CCPS Consequence Analysis of Chemical Release

Consequences of Toxic Release

The effect of exposure to toxic substance depends upon the duration of exposure and the concentration of the toxic substance.

Short-term exposures to high concentration give Acute Effects while long term exposures to low concentrations result in Chronic Effects.

Only acute effects are considered under hazard analysis, since they are likely credible scenarios. These effects are:

- Irritation (respiratory system, skin, eyes)
- Narcosis (nervous system)
- Asphyxiation (oxygen deficiency)
- System damage (blood or/and organs)

7.2.4 Selection of Maximum Credible Loss Scenarios (MCLs)

Following important points should be considered for the selection of release scenarios:

- Flammability and the flash point of the material;
- Phase of material i.e. liquid or gas;
- IDLH of the material;
- Threshold quantity of the chemicals as prescribed in MSHIC Rule;
- Operating temperature and pressure of the material;
- Total inventory of the material.

On the basis of study of chemical properties (MSDS) of the chemicals those are selected for simulation are presented in ***Table 7-6.***

Table 7-6: Storage Details of Hazardous Material

S. No.	Chemical	Flash Point (°C)	IDLH (PPM)	Melting Point	Boiling Point	Max. Storage Capacity (m^3)	No. of Storage Vessels	Safe filling Volume (m^3)	Dyke		Pressure (bar)	Temperature (°C)
									Height, m	Area, m^2		
1	Diethylene Glycol	143	-	-10^{0}C	245^{0}C	100	1	100	1.5	1974	Atmospheric	Amb.
2	Monoethylene Glycol (MEG)	111	-	-13^{0}C	197^{0}C	1250	2	2500	1.5	1974	Atmospheric	Amb.
3	HSD	32^{0}C	-	18^{0}C	215^{0}C	600	1	600	1.5	476	Atmospheric	Amb.

On the basis of the information provided in ***Table 7-6***, and as discussed over failures sceneries given in publications like World Bank Technical Paper 55 and TNO Purple Book and the experience of the consultant, MCLs' which may take place are presented in ***Table 7-7.***

Table 7-7: Scenario Selected for Simulation

S. No.	Storage Tanks of	Hazard Involved	Types of Failure Possible		Consequences Studied
			Credible Scenarios	Worst Case Scenarios	
1.	Diethylene Glycol	Flammable	10 mm dia hole leak in tank	Catastrophic Rupture	Jet Fire & Late Pool Fire, Explosion
2.	Monoethylene Glycol (MEG)	Flammable	25 mm dia hole leak in tank	Catastrophic Rupture	Late Pool Fire & Explosion
3.	HSD	Flammable	25 mm dia hole leak in tank	Catastrophic Rupture	Jet Fire, Flash Fire & Worst case radii, Explosion

Failure Rates

A leak or rupture of a tank, release some or all of its content, can be caused by brittle failure of the tank wall, welds or connected pipework due to use of inadequate materials, combined with loading such as wind, earthquake or impact. Failure rates for selected MCLS' are provided in ***Table 7-8.***

Table 7-8: Failure Frequency for Storage Tanks

Categories	Catastrophic Rupture Frequency	Categories
Refrigerated Storage Tank (Single Wall)	2.3×10^{-5}	1.0×10^{-5}
Refrigerated Storage Tank	2.5×10^{-8}	1.0×10^{-5}
(Double Walled)	(for primary containment)	
Pressure Vessels	4.7×10^{-7}	1.2×10^{-5} (for Hole Size 3 to 10 mm)
		7.1×10^{-6} (for Hole Size 10 to 50 mm)

Reference: International Association of Oil & Gas Producers (OGP); Report No. 434-3, March 2010

Also, the risk assessment is considered using certain internationally recognized yardsticks for measuring risk. These first need to be explained, and this is done as ***Table 7-9.***

Table 7-9: Broadly Accepted Frequency

Annual Fatality risk level per year	Conclusion
10^{-3}	Unacceptable to everyone. Immediate action shall be taken to reduce the hazards
10^{-4}	Willing to spend public money to control hazards, such as traffic signs, fire departments etc.
10^{-5}	People still recognize. Safety slogans have precautionary rings. Such as never swim alone, never point a gun
10^{-6}	Not of great concern to everyone. People are aware of these hazards but feel that they cannot happen to them. Such as Lightning Never Strikes twice an Act of God.

7.2.5 Simulation of Release & Development of Contours

As the MCLS' were developed for the selected set of chemicals, the next step is to carry out the consequence analysis. The consequence analysis results along with their contours are presented in the following sections:

Diethylene Glycol

Radiation level and effect distance are presented in ***Table 7-10***, whereas the flash fire distance is presented in ***Table 7-11,*** whereas the Overpressure Effect distance in ***Table 7-12.***

Table 7-10: Radiation Level and Effect Distance due to Release of DEG

Chemical (Storage Tank)	Failure Scenarios	Consequence	Met. Data	Effect Distance in Meters to Radiation Level		
				4 kW/m²	12.5 kW/m²	37.5 kW/m²
DEG	10 mm Leak	Latepool Fire	1.5/D	75	49	33
			1.0/E	74	48	31
			4.0/D	74	50	35
	25mm Leak	Jet Fire	1.5/D	NR	NR	NR
			1.0/E	NR	NR	NR
			4.0/D	NR	NR	NR
		Latepool Fire	1.5/D	119	75	49
			1.0/E	117	74	47
			4.0/D	118	77	53

Chemical (Storage Tank)	Failure Scenarios	Consequence	Met. Data	Effect Distance in Meters to Radiation Level		
				4 kW/m²	12.5 kW/m²	37.5 kW/m²
	Catastrophic Rupture	Latepool Fire	1.5/D	119	75	49
			1.0/E	117	74	47
			4.0/D	118	77	53
NR: Not Reached						

Table 7-11: Flash fire Distance due to Release of DEG

Chemical (Storage Tank)	Failure Scenario	Consequence	Met Data	Effective Distance in (m)	
				0.5 LEL (10000 ppm)	LEL (20000 ppm)
DEG	10 mm leak	Flash fire	1.5/D	6	4
			1.0/E	7	4
			4.0/D	4	4
	25 mm leak	Flash fire	1.5/D	14	11
			1.0/E	14	11
			4.0/D	14	9
	Catastrophic Rupture	Flash fire	1.5/D	18	18
			1.0/E	18	18
			4.0/D	21	21

Table 7-12: Overpressure Distances due to Release of DEG

Chemical (Storage Tank)	Failure Scenarios	Consequence	Met Data	Overpressure Distances in Meters		
				0.02 bar	0.21 bar	1 bar
DEG	25mm Leak	Late explosion	1.5/D	34	15	12
			1.0/E	33	15	12
			4.0/D	34	15	12
	Catastrophic Rupture	Late explosion	1.5/D	14	11	10
			1.0/E	14	11	10
			4.0/D	25	21	20

The contours for effect distance generated for the release of Diethylene Glycol are presented in ***Figure 7-1 to Figure 7-3.***

Figure 7-1: Late Pool Fire Consequence Contour due to 10 mm leak in DEG tank at Weather condition 1.0/E

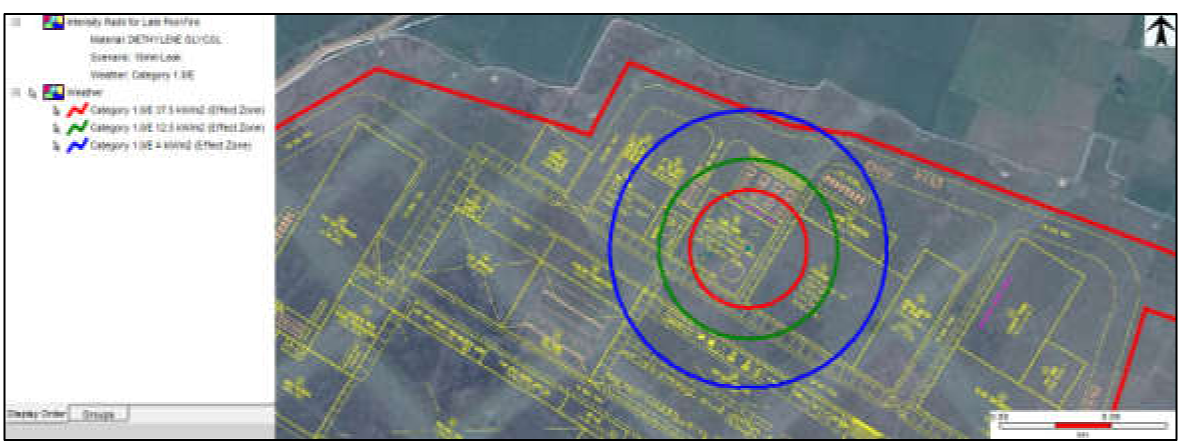


Figure 7-2: Late Pool Fire Consequence Contour due to Catastrophic Rupture in DEG tank at Weather Condition 1.5/D

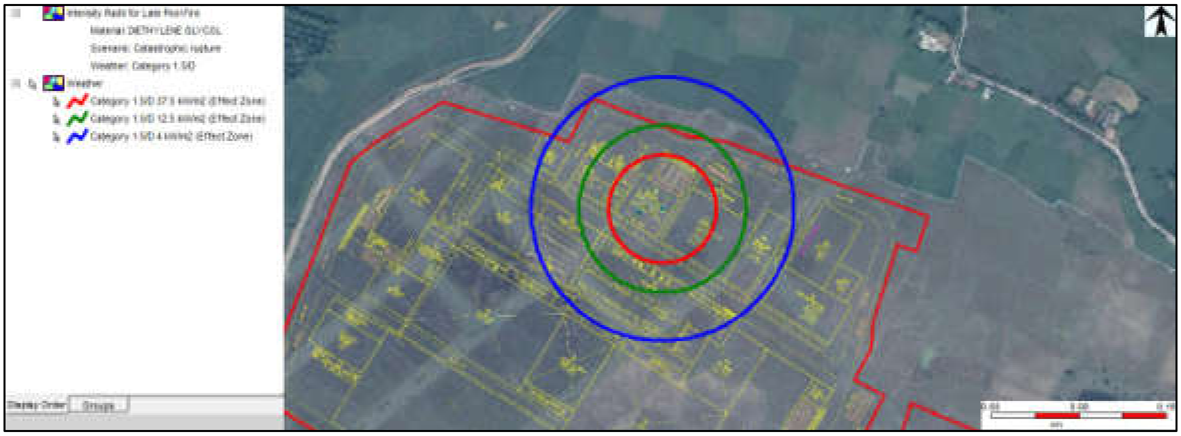


Figure 7-3: Worst Case Radii Consequence Contour due to Catastrophic Rupture in DEG tank at Weather Condition 4.0/D

Mono Ethylene Glycol

Radiation level and effect distance are presented in ***Table 7-13,*** whereas the flash fire distance is presented in ***Table 7-14***, whereas the Overpressure Effect distance in ***Table 7-15.***

Table 7-13: Radiation Level and Effect Distance due to Release of MEG

Chemical (Storage Tank)	Failure Scenarios	Consequence	Met. Data	Effect Distance in Meters to Radiation Level		
				4 kW/m²	12.5 kW/m²	37.5 kW/m²
MEG	25mm Leak	Jet Fire	1.5/D	NR	NR	NR
			1.0/E	NR	NR	NR
			4.0/D	NR	NR	NR
		Latepool Fire	1.5/D	109	69	46
			1.0/E	108	68	44
			4.0/D	107	70	49
	100mm Leak	Jet Fire	1.5/D	NR	NR	NR
			1.0/E	NR	NR	NR
			4.0/D	NR	NR	NR
		Latepool Fire	1.5/D	109	69	46

			1.0/E	108	68	44
			4.0/D	107	70	49
	Catastrophic Rupture	Latepool Fire	1.5/D	109	69	46
			1.0/E	108	68	44
			4.0/D	107	70	49
NR: Not Reached						

Table 7-14: Flash fire Distance due to Release of MEG

Chemical (Storage Tank)	**Failure Scenario**	**Consequence**	**Met Data**	**Effective Distance in meter**	
				0.5 LEL (16000 ppm)	**LEL (32000 ppm)**
MEG	25 mm leak	Flash fire	1.5/D	6	6
			1.0/E	6	6
			4.0/D	6	6
	100 mm leak	Flash fire	1.5/D	7	7
			1.0/E	7	7
			4.0/D	7	7
	Catastrophic Rupture	Flash fire	1.5/D	37	37
			1.0/E	37	37
			4.0/D	44	44

Table 7-15: Overpressure Distances due to Release of MEG

Chemical (Storage Tank)	**Failure Scenarios**	**Consequence**	**Met Data**	**Overpressure Distances in Meters**		
				0.02 bar	**0.21 bar**	**1 bar**
MEG	Catastrophic Rupture	Late explosion	1.5/D	66	37	33
			1.0/E	67	37	33
			4.0/D	77	43	43

The contours for effect distance generated for release of Mono Ethylene Glycol are presented in ***Figure 7-4*** to ***Figure 7-7***.

Figure 7-4: Late Pool Fire Consequence Contour due to 25 mm leak in MEG tank at Weather condition 1.0/E

Figure 7-5: Late Pool Fire Consequence Contour due to Catastrophic Rupture in MEG tank at Weather Condition 1.0/E

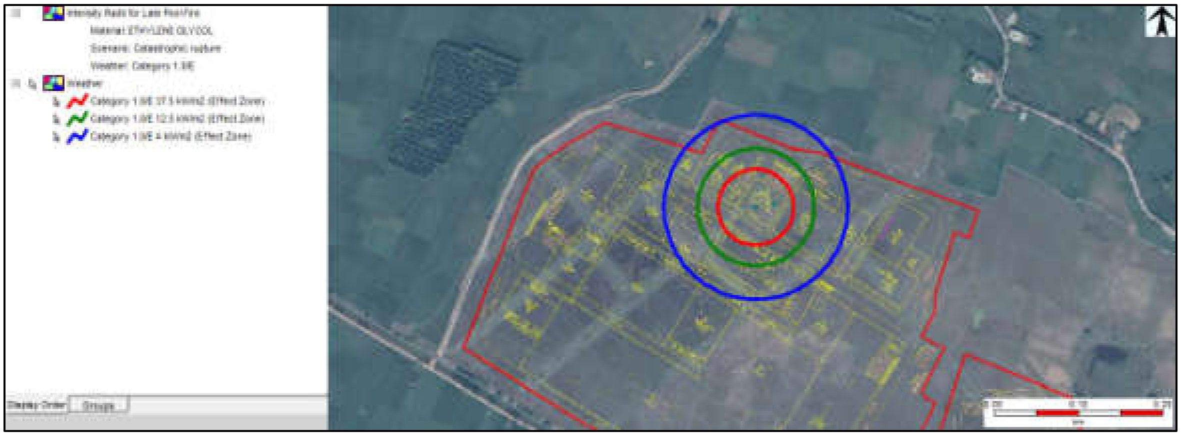


Figure 7-6: Flash Fire Consequence Contour due to Catastrophic Rupture in MEG tank at Weather Condition 4.0/D

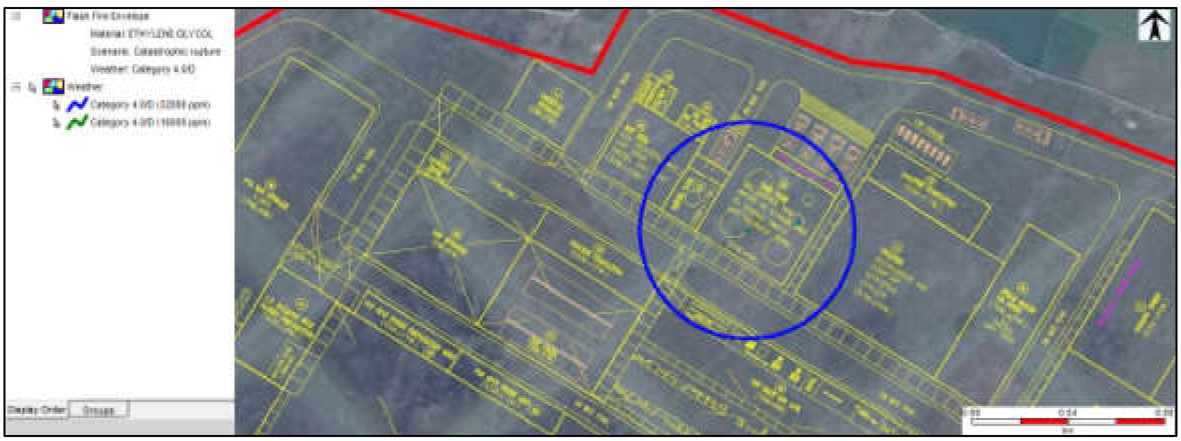
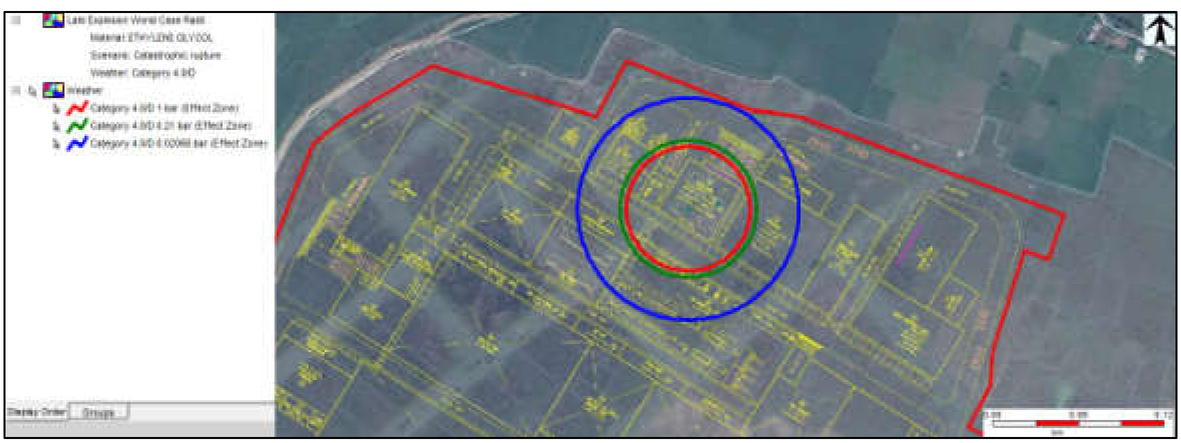


Figure 7-7: Worst Case Radii Consequence Contour due to Catastrophic Rupture in MEG tank at Weather Condition 4.0/D



HSD

Radiation level and effect distance are presented in ***Table 7-16***, whereas the flash fire distance is presented in ***Table 7-17***, whereas the Overpressure Effect distance in ***Table 7-18.***

Table 7-16: Radiation Level and Effect Distance due to Release of HSD

Chemical (Storage Tank)	Failure Scenarios	Consequence	Met. Data	Effect Distance in Meters to Radiation Level		
				4 kW/m²	12.5 kW/m²	37.5 kW/m²
HSD	25mm Leak	Jet Fire	1.5/D	15	12	10
			1.0/E	15	12	10
			4.0/D	13	10	8
		Flash Fire	1.5/D	42	16	NR
			1.0/E	39	15	NR
			4.0/D	50	19	NR
	100mm Leak	Jet Fire	1.5/D	37	29	24
			1.0/E	38	30	25
			4.0/D	36	27	22
		Latepool Fire	1.5/D	42	16	NR
			1.0/E	39	15	NR
			4.0/D	50	19	NR
	Catastrophic Rupture	Latepool Fire	1.5/D	42	16	NR
			1.0/E	39	15	NR
			4.0/D	50	19	NR
NR: Not Reached						

Table 7-17: Flash fire Distance due to Release of HSD

Chemical (Storage Tank)	Failure Scenario	Consequence	Met Data	Effective Distance in meter	
				0.5 LEL (4000 ppm)	LEL (8000 ppm)
HSD	25 mm leak	Flash fire	1.5/D	34	14
			1.0/E	31	12
			4.0/D	24	10
	100 mm leak	Flash fire	1.5/D	39	16
			1.0/E	37	16
			4.0/D	39	18
	Catastrophic Rupture	Flash fire	1.5/D	79	33
			1.0/E	82	32
			4.0/D	78	35

Table 7-18: Overpressure Distances due to Release of HSD

Chemical (Storage Tank)	Failure Scenarios	Consequence	Met Data	Overpressure Distances in Meters		
				0.02 bar	0.21 bar	1 bar
HSD	25mm Leak	Late explosion	1.5/D	50	34	32
			1.0/E	47	33	31
			4.0/D	35	23	21
	100mm Leak	Late explosion	1.5/D	52	34	32
			1.0/E	51	34	32
			4.0/D	53	34	32
	Catastrophic Rupture	Late explosion	1.5/D	203	75	66
			1.0/E	202	75	66

			4.0/D	208	72	62

The contours for effect distance generated for release of High Speed Diesel are presented in ***Figure 7-8*** to ***Figure 7-13***.

Figure 7-8: Jet Fire Consequence Contour due to 25 mm leak in HSD tank at Weather condition 1.0/E

Figure 7-9: Flash Fire Consequence Contour due to 25 mm leak in HSD tank at Weather condition 1.5/D

Figure 7-10: Worst Case Radii Consequence Contour due to 25 mm leak in HSD tank at Weather condition 1.5/D

Figure 7-11: Late Pool Fire Consequence Contour due to Catastrophic Rupture in HSD tank at Weather condition 4.0/D

Figure 7-12: Flash Fire Consequence Contour due to Catastrophic Rupture in HSD tank at Weather condition 1.0/E

Figure 7-13: Worst Case Radii Consequence Contour due to Catastrophic Rupture in HSD tank at Weather condition 4.0/D

7.2.6 Conclusions

Table 7-19: Conclusion of Consequence Analysis

Chemical	Scenario	Effective Distance in meter				Consequence Zone
		At Radiation Level 4 kW/m²	At Radiation Level 37.5 kW/m²	At Overpressure 0.02 bar	At Overpressure 1 bar	
Diethylene Glycol	10 mm leak	75 at 1.5/D	35 at 4.0/D	-	-	Within the site
	25 mm leak	119 at 1.5/D	53 at 4.0/D	34 at 1.5/D & 4.0/D	12 at 1.5/D, 1.0/E & 4.0/D	Within the site
	Catastrophic Rupture	119 at 1.5/D	53 at 4.0/D	25 at 4.0/D	20 at 4.0/D	Within the site
Mono Ethylene Glycol	25 mm leak	109 at 1.5/D	49 at 4.0/D	-	-	Within the site
	100 mm leak	109 at 1.5/D	49 at 4.0/D	-	-	Within the site
	Catastrophic Rupture	109 at 1.5/D	49 at 4.0/D	77 at 4.0/D	43 at 4.0/D	Within the site
HSD	25 mm leak	50 at 4.0/D	10 at 1.5/D & 1.0/E	50 at 1.5/D	32 at 1.5/D	Within the site
	100 mm leak	50 at 4.0/D	10 at 1.0/E	53 at 4.0/D	32 at 1.5/D, 1.0/E & 4.0/D	Within the site
	Catastrophic Rupture	50 at 4.0/D	-	208 at 4.0/D	66 at 1.5/D & 1.0/E	Within the site

7.2.7 Individual Risk

Individual risk is the annual risk of death or serious injury to which specific individuals are exposed. Whether the risk is tolerable can be judged relatively easily as individuals knowingly take and accept risks all the time by, for example, travelling in a car. By reference to known statistics about such risks, it is generally accepted that risk of death or serious injury to third parties should not exceed 1 in 10,000 in any year and that risk below 1 in 100,000 is negligible in relation to other accepted risks. Between these limits, the risk arising from a hazard must be made "as low as reasonably practicable" (ALARP).

The iso–risk contours representing Location specific individual risk (LSIR) in Hazardous chemical storages are shown in the ***Figure 7-14.***

Figure 7-14: Risk Contours for Individual Risk – Hazardous chemical storages

7.2.8 Societal Risk

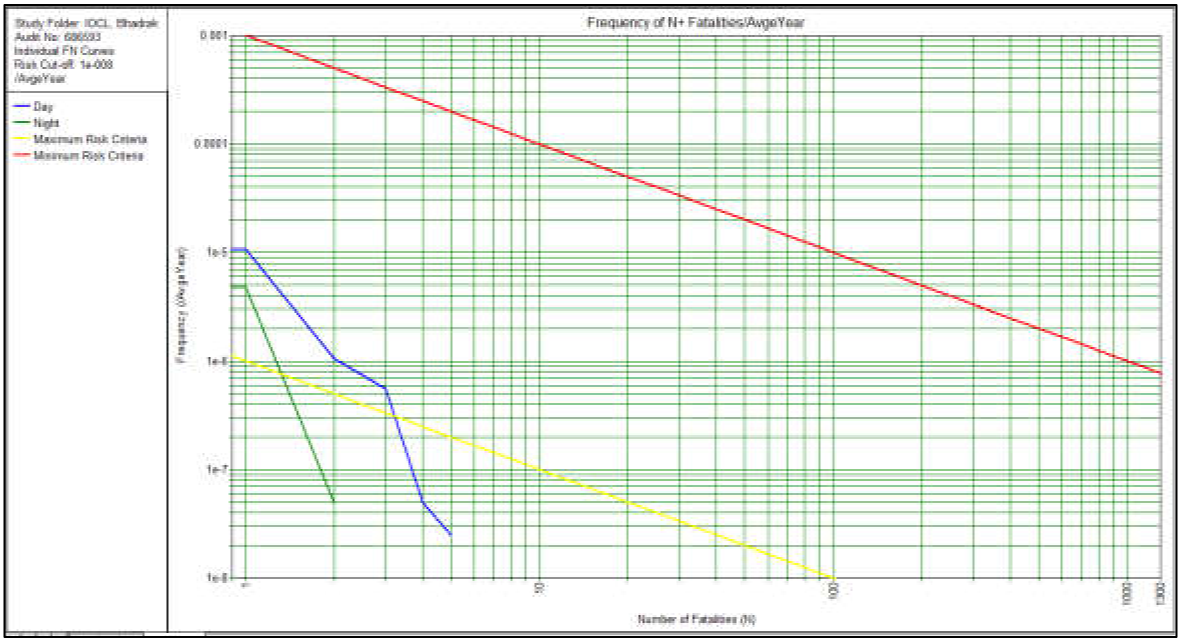
Individual risk does not, however, completely describe situations where a single accident could kill or injure large numbers of people. Decision makers are aware that there is a big public reaction when, for example, a train crash kills a number of people while the fact that a greater number die on the UK's road everyday goes largely unnoticed. The cost effectiveness of risk reduction measures must be assessed in relation to the likely number of casualties.

These situations are addressed by estimating ***societal risk*** which is expressed as the relationship between the probability of a catastrophic incident, expressed as the average frequency with which it can be expected to occur, and its consequences. It is usually represented as an F-N curve.

This graph plots the expected annual frequency (F) of the number (N or more) of casualties in the whole surrounding area arising from all possible dangerous incidents at a hypothetical hazardous site. Note that the number of casualties (N) is cumulative so the curve can only increase towards the left of the graph.

The FN Curve representing Location specific societal risk for Hazardous chemical storages are shown in ***Figure 7-15***.

Figure 7-15: FN Curve for Societal Risk – Hazardous chemical storages (Using HK standard from Societal Risk Estimation, Hall and Floyd)



- DAY POPULATION: PLANT: 2,000; VILLAGE: 150
- NIGHT POPULATION: PLANT: 800; VILLAGE: 265
- IGNITION SOURCE: BOILER, CANTEEN, VILLAGE KITCHENS

7.2.9 Risk Criteria

Risk criteria are the acceptable levels of risk that can be tolerated under a particular situation, 'In many countries the acceptable risk criteria has been defined for industrial installations and are shown in below photograph. These criteria are yet to be defined in the Indian context, but values employed in other countries can be used for comparison.

RISK CRITERIA IN SOME COUNTRIES

Authority and Application	Maximum Tolerable Risk (Per Year)	Negligible Risk (Per Year)
VROM, The Netherlands (New)	1.0E - 6	1.0E - 8
VROM, The Netherlands (existing)	1.0E - 5	1.0E - 8
HSE, UK (existing hazardous industry)	1.0E - 4	1.0E - 6
HSE, UK (New nuclear power station)	1.0E - 5	1.0E - 6
HSE, UK (Substance transport)	1.0E - 4	1.0E - 6
HSE, UK (New housing near plants)	3 × 1.0E - 6	3 × 1.0E - 7
Hong Kong Government (New plants)	1.0E - 5	Not used

7.2.10 Treatment & Control

After examining the high priority risks, a prime consideration is given to the potential to reduce or eliminate the risk by using the hierarchy of controls. This assists in establishing methods to reduce risk. The desirability of control plans (with reducing effectiveness) is as follows;

- Elimination: Take step to eliminate the hazard completely,
- Substitution: Replace with less hazardous material, substance or process,
- Separation: Isolate hazard from person by guarding, space,
- Administrative: Adjusting the time or conditions of risk exposures
- Engineering Control: includes designs or modifications to plants, equipment, ventilation systems, and processes that reduce the source of exposure.
- Training: Increasing awareness, improving skills and making tasks less hazardous to persons involved,
- Personal protective equipment: Use appropriately designed and properly fitted PPE.

Control measures can reduce either the likelihood or consequence of the event or both. Depending on the level of reduction of the hazard, there could still be a residual risk that needs to be monitored so that a secondary prevention process can be initiated when trigger points are reached.

The control measures and action will be adopted by M/s IOCL to minimize the risk present in the facility for the hazardous event are summarized in ***Table 7-20.***

Table 7-20: Event Consequences, Treatment and Control

Hazardous Event	Possible Consequences	Treatment and Control
Loss of containment Rupture / leak in storage tanks	Fire, explosion and toxic hazards	Gas detectors, Dyke wall provision, Level indicator, Earthing, flame arrestor & visual observation, Ready availability of fire extinguishers and fire hydrant system

7.2.11 Precautions to be taken during hazardous chemical handling & storage

Diethylene Glycol

Handling & Storage

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist. Store in cool place. Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage. Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personnel Protective Equipment

Eye Face Protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH.

Skin Protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection

Complete suit protecting against chemicals, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory Protection

Where risk assessment shows air-purifying respirators are appropriate use respirator cartridges as a backup to enginee protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards.

Mono Ethylene Glycol

Handling & Storage

Observe all fire-fighting measures (no smoking, do not handle with naked flame and remove all possible sources of ignition). Take precautionary measures against static discharges. Wear recommended personal protective equipment and observe instructions to prevent possible contact of substance with skin and eyes and inhalation. Avoid leak to environment.

Storerooms should meet the requirements for the fire safety of constructions and electrical facilities and should be in conformity with valid regulations. Store in cool, well-ventilated place with effective exhaust, away from heat and all sources of ignition. Store in tightly closed container. Do not store together with oxidizing agents.

Personnel Protective Equipment

Eye Protection

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

Hand Protection

Wear gloves of impervious material.

Body Protection

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Protective coverall antistatic design recommended, impervious when handling big amounts (nitrile rubber), sealed leather footwear (free from synthetic adhesives).

Respiratory Protection

If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-face piece respirator, airline hood, or full face piece self-contained breathing apparatus. protective mask with canister A (brown coloured, protecting against organic vapours), self-contained breathing apparatus.

High Speed Diesel (HSD)

Handling & Storage

Do not expose to heat and naked lights, keep containers and valves closed when not in use.

Personnel Protective Equipment

Canister type gas mask. PVC or Rubber. Goggles giving complete protection to eyes. Eye wash fountain with safety shower.

7.2.12 Precautions to be taken during handling for other chemicals

Following are some precautions will be taken during the handling of material in plant premises:

- All hazardous and toxic chemicals (acids, alkalines, some salts, and organics) must be identified. Material information sheets must be acquired and specific warning sign must be shown for potentially dangerous chemicals.
- In transfer of chemicals, proper handling precautions provided by manufacturer must be observed. All containers for storage should be chemical resistant, leak free, and with good caps of stoppers.
- Gloves and goggles should be used while handling chemical of toxic nature. It is preferred that at least two persons should be present at all time while working with chemicals.
- Heating flammable solvent may cause fire. Such work must be carried out in a well-ventilation fume-cupboard.
- When anybody is contact with the chemical, flush the body with plenty of fresh water and report the accident to the laboratory technician.
- Waste products and disposals must be discharged with proper neutralization. If the material to be disposed is extremely toxic or poisonous, the material should be kept in closed container and sent to appropriate agency for proper disposal.

7.2.13 Precautions to be taken during Transportation for other chemicals

Following are some precautions to be taken during loading and unloading of material in plant premises:

- Before the tanker enters the industry premises, the tanker is to be inspected for authorized entry and safe & sound condition of the tanker, its contents and that of the prime mover. Tankers entering plant are to be fitted with flare arresters on their exhaust;
- Static charge neutralizing;
- The quality of the chemical in the tanker should be ascertained before unloading to avoid contamination of chemical already at storage;
- Coupling used for connecting hose to tanker must be leak proof;
- For flammable chemicals, the tanker and the hose are to be properly earthed before starting unloading operation;
- Unloading should be done under personal supervision of responsible staff authorized by the management;
- Provision of sample quantity of water / neutralizing medium to take care of leakage / spillage must be made. Also steam and inert gas hose stations must be available at unloading point.
- Fire alarm and firefighting facility commensurate with the chemical should be provided at the unloading point.

7.3 DISASTER MANAGEMENT PLAN

The Disaster Management Plan (DMP) is a guide, giving general considerations, directions and procedures for handling emergencies likely to arise from planned operations. Site specific documentation contingent to – and demonstrating suitable implementation of the DMP is described in the annexures to the DMP. The annexures, being site specific, will require to be updated once the actual site operations are underway.

The DMP must also be revaluated prior to start of operations and it is the responsibility of the Plant Manager to do this. The DMP has been prepared for IOCL Industry on the basis of the Risk Assessment and related findings covered in the earlier chapters of this report.

7.3.1 Identification & Prevention of Possible Emergency Situations

Identification of Emergencies

Possible emergency situations can broadly be classified into, fire or explosion. While doing so, it is stressed that these results are only for the modelled scenarios and that the distances as well as damages can change depending upon the actual development of a scenario. Additional emergency situations can be developed on the basis of audit / HAZOP or other procedures prior to commencement of operations.

Emergency Preventions

Some of the ways of preventing emergencies are as follows:

- Preparation of a Preventive Maintenance Schedule Programme based on recommendations and also covering maintenance schedules for all critical equipment and instruments as per recommendations of the manufacturers user manuals.
- Importantly, it is of great importance to collect and analyse information pertaining to minor incidents and accidents at the site, as well as for recording near-misses or emergencies that were averted. This information gives an indication of how likely or unlikely it is for the site to face actual emergencies and what should be further done to prevent them from occurring.
- Establishment of an ongoing training and evaluation programme, incorporating the development of capabilities amongst employees about potential emergencies and ways and means of identifying and averting the same. Most emergencies do not occur without some incident or an abnormal situation. So there is always sometime of few seconds to few minutes to arrest an incident of abnormal situation from turning in to an emergency. This is the role of the shift in-charge who is the incident controller (IC) along with his shift team.

7.3.2 Formation of Emergency Plan Objectives

An emergency in the plant premises has the potential to cause serious injury or loss of lives or extensive damage to the property and/or environment and serious disruption both inside and outside the plant. In such cases sometimes outside agencies are required to call for help in handling the situation. The causative factors like plant/equipment failure, human error, earth quake, sabotage etc. will normally manifest in various forms viz. fire, Explosion, Toxic release, Structure collapse etc.

This OEP lays down the code of conduct of all personnel in the Plants and the procedures to be adopted by them in the event of an "Emergency". These procedures have been prepared taking into account the minimum strength of manpower available at all times in the plant premises. The individuals under the direction of the respective Team Leaders shall carry out the responsibilities assigned. However, Chief Controller has authority to approve of deviations and reassign the work for any individuals.

The emergency procedures outlined are suitable for round the clock coverage including holidays. These emergency procedures shall be followed as outlined in the OEP during general shifts as well.

Specific objectives of the Emergency Response Plan are to be clearly listed with regards to the responses desired for successful management of the possible emergency situations. Suggested Objectives could, initially include:

The primary objective of the emergency procedure is to safeguard of life of the personnel working in the plant and the plant itself. Another objective is to familiarize all employees with the organizational set-up to combat any emergency likely to arise. The OEP is also to develop a permanent infrastructure of trained persons and suitable facilities to meet probable eventualities that may affect safety of people, plant and/or environment.

The overall objectives of OEP are:

- To control the situation and if possible eliminate as quickly as possible.
- To avoid confusion/panic and to attend the emergency with clear-cut line of action.
- To minimize the loss of property to the plant as well as to our neighborhood.
- To safe guard the non-affected areas.
- To alert the neighborhood.
- To arrange head-count and rescue operation.
- Treatment of the injured.
- To safeguard others by timely evacuation.
- To prevent any cascade of emergencies.
- To preserve the records.
- To obtain external assistance, if required.

- To restore the normalcy.
- To investigate and take necessary steps to prevent the recurrence.
- To ensure safety before personnel re-enter and resume the work.

Emergencies can be categorized into three broad levels on the basis of seriousness and response requirements, namely:

Level 1: This is an emergency or an incident which

- Can be effectively and safely managed, and contained within the site, location or installation by the available resources;
- Has no impact outside the site, location or installation?

Level 2: This is an emergency or an incident which –

- Cannot be effectively and safely managed or contained at the location or installation by available resource and additional support is alerted or required.
- Is having or has the potential to have an effect beyond the site, location or installation and where external support of mutual aid partner may be involved.
- Is likely to be danger to life, the environment or to industrial assets or reputation.

Level 3: This is an emergency or an incident with

- Off-site impact which could be catastrophic and is likely to affect the population, property and environment inside and outside the installation, and management and control is done by district administration. Although the Level-III emergency falls under the purview of District Authority but till they step in, it should be responsibility of the unit to manage the emergency.

Note: Level-I and Level-II shall normally be grouped as on-site emergency and Level-III as off-site emergency.

7.3.3 Identification of Credible Hazards

Isolation Segment Classification

For the purpose of the analysis, plant process system should be classified into several isolation segments. Following issues will be taken into consideration for dividing of isolation segment:

- Nature of the process units
- Main process stream of the system
- Flow character, e.g. oil, gas, etc.
- Operation parameters, i.e. temperature, pressure and materials

Shut down Time

The Emergency Shutdown and HIPPS valves are designed to isolate parts of the process upon an emergency in order to limit the available inventory upon a leak and to effectively blow down the sections. Response time for SIS/ DCS shutdown valves is assumed below:

- Release rate >100kg/s, response time is assumed less than 30s
- Release rate between 10-100 kg/s, response time is assumed less than 30s
- Release rate <10kg/s, response time is assumed less than 180s

Leak Frequency

The frequency of the initiating event is usually estimated based on historical leak frequency data and statistic of the amount of potential leak sources derived i.e. 'parts count'. A parts count is a summation of all the potential leak paths in each isolatable section of the process e.g. instrument connection, flanges, pump seals, valve stems, piping, vessels, etc. It is derived from the process piping and instrumentation diagrams (P&ID) taking due account of isolation provisions following a leak. Leak frequencies are then derived by applying a leak frequency to each component.

The objective of the parts count is to identify and record all the leak sources associated with a system under consideration. The parts should be based on the latest revision of P&IDs and should ensure a consistent auditable approach. The approach should be:

- Identify system boundaries: The system boundaries must be clearly identified by isolatable sections.
- Count and record the number of parts in the system: count the components such as equipment, vessels, pipes, valves, flanges etc. and record them against their size.

7.3.4 Emergency Command Structure

Works Main Controller

- Decision of declaring on-site disaster to be taken in consultation with Chief Incident Controller.
- WMC will receive necessary input from Chief Incident Controller /disaster control room from time to time and guide Co-coordinators as desired.
- WMC will facilitate coordination with higher government authorities for seeking any help required.
- Any information to press or to any outside agency should be cleared by WMC.
- He will ensure assistance from mutual aid partners through fire control room.
- WMC should be kept informed about causalities and he will ensure that necessary medical attention is given to causalities in time.
- In case Disaster is beyond control and which may convert to offsite disaster, WMC should be consulted by the Site Incident Controller before communicating district authority.
- WMC will conduct close out meeting with all coordinators after control of disaster.

Site Incident Controller

In an unlikely event of occurrence of an emergency, the chief controller will be responsible for handling the emergency. The incident controller will function with all powers within his command within the plant.

On arrival of other Key Personnel, he can consult of self-combating of emergency or shutting down the plant and co-ordinate for handling the emergency.

He will direct the various teams as specified below:

- Welfare Team
- Rescue Team
- Fire team
- Engineering Team

On receipt of Emergency Call

Take charge of the situation as Incident Controller.

- Rush to the site of emergency to get the correct picture and then to Emergency Control Centre for speedy control over the situation by making an arrangement for raising the alarm.
- On arrival of Team members, he shall assign duties as required and active the On – Site Emergency Plan.
- Ensure safety of the plant and the personnel in the plant. He will make an assignment of the emergency and decide on external assistance.
- Communicate and coordinate among the Dy. Incident Controller, Site Controller, Liaison Officer, Medical Officer and various Team Leaders and will be final authority on all matters related with management of emergency such as:

- Fire Fighting
- Welfare & Rescue Operation
- Arrange for Civil/Mechanical/Electrical work during Emergency
- Calling outside agencies for assistance
- Transport
- Liaison & public relations etc.

Deputy Incident Controller

The Deputy Incident Controller will assist the Incident Controller in all his activities. In the absence of the Incident Controller, the Deputy Incident Controller will carry out the functions of the Incident Controller.

At the same time, he will:

- Evaluate the hazard / situation and advise the Incident Controller.
- Arrange for temporary shelter
- Co-ordinate with all teams
- Arrange for transport of injured people and evacuation
- Arrange for messenger arrange for keeping record of every activity.

Site Controller

Rush immediately to the scene of the fire/emergency, select and set out appropriate fire/emergency equipment. He will take the below mentioned actions at the earliest opportunity, if the fire/emergency is not controlled:

He will;

- Inform the Incident Controller / Dy. Incident Controller about the emergency.
- Call the fire safety personnel from fire station for additional manpower if required.
- Regulate entry and exit of personal requires for controlling the fire/emergency.
- Restrict exit of personal required for controlling the fire/emergency.
- Take command of the fire team.
- Arrange for personnel Protective Equipment required for the emergency.
- Any other work in consultation with the Dy. Incident Controller and / or Incident Controller.
- Take responsibility of law and order.
- Keep detailed records of the incident and progress of operation to fight the emergency.

Liaison Officer

He will rush to the Emergency Control Centre and collect the information from the Incident Controller. Further he will,

- Announce the location of the Assembly Point after getting information from Incident Controller.
- Take the list of persons to be communicated internally and externally.
- Maintain liaison with the press, government agencies i.e. Police, Fire Brigade etc. and the neighbourhood regarding the emergency under instruction from Incident Controller.
- Courteously receive officers from the State Government or neighbours to the Administration Block only and inform to Incident Controller that they can be taken care off.
- Take all the steps required for the welfare such as providing tea, snacks, emergency temporary Medical Centre in consultation with the Incident Controller.
- Disclose all the necessary information in the plant and media so as to avoid rumours and confusion.
- Also be responsible for the head counts at the Assembly Points.

Medical Officer

As soon as emergency is declared, he along with male nurses will remain in the Occupational Health Centre to treat the injured persons. He will,

- Be the Team Leader for the Welfare Team.
- Evaluate the Health Hazard and information according to the Incident Controller.
- Assume complete responsibility for providing medical assistance and treatment during the emergency.
- Provide and arrange for ambulance services and medical facilities from outside agencies and hospitals, if so required through the Incident Controller.
- Inform the hospitals in advance so that they are prepares for the emergency.

Keep continuous communication with the Incident Controller / Dy. Incident Controller / Liaison Officer.

Head – Fire & Safety

- Proceed to the scheme; establish contact with firemen and Incident Controller to supplement efforts in firefighting.
- Assist in searching causalities and help to remove them to the medical centre.
- Organize outside assistance in firefighting and rescue operation if required.
- Mobilize personal protective equipment and safety applications and assist personnel handling emergency in using them.
- Keep and check on any new development of unsafe situation and report the same to Site Main Controller.
- Collect and preserve evidence to facilitate future inquiries.

Head – Security

- Control Traffic Movement.
- Remove tankers, tanker drivers outside.
- Entry of unauthorized public to be prevented.
- Arrange for vehicles for shifting causalities and essential workers to safe points.

Telephone Operators

On hearing the emergency alarm, he / she will,

- Immediately contact Incident Controller Key – Personnel and other Team Members of the OEP.
- Call the local Fire Brigade, RTO, Home guard or Police an advice of the Incident Controller.
- Follow instructions only from the Incident Controller / Dy. Incident Controller.
- Keep the telephone board free for urgent communications with external agencies.
- Inform the Govt. agencies such as Factory Inspectorate, Electrical Inspectorate and Pollution Control Board etc., if asked by the Incident Controller.

Responsibilities of Various Team

Welfare Team

Be responsible for providing First Aid and Canteen facilities such as snacks to the injured as and when required.

- He will mobilize all the available First Aiders to report at the dispensary.
- He will accompany the injured to the dispensary in the Ambulance.
- He will provide necessary medicines.
- Maintain list of names of all personnel for whom treatment has been given and others who have been directed to the hospital.
- He will assist the Liaison Officer.

Engineering Team

This team will;

- Ensure the safety of the remaining part of the plant.
- Take necessary steps for plant shutdown in consultation with the Incident Controller.
- Ensure that an Operator is immediately available at the Water Pump House for firefighting.
- Mobilize with necessary tools and tackles to handle any repair work on an emergency basis.

Fire & Rescue Team

The team will,

- Directly fight the emergency under the instruction from the Team leader and Emergency Coordinator.
- Cordoned off the area of emergency with the help of Fire Team so that it does no escalate.
- Collect information about contractor employees from Security Department and number of company employees from Time Office.
- Ensure that the list of all personnel who have entered the plant is made available immediately.
- Wear the necessary Personal Protective Equipment while doing rescue operation.
- Facilitate easy rescue of affected personnel either to the hospital or dispensary.
- Ensure that the non-concerned personnel are evacuated from the scene of the emergency.

Security Team

The team will,

- Ensure that the main gates are closed and movement restricted and prevent external people entering the premises and cause confusion.
- Take instruction from Site Controller and will arrange to provide security coverage at the main gate and at the site of occurrence of the emergency.
- Effectively cordon off the emergency area and will prevent unauthorized people entering the scene.
- Permit the Fire tenders or Ambulance requisitioned by Incident Controller to the Plant.
- Ensure that vehicles and lorries are sent out of the plant premises.
- Eliminate the source by transferring materials to safer place.
- Ensure that contractor's personnel are conducted out of plant and assembled at Assembly Point.

CLOSING /ALL CLEAR / RE-ENTRY PROCEDURE

- All clear will be declared by Site Incident Controller. He will declare it after the emergency has been successfully tackled and situation is under complete control, as verified at site and after consultation with all the coordinators.
- All clear will be communicated through siren as per siren code i.e. straight siren for two minutes. The siren will be sounded by F&S section on the instruction from the Fire & Safety Controller.
- After the all clear siren, Site Incident Controller will constitute a team for assessing the damage done and formulate the procedure for re-entry and re-commissioning of the unit / facility.
- Team will be comprising of personnel from – Fire & Safety, Production, Maintenance, Inspection, Technical Services etc.
- Team will carry out a thorough audit of the affected area, assess the damage done, identify the repair jobs will be carried out and accordingly formulate the plan based on which the unit / facility will be commissioned.

Procedure on Noticing an Emergency

- If anybody notices any situation, which may lead to a de\disaster, should be immediately inform the Shift In-charge / Incident Controller / Dy. Incident Controller/ Fire & Safety / Security Gate / Telephone Operator.
- In case of injury inform Medical Center.
- Get back to your normal workstation if safe, or else report to the assembly point.

7.3.5 Facilities available in Emergency Situation

Fire Protection

General

The Facility will be provided with a fire water system consisting of fire water storage tanks, fire water pumps and a fire main network that will support the necessary hydrants, monitors, hose reels and fixed systems required throughout the facility.

The fire-fighting system consists of one Fire Water Tank having capacity of 1,100 m^3, 2 electric driven pumps having capacity 275 m^3/hr along with a required jokey pump and one diesel driven pump having capacity 275 m^3/hr for standby. A fire protection and alarm system, communication system and telephone system have been envisaged for the proposed plant.

Water Supplies

The facility will be provided with fire water storage.

Foam System

The Facility will be provided with fixed or semi-fixed or mobile foam systems to extinguish hydrocarbon fires and prevent ignition/ re-ignition of hydrocarbon spills.

Carbon Dioxide System

Fixed fire extinguishing systems utilizing carbon dioxide as the extinguishing medium will be provided.

Steam System

Steam will be used to avoid the escalation of flange fires and at hot pumps. Low pressure steam will be applied for smothering small fires using properly earthed steam lances located at Utility Stations.

Mobile Monitors

Trailer mounted firewater monitors will be provided where necessary to give cover where the risk is obstructed by structures, pipe rack or other equipment.

Safety Equipment

Breathing Air Sets:

Breathing air sets will be provided to rescue operation in toxic and Oxygen deficient environment.

Safety Showers and Eye Wash Units

Safety showers and eyewash units will be installed wherever there is a risk of exposure of personnel to irritants that are toxic by absorption, material being handled at elevated temperatures or chemicals that can cause immediate or irreversible damage on contact with the skin. If the potential hazard is only to the eyes, then an "eyewash only" unit will be provided however a shower unit always include an eyewash unit.

Personal Protection Equipment (PPE)

Personal protection equipment such as gas masks, portable H_2S and CO gas detectors, explosimeters, tripod mounted mobile multi-gas detectors, fire protection suits, gloves, fireman's equipment cabinets, safety goggles, hard hats, toe protector boots will be made available on site for specialist and general use.

Fire Training Ground

A fire training ground will be provided. The training ground consist of an area of at least 10,000 m^2 concrete base equipped with a number of training skids and provided with all necessary utilities required to allow the appropriate practical firefighting training.

Fire Detection System

Required buildings on the Facility will be fitted with fire detection and alarm systems, standard building FACP (Fire Alarm Control Panels) located within the building is provided for this purpose. Distributed FDAS (Fire Detection and Alarm Systems) provided for fire detection/protection in the plant areas and connect to fire detectors and alarm devices in the respective Process, Utilities and Offsite areas.

Manual Alarm Call Points (MAC)

A manual alarm call point (MAC) will be located at each exit / near stair case from all buildings. Manual Call Points at the unit peripheral roads are located at maximum interval distances of 61m. Manual Call Points within the units must be located at Max. 60m travel distance from the nearest MCP.

Smoke Detection

Required buildings /areas, offices, corridors, telephone rooms, meeting rooms and similar locations, point type smoke detectors will be installed where there is no sprinkler system installed. Electrical substations have smoke detection systems to be installed. Smoke Detectors located in floor, ceiling voids or HVAC ducts have their associated LED status indicator wired and surface mounted remotely from the detector. This LED status indicator will be illuminated in the event of smoke being detected.

Heat Detection

In kitchens, canteens or similar environments point type heat detectors will be installed. These are combined rate of rise with fixed temperature addressable devices.

In process areas, pneumatic tubing circuits routed around critical equipment to be protected by deluge system. The pneumatic line connected directly to the deluge system. The operation of one of these detectors will sound alarms and the deluge release shall then be automatically initiated over critical equipment and in other cases manually by the site operators.

Flame Detection

Critical equipment handling flammable products and products at or above their auto-ignition temperature to be monitored by infra-red flame detectors.

Location of Gas Detectors

Gas detectors in process and storage areas will be located on the basis of specific spot detection rather than general grid area cover. For siting of fire and gas detectors to provide the detection coverage to specific process equipment within process plots, general guidelines as below is followed.

- Light hydrocarbon pumps in process units
- Process cooling tower top platform in the units having pressurized cooling water return
- Fuel gas knock out drum
- Suction side of forced draft air blowers if located where hydrocarbon vapors may present
- Light hydrocarbon pump station if located below grade level
- LPG Mounded Bullets
- LPG pump house
- LPG bulk truck loading area

- LPG bulk wagon loading area
- LPG bottling, storage, repair sheds
- Gas Compressors
- Class A product storage tanks in tank farm

Fittings & Power Supplies

Gas detectors will be mounted on vibration free mountings and fitted with guards to protect them from mechanical damage, rain, wash water, wind, dust and sand and protected against grease and silicone oils which can contaminate the units. They are readily accessible for calibration and provided with access platforms if necessary to allow for this.

7.3.6 Communication and Alarm System

The following communication system will be provided for the fire defence of the complex.

Telephone

Two (2) internal telephones which is dedicated to receiving fire/ emergency calls only. For general communications separate telephones provided.

Public Address System (PAS)

Public address system will be connected to all control rooms and floors on administration buildings. The FDAS connected to the PAS and it will generate the appropriate alarm tones and/or issue pre-recorded announcements. Upon the receipt of an alarm from the FDAS the operator shall activate the PAS, which shall transmit a pre-recorded fire alarm message to all floors.

Private Portable Radio System

All fire tenders will be provided with intrinsically safe PPR sets which allows communications in the event of failure of other systems. Key personnel involved in co-ordinating emergency operations also be provided with handsets as operators in the main and satellite control rooms.

CCTV

CCTV's will be installed covering tank farm areas and other critical areas. The CCTV will be provided with an alarm to provide warning in case of deviation from any normal situation.

7.3.7 Emergency Do's & Don'ts

Do's	Don'ts
ANY ONE NOTICEING AN EMERGENCY	
• Actuate nearest manual call point and inform the concerned person. • Get back to your normal workplace if safe or else report to the assembly point.	• Panic and avoid running all over the place, prevent other from doing so. • Enter the site unless instructed, if you are outside and disaster alarm is heard.
SECURITY	
• Keep the gate manned. • Keep the road clear for movement of fire tenders, ambulance and control traffic at gate	• Allow unauthorized persons to enter the premises.
ALL EMPLOYEES	
• On hearing alarm go back to work place, if safe instructions from HOD/Supervisor. • Give attention to all instructions. • Switch off the Electrical, fuel, gas supply lines. • Assemble assembly point	• Go to the scene of the emergency unless specifically instructed by Site Controller. • Disturb team members. • Panic and spread exaggerates information. • Communicate with any external agency.

TEAM MEMBERS	
• Report to your leader and carry out your assignment	• Interfere with other team member
FIRST AIDERS	
• Render first aid wherever possible and wait for the Doctor.	• Render first aid if you are not qualified and asked.
OUTSIDE DRIVERS / OWNER OF THE VEHICLES	
• On hearing alarm should move their vehicle out of the gate	• Obstruct the road.
CONTRACT PERSONNEL	
• Stop work on hearing alarm and assemble at the Assembly Point and be ready to evacuate.	• Enter the site until it is cleared for the normal work by Site Controller.
VISITOR	
• Leave the place and assemble at Assembly Point give attention to all instruction.	• Enter the site of emergency. • Disturb the team member. • Panic and communicate with external agency.

7.3.8 Post Emergency Activities

Investigation & Report Preparation

Incident Controller will assess the situation and then declare that the Emergency is over. Even after the emergency is over the team will be available at site for at least half an hour.

After the emergency is over team leaders will prepare the report and submit to the Dy. Incident Controller within 24 hours of the occurrence.

Dy. Incident Controller, Site Controller and Medical Officer will further investigate the emergency jointly and prepare the investigation report for submission to the Incident Controller. Based on this report and visits to the site a final investigation report will be prepare by the Incident Controller and submitted to the concerned authorities within 72 hours of the occurrence.

7.3.9 Setting Up of Emergency Infrastructure

To enable the key persons to implement the DMP, the following infrastructure will require to be set up:

Site Map with Escape Routes and Safe Assembly Points marked on it

Site layouts have to be put up at key areas where assembly is to be done. These points could vary depending upon the atmospheric stability and location and intensity of the emergency.

With the onset of emergency, all non-essential workers (those workers not assigned emergency duty) shall evacuate the area and report to the specified emergency assembly point.

Wind Sock

It is required to install wind sock at the top of any tall structure in the vicinity of the site. In case there is a risk of the structure getting damaged during the emergency, it is desirable to have alternate wind sock(s) as required. At least one wind sock should be visible from any part of the site. Site personnel have to be trained in reading the atmospheric conditions on the basis of the status of the wind sock.

Evacuation, Escape & Rescue (EER) Plan

In a major emergency, it will be necessary to evacuate personnel from effective areas and as a precaution / measure to further evacuate non-essential workers from areas likely to be affected should the emergency escalate. Whether evacuation is required or not can be decided by the Incident Controller, and arrangements made to communicate with employees in this regards. Arrangements could include announcements over the public address system, or through other suitable means.

On evacuation, employees should be directed to pre-determined assembly points already explained earlier. If they are required to be evacuated outside the site and at a remote place, their transportation will be necessary for which vehicles will be required. At remote shelters their care and welfare will also be through beforehand. Employees should use own vehicles fist and then use, if necessary, the mutual aid system or hired vehicles from elsewhere. The vehicle may be needed to warn public also.

Safe Assembly Points

In affected and vulnerable locations, all non-essential workers (who are not assigned any emergency duty) shall evacuate the area and report to a specified assembly point. The need to evacuate non-essential workers from non-affected areas will be determined by the foreseeable rate at which the incident may escalate.

Each assembly point must be situated in a safe place, well away from areas of risk and least affected by down wind direction. It may be in the open or in a building depending on hazard involved. More than one assembly point is needed:

- To ensure that employees do not have to approach the affected area to reach the assembly point;
- In case any assembly point lies in the path of wind-blown harmful materials, e.g. toxic gas, burning brands, thrown (expected) materials and;

Before reaching an assembly point, or subsequently, if it is required to pass through an effected area or the release of toxic substance, suitable personal protective equipment (PPE) including respirator, helmets etc., should be available to the people.

Emergency Control Centre

For the purpose of handling emergency, Emergency Control Centres will be provided for various plants. This centre will be equipped with:

- A copy of On-Site Emergency Plan.
- Address and Telephone numbers of the Factory Inspectorate, Pollution Control Board, Police, Fire Brigade, Hospitals and OEP Team Members.
- Plant layout-indicating storage of hazardous materials, lay out of fire Hydrants/extinguishers, entrances/exits, roads etc.
- Manual Siren, Flood Lights, Torches, Pickaxe, Saw, Nylon Ropes.
- Fire Blankets, Fire Proximity Suit, Breathing Apparatus, First Aid Box etc.
- Portable Diesel Generator Set.
- List of employees with address, telephone number, blood group etc.
- One vehicle as stand by for emergency duties.
- Material Safety Data Sheets of all chemical handled.
- Note pads, pen/pencils to record the messages and activities.

Fire Fighting

These include the following facilities:

- Sufficient water supply;
- Dedicated, above ground fire water storage;
- Dedicated fire pumps to pump the water, connected to the DG Set as well as the GEB supply;
- The system should be designed such that when half the aggregate pumping capacity has been discharged at the hydraulically most remote point and the other half in the most vulnerable area.

The following firefighting equipment will be provided at the site:

1. Portable Fire Extinguishers: Potable fire extinguishers will be placed as per the suitability and requirement at strategic locations.
2. Fire Hydrant System (Pressurized)

- Signal Fire Hydrant Post
- Foam Water Monitor
- Fire Escape Hydrant

3. Mechanical Foam Trolley
4. Fire Alarm System
5. Foam Water Tender
6. Water Tender
7. Automatic medium velocity water / foam spray system

First Aid

Well equipped first aid kits will be provided in Plant.

7.3.10 Awareness, Training & Competence

Awareness

General awareness is to be invoked in all site personnel (including contractor's employees) with regards to the importance of safety in general and emergency procedures in particular. Awareness can be generated in a number of ways, some of which are:

- Awareness of Environment, Health and Safety Policies, and the role of each employee in achieving what is covered under the policies;
- Awareness of the importance of carrying out tasks as mentioned in the Standard Operating Procedures and the potential impacts of not doing so;
- The importance of wearing personal protective equipment;
- Awareness with regards to relevant recommendations issued;
- Awareness about relevant portions of the safety instructions covered in equipment manuals used at site.

Training

Specific training requires to be given to key employees. Examples of such training include:

- Testing of critical equipment and controls
- Provision of Cardio-Pulmonary Resuscitation
- Use of firefighting equipment
- Emergency Evacuation and Rescue (EER) procedures.
- Training in use of communication procedures to be followed in case of emergencies.

Training needs identification exercises should be undertaken prior to commencement of operations and the same must cover environment, health and safety issues.

Competence

Competence is a function of training, experience and education. Key persons involved in administering the DMP, should be competent. The level of competence can be decided for each key task and a clearly defined competence chart should be prepared.