7.0 ADDITIONAL STUDIES

7.1 RISK ASSESSMENT, DISASTER MANAGEMENT PLAN

Industrial process & activities inherently pose hazards. There may be possible hazards to human beings, flora-fauna, all forms of property and the environment as a whole. Extreme care is essential in handling all of them in various stages of manufacturing viz. processing, treatment etc. The management aims at full preparedness to meet effectively the eventualities resulting from any unfortunate occurrence of fuel hazards/accidents. Hazard analysis involves the identification and quantification of the various hazards (unsafe conditions) that exist in the project site. On the other hand, risk analysis deals with the identification and quantification of risks; the Terminal equipment and personnel are exposed to, due to accident resulting from the hazards present in the Terminal.

The main objective of the risk assessment study is to determine damage due to major hazards having damage potential to life and property and provide a scientific basis to assess safety level of the facility. The secondary objective is to identify major risk in manufacturing process, operation, occupation and provide control through assessment. To prepare on-site, off site, for control of hazards.

The concept of risk assessment and its industrial application has been well acclaimed since more than a decade. A variety of major accidents have focused attention on the dangers of risk exposure for human health and environment.

Risk analysis (RA) provides a numerical measure of the risk that a particular facility poses to the public. It begins with the identification of potential hazardous events and determination of impact of each event. The consequences of each event are then calculated for numerous combinations of weather conditions and wind direction. These consequences predications are combined to provide numerical measures of the risk for entire facility.

Risk for a particular facility is based on the following variables:

- Multiple accident outcomes
- Population distribution
- Site specific meteorological data

Risk analysis is a tool which helps to translate hindsight (accidents) into foresight (planning) showing ways and means (improved engineering, procedure and supervision) to prevent the calculated accident from happening".

OBJECTIVE OF THE STUDY

Risk assessment is a process of estimating the likelihood of an occurrence of specific consequences (Undesirable events) of a given severity of damage potential to life and property. The main objective of risk assessment study is to determine the potential risks and their likelihood for the proposed activities of the project proponent and accordingly suggesting the mitigation measures.

This is achieved by the following:

- To conduct systematic identification of probable hazards (Toxic/flammable) prevailing in the facility i.e. identification of probable failure scenarios.
- Identification of specific Terminal sections which could trigger events in both process operations and storage areas.

- Identification of maximum credible loss scenario (MCLS) & worst case scenarios taking into account the safety features to be incorporated in the Terminal design and other parameters such as response time, trips provided etc.
- To asses, the potential risks associated with identification hazards to which the Terminal, people and outside community may be subjected to.
- Consequence analysis of various hazards to determine the vulnerable zones for each probable accident scenario.

7.1.1 METHODOLOGY

Risk Analysis is proven valuable as a management tool in assessing the overall safety performance of the Chemical Process Industry. Although management systems such as engineering codes, checklists, and reviews by experienced engineers have provided substantial safety assurances, major incidents involving numerous casualties, injuries and significant damage can occur - as illustrated by recent world-scale catastrophes. Risk Analysis techniques provide advanced quantitative means to supplement other hazard identification, analysis, assessment, control and management methods to identify the potential for such incidents and to evaluate control strategies.

The underlying basis of Risk Analysis is simple in concept. It offers methods to answer the following four questions:

1. What can go wrong?
2. What are the causes?
3. What are the consequences?
4. How likely is it?

This study tries to quantify the risks to rank them accordingly based on their severity and probability. The report shall be used to understand the significance of existing control measures and to follow the measures continuously. Wherever possible the additional risk control measures shall be adopted to bring down the risk levels.

7.1.2 RISK ASSESSMENT PROCEDURE

Hazard identification and risk assessment involves a series of steps as follows:

Step 1: Identification of the Hazard

Based on consideration of factors such as the physical & chemical properties of the fluids being handled, the arrangement of equipment, operating & maintenance procedures and process conditions, external hazards such as third party interference, extreme environmental conditions, and other threats shall also be considered.

Step 2: Assessment of the Risk

Arising from the hazards and consideration of its tolerability to personnel, the facility and the environment, this involves the identification of initiating events, possible accident sequences and likelihood of occurrence and assessment of the consequences. The acceptability of the estimated risk must then be judged based upon criteria appropriate to the particular situation.

Step 3: Elimination or Reduction of the Risk

Where this is deemed to be necessary, this involves identifying opportunities to reduce the likelihood and/or consequence of an accident.

Hazard Identification is a critical step in Risk Analysis. Many aids are available, including experience, engineering codes, checklists, detailed process knowledge, equipment failure experience, hazard index techniques, What-if Analysis, Hazard and Operability (HAZOP) Studies, Failure Mode and Effects Analysis (FMEA), and Preliminary Hazard Analysis (PHA). In this phase all potential incidents are identified and tabulated. Site visit and study of operations and documents like drawings, process write-up etc. are used for hazard identification.

Assessment of Risks

The assessment of risks is based on the consequences and likelihood. Consequence Estimation is the methodology used to determine the potential for damage or injury from specific incidents. A single incident (e.g. catastrophic rupture or heavy leakage) can have many distinct incident outcomes (e.g. Vapour Cloud Explosion (VCE), Pool Fire.

Likelihood assessment is the methodology used to estimate the frequency or probability of occurrence of an incident. Estimates may be obtained from historical incident data on failure frequencies or from failure sequence models, such as fault trees and event trees. In this study the historical data developed by different software models are used.

Risk Assessment combines the consequences and likelihood of all incident outcomes from all selected incidents to provide a measure of risk. The risks of all selected incidents are individually estimated and summed to give an overall measure of risk. Risk-reduction measures include those to prevent incidents (i.e. reduce the likelihood of occurrence) to control incidents (i.e. limit the extent & duration of a hazardous event) and to mitigate the effects (i.e. reduce the consequences). Preventive measures, such as using inherently safer designs and ensuringasset integrity, shall be used wherever practicable. In many cases, the measures to control and mitigate hazards and risks are simple and obvious and involve modifications to conform to standard practice. The general hierarchy of risk reducing measures is:

- Prevention
- Detection
- Control
- Mitigation
- Emergency response

7.1.3 ABOUT SANGRUR POL, TERMINAL

The IOCL POL Terminal is located 4kms away from the Sangrur city on Sangrur-Jind Highway No.71, Village-Kammomajra Khurd, IOCL Sangrur terminal was commissioned in 1992. The Terminal handles MS, SKO, HSD, and Ethanol. MS and Ethanol falls under Flammability Class ‘A’ product as per MSIHC rules-1989 while SKO and HSD falls under Flammability Class ‘B’. The petroleum products are receiving to plant through Panipat-Bathinda cross country pipeline. Petroleum products are then stored in respective storage tanks in a tank farm and dispatched to the dispensing units/dealers through truck tankers. Total area occupied by the plant is approx. 103.81 acres. The site is easily accessible by road.

The nearest railway station is Sangrur approx. 5 km, and nearest domestic airport at Mohali approx. 120 km and International airport at Delhi which is 270 km form Sangrur.

The project activity is to enhance the petroleum product storage capacity of the IOCL terminal from 82,515 KL to 1,99,725 KL by constructing petroleum product storage tanks 2 X 600 KL for ethanol, 4 X 25,000 KL for HSD, 1 X 12,000 KL for HSD and 1 X 4,010 KL for HSD at Indian Oil Corporation Ltd.(MD)

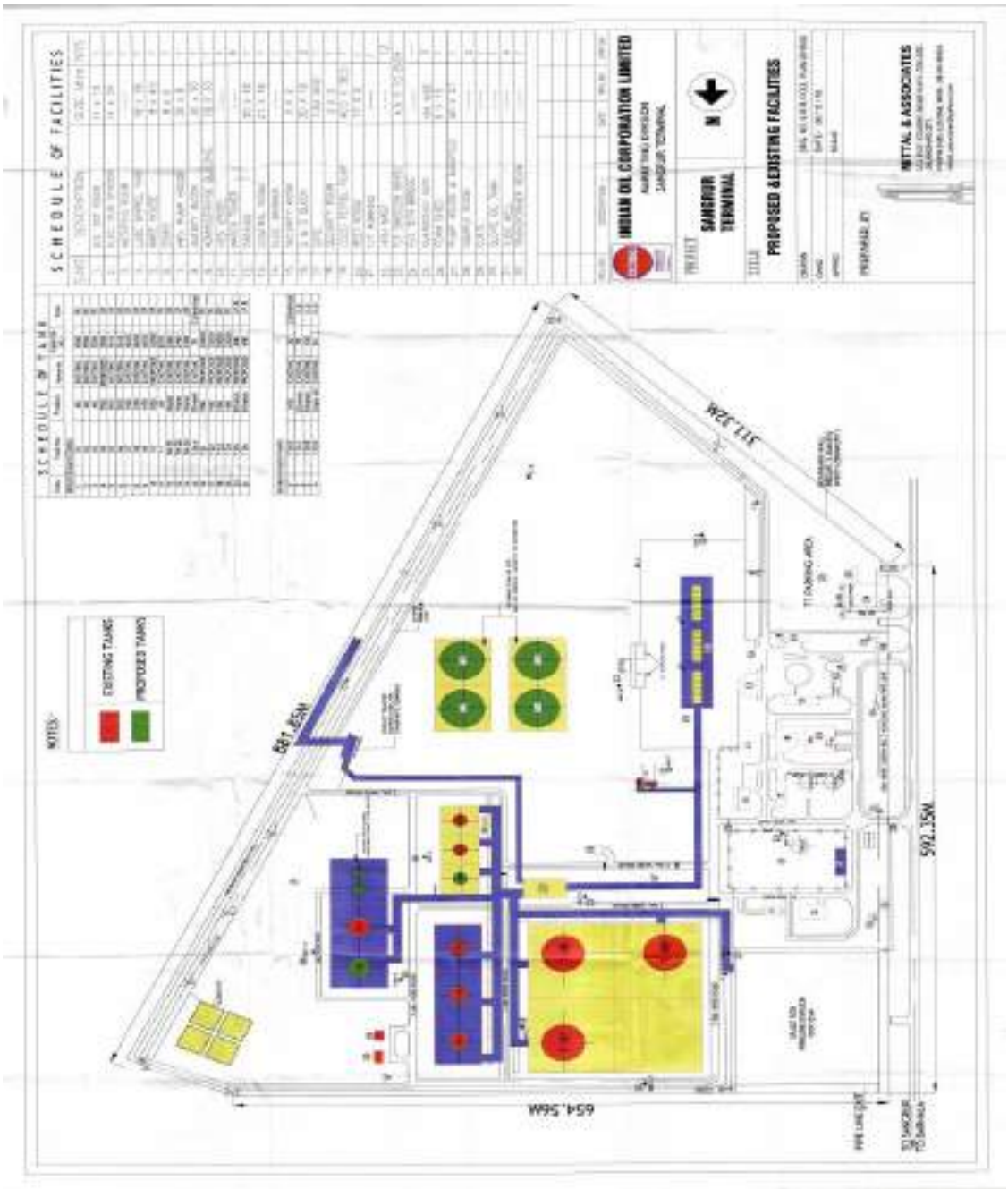


FIGURE 7.1: PLANT LAYOUT

Maximum Inventory of Petroleum products

Details on maximum POL product Inventory at Terminal are provided in below mentioned Table. To analyze Maximum Credible Accident (MCA) Scenarios, following inventory of POL product has been considered:

TABLE 7.1

DETAILS OF EXISTING POL STORAGE CAPACITY OF THE TERMINAL

Sr. No.	T. No.	Product	Class	Capacity (KL)
1	01	MS	A	5500
2	02	MS	A	5500
3	03	MS	A	5500
4	05	SKO	B	3610
5	06	SKO	B	3610
6	07	HSD	B	16300
7	08	HSD	B	16300
8	09	HSD	B	16300
9	11	MS	A	8250
10	12	HSD	B	20
11	13	ETHANOL	A	70
12	14	ETHANOL	A	70
13	18	ETHANOL	A	130
14	19	SLOPE OIL	--	20

TABLE 7.2

DETAILS OF PROPOSED POL STORAGE CAPACITY OF THE TERMINAL

Tank. No.	Product Details	Class	Proposed Capacity (KL)
21	HSD	B	25,000
22	HSD	B	25,000
23	HSD	B	25,000
24	HSD	B	25,000
25	Ethanol	A	600
26	Ethanol	A	600
10	HSD	B	12,000
4	HSD	B	4,010
Total Proposed Capacity			**1,17,210 KL**
Existing Capacity			**82,515 KL**
Total Capacity after Expansion			**1,99,725 KL**

Dispatch of Petroleum Products

The petroleum products shall be distributed to various Industries/Petrol Pumps through truck tanker up to capacity of 20,000 litres. On an average, 150-200 truck tanker are normally filled and dispatched on daily basis. The loading facilities shall consist of PD metering system, batch controllers, blending facilities for Ethanol, branded fuels etc. Vapour recovery system to be designed & developed for handling of MS.

Truck Loading Facility (TLF) Sheds

There are 3 nos. of TLF sheds having 2 x 8 and 1 x 9 Tank trucks loading bays respectively. The loading facilities will be TOP loading for MS, HSD and SKO.

Product Pump House

The details of the pumps are as shown in **Table 7.3**.

TABLE 7.3

SCHEDULE OF PUMPS

Sr. No.	Typeof Pump	Location of Pump/ Area	Intend use of the Pump (loading/ unloading / fire fight)	Product Service	Make of Pump	Pump Capacity in LPM	Pump Head in mts	H. P. of motor/ engine	Speed (RPM)
1	Centrifugal	Pump House	Loading	MS	Khimline	3966	88	100	2960
2	Centrifugal	Pump House	Loading	MS	Khimline	3966	88	100	2960
3	Centrifugal	Pump House	Loading	SKO	Kirloskar	5266	71	100	2970
4	Centrifugal	Pump House	Loading	SKO	Kirloskar	5266	71	100	2970
5	Centrifugal	Pump House	Loading	HSD	Khimline	5950	84	150	2960
6	Centrifugal	Pump House	Loading	HSD	Khimline	5950	84	150	2960
7	Centrifugal	Pump House	Loading	HSD	Khimline	5950	84	150	2960
8	Centrifugal	Pump House	Loading	HSD	Khimline	5950	84	150	2960
9	Centrifugal	Pump House	Loading	HSD	Khimline	5950	84	150	2960
10	Centrifugal	Ethanol Tank Farm	Loading	Ethanol	Kirloskar	300	46.2	10	2900
11	Centrifugal	Ethanol Tank Farm	Loading	Ethanol	Flo-Rite Engg.		45	7.5	2900
12	Centrifugal	Ethanol Tank Farm	Loading	XTRA PREM.	Kirloskar	334	14	5	2880
13	Centrifugal	Ethanol Tank Farm	Loading	XTRA MILE	VindiVak			1	1410

Fire Fighting Facilities

Following Fire Fighting Facilities will be provided.

- Water Sprinkler system on proposed MS and HSD as per prevailing safety guidelines issued by OISD
- Foam fighting system on proposed Diesel (HSD) and Petrol (MS) tanks as per prevailing safety guidelines issued by OISD
- Provision of Fire hydrant piping network for the new product tank farms.

The Fire Water tanks have been provided as shown in **Table 7.4** and Schedule of Fire pumps have been provided in **Table 7.5.**

TABLE 7.4

DETAILS OF FIRE TANKS

Sr. No	T. No.	Nos	Capacity (KL)
1	FW-01	1	2550
2	FW-02	1	2550
3	FW-03	1	3280
Total	**Total Fire Water Storage :8380 KL**		

TABLE 7.5

SCHEDULE OF FIRE WATER PUMPS

Sr. No.	Type of Pump	Location of Pump/ Area	Make of Engine/Pump	Pump Capacity in LPM	Pump Head in mts	H. P. of motor/ engine	Speed (RPM)
1	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
2	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
3	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
4	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
5	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
6	Fixed	Fire Engine Room	Kirloskar/Varat	6833	88	250	2100
7	Fixed	Fire Engine Room	Kirloskar/Varat	6833	88	250	2100
8	Fixed	Fire Engine Room	Crompton Greaves	167	88	20	
9	Fixed	Fire Engine Room	Crompton Greaves	167	88	20	--

Other Facilities available at terminal

Details of various facilities available at terminal are given in **Table 7.6**.

TABLE 7.6

VARIOUS FACILITIES AVAILABLE AT TERMINAL

S. No.	DESCRIPTION	SIZE(M)
1	D.G. set room	11 X 15 M
2	Electrical sub station	14 X 24 M
3	Metering Room	-
4	Lube Barrel Yard	18 X 18 M
5	Ware House	8 X 4.5 M
6	Store	8 X 2 M
7	Hyd. Pump house	30 X 8 M

S. No.	DESCRIPTION	SIZE(M)
8	Amenity Block	30 X 20 M
9	Administrative Building	10 X 30 M
10	HSD Vessel	-
11	Watch Tower	-
12	Parking	30 X 10 M
13	Control Room	21 X 16 M
14	Elec. Barrier	-
15	Security KIOSK	2 X 2 M
16	S and D Block	30 X 20 M
17	Gate	1.2 M
18	Security Room	3 X 3M
19	COCO Petrol Pump	40.5 X 38.5 M
20	Rest Room	17 x 5 M
21	T. T. Parking	-
22	High Mast	-
23	TLF Shed(25 Bays)	4.5 x10 M each
24	P/L o/H Bridge	-
25	Emergency Gate	6 M wide (3 Nos.)
26	Foam Shed	6 X 10 M
27	Pump House and Manifold	40 X 21 M
28	Sample Room	-
29	O.W.S.	-
30	Slope oil Tank	-
31	Tube Well	-
32	Transformer Room	-

IDENTIFICATION OF HAZARDS AT IOCL, POL TERMINAL, SANGRUR

Petroleum Products (MS, HSD, SKO & Ethanol) are highly inflammable in their basic character. They are dangerous because of their intrinsic properties i.e. flash point, ignition energy required, heat of combustion, flammability limits, etc. In addition to such intrinsic properties, extrinsic factors like storage & operating conditions and large storage quantity is also considered for hazard identification. Physico-chemical properties of the petroleum products, employed in the Installation, are given in **Table 7.7**.

The extent of the consequences arising from the petroleum products Installation would depend on type & quantity of products present, mode of containment, and external factors like location, density of population etc. In many cases, realization of hazard and its potential also depend on prevailing meteorological conditions and availability of ignition source. Thus, most serious consequences would arise from a large inventory of petroleum products surrounded by a densely populated area.

TABLE 7.7

HAZARDOUS PROPERTIES OF PETROLEUM PRODUCTS

SN	Properties	POL Products			
		MS	SKO	Ethanol	HSD
1	State	Highly Volatile liquid	Liquid	Highly Volatile Liquid	Liquid

SN	Properties	POL Products			
		MS	SKO	Ethanol	HSD
2	Petroleum Act/OISD Flammability Class	A	B	A	B
3	Specific Gravity	0.72	0.76	0.79	0.81
4	Reactive to	Strong Oxidizers	-	-	-
5	Flash point ºC (Range)	< 23	35	< 23	≥ 23 ≤ 65
6	Boiling point ºC	Upto 150	150 - 250	78.32	225 - 300
7	Auto – Ignition Temperature ºC	280 - 429	254	422	277
8	Specific Heat (KJ/Kg °K)	2.9	3.25	2.13	3.39
9	Heat of Evaporation (KJ/Kg)	98	115.9	85.38	134.2
10	Heat of Combustion (KJ/Kg)	47025	46398	30624	45980

Flammability Classification Criteria:

SN	Flammability Class	Flash point (°C)
1	Class A Flammable Liquid	FP < 23
2	Class B Flammable Liquid	23 > FP <65

Petroleum Products (MS & Ethanol) require interaction with air or oxygen for its hazard to be realized. Under certain circumstances, vapors of the products when mixed with air may be explosive especially in confined spaces. Following methods of hazard identification have been employed in this study:

1. Characterization of major hazardous units based on Manufacture, Storage and Import of Hazardous Chemicals Rules, Government of India, 2000; referred here as MSIHC Rules.
2. Identification of hazardous installations based on relative ranking technique, viz. Dow's Fire Explosion Index and Mond's Toxicity Index (FEI & TI)

Identification of Chemical Release & Accident Scenarios

Based on the hazard identification and comparing the nature of installation with that from past accidents in similar units, a final short list of MCA scenarios for the Terminal has been made, which are given in following Table. These are the maximum credible accidents, which may occur, in the respective unit.

TABLE 7.8
SHORT LISTING OF MCA SCENARIOS FOR IOCL, SANGRUR POL TERMINAL

SN	T. No.	Product & Class	MCA Scenario
Existing Tankage			
1	01	MS-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
2	02	MS-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
3	03	MS-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
4	05	SKO-B	Pool Fire, Spilled product Fire & Tank on Fire
5	06	SKO-B	Pool Fire, Spilled product Fire & Tank on Fire
6	07	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
7	08	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire

SN	T. No.	Product & Class	MCA Scenario
8	09	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
9	11	MS-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
10	12	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
11	13	ETHANOL-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
12	14	ETHANOL-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
13	18	ETHANOL-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
Proposed Tankage			
14	21	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
15	22	HSD–B	Pool Fire, Spilled product Fire & Tank on Fire
16	23	HSD–B	Pool Fire, Spilled product Fire & Tank on Fire
17	24	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
18	25	Ethanol-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
19	26	Ethanol-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
20	10	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
21	4	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire

The above foreseen accident scenarios will have certain adverse effects on the nearby units/structures in the Terminal which may lead to escalation of the accident further.

The analysis when carried out based on aforementioned assumptions has lead to reduction of the total list of incidents into three representative sets of incidents. They are:

- Catastrophic failures of storage tanks or any full bore liquid line rupture.
- Liquid release through a hole.
- Vapor release through a hole.

Consequence Analysis

This chapter deals with the quantification of various effects of release of POL product on the surrounding area by means of mathematical models and internationally recognized Safety software like WHAZAN, EFFECTS & CAMEO.

It is intended to give an insight into how the physical effects resulting from the release of hazardous substances can be calculated by means of computerized models and how the vulnerability models can be used to translate the physical effects in terms of injuries and damage to exposed population & environment Models, applied in the analysis, are listed below.

- EFFECTS by TNO, The Netherlands
- WHAZAN by DNV Technical, UK.
- CAMEO (Computer Aided Management of Emergency Operations) by National safety Council Environment & Health, USA.

TABLE 7.9

MATHEMATICAL & ANALYTICAL MODELS FOR HAZARD ANALYSIS

S. No.	Phenomenon	Applicable Models
1	Outflows: * Liquid, Two phase Mixtures, Gas/vapor	Bernoulli flow equation; phase equilibrium; multiphase flow models; orifice/nozzle flow equations; gas laws; critical flow criteria
2	Discharges: * Spreading liquid	Spreading rate equation for no penetrable surfaces based on cylindrical liquid pools
	* Vapor jets	Turbulent free jet model
	* Flashing liquids	Two zone flash vaporization model
	* Evaporation of liquids on land & water	Spreading, boiling & moving boundary heat transfer models; Film &met stable boiling phenomenon; cooling of semi-infinite medium
3	Dispersion: * Heavy Gas	● Boundary dominated, stably stratified & positive dispersion models (similarity) ● 3D Models based on momentum, mass & energy conservation
	* Natural Gas	Gaussian Dispersion models for naturally buoyant plumes
	* Atmospheric Stability	Boundary layer theory (turbulence), Gaussian distribution models
4	Heat Radiation: * Liquid pool fires	Burning rate, heat radiation & incident heat correlation (semi imperial); Flame propagation behavior models
	* Jet fires	Fire jet dispersion model
	* Fire balls	API fire ball models relating surface heat flux of flame, geometric view factor & transmission coefficients
5	Explosion: * BLEVE * Vapor Cloud Explosion	Fire balls & physical over pressure models Deflagration & Detonation models
6	Vulnerability: * Likely damage	Probit functions; Non-Stochastic vulnerability models

First, attention is paid to the factors, which are decisive for the selection of the models to be used in a particular situation, after which the various effect models are discussed.

Factors that Influence the Use of Physical Effect Model

In order to calculate the physical effects of the incidental release of hazardous substances the following steps have been carried out in succession:

- Understanding of the form in which the hazardous substance is in existence (i.e. liquid of highly volatile nature in case of petroleum Product)
- Determination of the various ways in which the release can take place
- Determination of the outflow volume or quantity (as a function of time) i.e. estimating rate of evaporation from the pool of liquid;

In the case of petroleum product, quantity of leaked or spilled product along with pool size has been calculated. Finally, the analysis results in computation of heat radiation intensity (KW/m2) with respect to distance for various MCA scenarios. In this analysis, final effect calculations have been made for pool fire for heat radiation intensity effects with respect to distance from dyke wall.

7.2 MODELS FOR DETERMINING THE SOURCE STRENGTH FOR RELEASE OF A HAZARDOUS SUBSTANCE

Source strength of a release means the quantity of the substance released with respect to time. The release may be instantaneous or continuous. In case of instantaneous release, the strength of the source is given in kg whereas in continuous release source strength depends on the outflow time and expressed in kg/s. In order to find the source strength, it is first necessary to determine the state of a substance in a vessel or pipe along with physical properties, viz. vapor pressure & minimum ignition energy required. Phase of petroleum Product at the time of accidental release is also to be determined. This may be gas, gas condensed to liquid or liquid in equilibrium with its vapor.

1. Instantaneous Release

Instantaneous release will occur, for example, if a storage tank fails. Depending on the storage conditions the following situations may occur.

(A) Instantaneous release of a Gas:

The source strength is equal to the contents of the capacity of the storage system.

(B) Instantaneous release of a Gas Condensed to Liquid:

In the case of a gas condensed to liquid, a flash off will occur due to reduction in pressure of the liquefied gas to atmospheric pressure. The liquid will spontaneously start to boil.

(C) Instantaneous release Resulting from a BLEVE:

A BLEVE is a physical explosion, which occurs when the vapor side of a storage tank is heated by fire e.g. a flare/torch. As a result of the heat the vapor pressure rises and the tank wall gets weakened. At a given moment the weakened tank wall is no longer capable to withstand the increased internal pressure and burst open. As a result of the expansion and flash off pressure wave occurs. With flammable gases, a fireball occurs in addition to the pressure waves.

(D) Instantaneous release of a Liquid:

In the event of the instantaneous release of a liquid a pool of liquid will form. The evaporation can be calculated on the basis of the pool.

2. Semi Continuous outflow

In the case of a semi continuous outflow, it is again first of all necessary to determine whether it is gas, a gas condensed to liquid or liquid that is flowing out. The following situations may occur here.

(A) Gas Outflow:

The model with which the source strength is determined in the event of a gas outflow is based on the assumption that there is no liquid in the system.

(B) Vapor Outflow:

If the outflow point is located above the liquid level, vapor outflow will occur. In the case of a gas compressed to liquid the liquid will start boiling as a result of the drop in pressure. The source strength of the out flowing vapor is a function of the pressure in the storage system and after the liquid has reached the boiling point at atmospheric pressure the temperature will remain constant.

(C) Liquid Outflow:

If the outflow point is located below the liquid level, liquid outflow will occur resulting in a flash off. The outflow will generally be so violent that the liquid will be turned into drops as a result of the intensity of the evaporation. The remaining liquid, which is cooled down to boiling point, will start spreading on the ground and forms a pool. Evaporation will also take place from this pool, resulting in a second semi continuous vapor source.

3. Models for Evaporation

In application of evaporation models, petroleum product is a case of volatile liquid. From the pool, which has formed, evaporation will take place as a result of the heat flow from the ground and solar radiation. The evaporation model only takes account of the heat flow from the ground since the heat resulting from solar radiation is negligibly small compared with the former. The evaporation rate depends on the kind of liquid and the kind of subsoil.

4. Models for Dispersion

The gas or vapor released either instantaneously or continuously will be spread in the surrounding area under the influence of the atmospheric turbulence. In the case of gas dispersion, a distinction is required to be made between neutral gas dispersion and heavy gas dispersion.

The concentrations of the gas released in the surrounding area can be calculated by means of these dispersion models. These concentrations are important for determining the nature of accidents for example an explosive gas cloud formation injuries will occur in the case of toxic gases.

Heavy Gas Dispersion Model:

If the gas density is higher than that of air due to higher molecular weight or marked cooling, it will tend to spread in a radial direction because of gravity. This results in a "gas pool" of a particular height and diameter. As a result of this, in contrast to a neutral gas, the gas released may spread against the direction of the wind.

5. Models for Heat Load and Shock Waves

MODEL FOR FLARE/JET FIRE/TORCH

If an out-flowing gas forms a cloud with concentrations between the lower and upper explosion limit and ignition takes place, a torch occurs. A model with which the length of a torch and the thermal load for the surrounding area can be calculated, assumes an elliptic shaped torch. The volume of the flare in this model is proportional to the outflow.

In order to calculate the thermal load, flare is regarded as a point source located at the center of the flare. If an out-flowing gas forms a cloud with concentrations between the lower and upper explosion limit and ignition takes place, a torch occurs. A model with which the length of a torch and the thermal load for the surrounding area can be calculated, assumes an elliptic shaped torch. The volume of the flare in this model is proportional to the outflow.

MODEL FOR POOL FIRE

The schematic of a pool fire is depicted in **Figure 7.2.** The heat load on objects outside a burning pool of liquid can be calculated with the heat radiation model. This model uses average radiation intensity, which is dependent on the liquid. Account is also taken of the diameter-to-height ratio of the fire, which depends on the burning liquid. In addition, the heat load is also influenced by the following factors:

- Distance from the fire
- Relative humidity (water vapor has relatively high heat absorbing capacity)
- The orientation i.e. horizontal/vertical of the object irradiated with respect to the fire

VULNERABILITY MODELS

Vulnerability models or dose response relations are used to determine how people are injured by exposure to heat load or a toxic dose. Such models are designed on the basis of animal experiments and on the basis of the analysis of injuries resulting from accidents occurred earlier. Vulnerability models often make use of a probit function. In a Probit function a link is made between the load and the percentage of people exposed who suffer a particular type of injury. The Probit function is represented as:

$Pr = k_1 + k_2 \ln (V)$

In which,

Pr = Probit, a measure for the percentage of the people exposed who incur a particular injury (relation between percentages & probit is given in **Table 7.10.**

k_1= a constant depending on the type of injury and type of load

k_2 = a constant depending on the type of load

V = load or dose

TABLE 7.10
RELATIONSHIPS BETWEEN PERCENTAGES & PROBITS

Percentage	Probit Values									
	0	1	2	3	4	5	6	7	8	9
0	-	2.67	2.95	3.12	3.25	3.36	3.45	3.52	3.59	3.66
10	3.72	3.77	3.82	3.87	3.92	3.96	4.01	4.05	4.08	4.12
20	4.16	4.19	4.23	4.26	4.29	4.33	4.36	4.39	4.42	4.45

30	4.48	4.50	4.53	4.56	4.59	4.61	4.64	4.67	4.69	4.72
40	4.75	4.77	4.80	4.83	4.85	4.87	4.90	4.92	4.95	4.97
50	5.00	5.03	5.05	5.08	5.10	5.13	5.15	5.18	5.20	5.23
60	5.25	5.28	5.31	5.33	5.36	5.39	5.41	5.44	5.45	5.50
70	5.52	5.55	5.58	5.61	5.64	5.67	5.71	5.74	5.77	5.81
80	5.84	5.88	5.92	5.95	5.99	6.04	6.08	6.13	6.18	6.23
90	6.28	6.34	6.41	6.48	6.55	6.64	6.75	6.88	7.05	7.33
-	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
99	7.33	7.37	7.41	7.46	7.51	7.58	7.65	7.75	7.88	8.09

INJURIES RESULTING FROM FLAMMABLE LIQUIDS AND GASES

In the case of flammable liquids and gases and immediate ignition a pool fire or a flare will occur depending on the conditions. The injuries in this case are mainly caused by heat radiation.

DAMAGE MODELS FOR HEAT RADIATION

It is assumed that everyone inside the area covered by the fire ball, a torch, a burning pool or gas cloud will be burned to death or will asphyxiate. The following Probit functions are an example of a method, which can be used to calculate the percentage of lethality, and first-degree burns that will occur at a particular thermal load and period of exposure of an unprotected body.

Lethality: $Pr = -36.83 + 2.56 \ln (t.q^{4/3})$

First degree burn symptoms: $Pr = -39.83 + 3.0186 \text{ in } (t.q^{4/3})$

In which, t = exposure time in seconds and;

q = thermal load W/m^2

Two values have been chosen for the exposure time to heat radiation:

* 10 seconds: for exposed persons in populated area it is assumed that they will have found protection from the heat radiation e.g. from a wall, within 10 seconds
* 30 seconds: this pessimistic assumption applies if people do not run away immediately or when no protection is available

The summary of damage criteria adopted in the study based on vulnerability models and published health criteria for arriving at damage distances for the identified effects are:

Damage criteria for quantification of damage due to heat radiation have been briefed in **Table No 7.11.**

TABLE 7.11
DAMAGE CRITERIA FOR POOL FIRE/JET FIRE

SN	Likely Damage	Incident Flux (KW/M2)
1.	100% Lethality & Severe damage to property	Within fireball
2.	100% Lethality	37.5
3.	50% Lethality	25
4.	1% Lethality	12.5
5.	Not Lethal, First degree burns	4.5

CLIMATOLOGICAL CONDITIONS

Climatological conditions of Sangrur have been studies. Data is taken from weather site. Form available data, it is found that, the minimum and maximum temperatures for the study period were **24 °C** and **9.4 °C.** Relative humidity as minimum and maximum is recorded as **92 %** and **28%**. Maximum wind speed and average wind flow data given in following table.

Meteorological Data of Sangrur is also consider for consequence modeling,

Meteorological Data:

Maximum Temperature - 24° C

Minimum Temperature -8° C

Maximum Relative Humidity -92%

Minimum Relative Humidity - 28%

Predominant wind Direction - From North-West and South-East

Wind Conditions:

I	II	III
Very Stable Atmosphere (Pasquill Stability Class A) Velocity = 1 m/s	Neutral Atmosphere (Pasquill Stability Class D) Velocity = 2 m/s	Un-stable Atmosphere (Pasquill Stability Class F) Velocity = 4 m/s

MAXIMUM CREDIBLE ACCIDENT (MCA) ANALYSIS

The maximum credible accident scenarios for the IOCL, SANGRUR POL Terminal have been identified and listed in **Table 7.12 (A-D)**. Following is the accident potential and the likely damage for the identified accident scenarios.

Spilled Product Fire Scenario:

In IOCL, Sangrur POL Terminal, handling of petroleum products (MS, HSD & SKO) for any leakage or spillage from Pipelines at Receipt area or leakage in any of the Tank Truck at the Tank Lorry Filling Shed and at the Pump House, there will be accumulation of petroleum products. In either of the cases if it catches fire depending on availability of potential ignition source in the vicinity, it will take form of a Spilled Product Fire. But this fire has comparatively less impact on the surrounding area and there are less chances of damaging the other facilities of the Terminal.

Result of MCA analysis for the storage tanks indicating the distance for various damage levels for Spilled Product Fire scenarios are as follows:

TABLE 7.12 (A)
DAMAGE DISTANCES DUE TO SPILLED PRODUCT FIRE AT TT GANTRY

SN	Damage		Product			
			Class A		Class B	
			MS	Ethanol	HSD	SKO
1	100 % Lethality--- Severe Damage to Life and Property		Within Spilled Product			
		Exposure Time in Sec		Damage Distance in Meters From TT Gantry		
2	1% Lethality (10s - 21.2 kW/m2) (30s - 9.3 kW/m2)	10	3.68	NR	NR	NR
		30	7.93	2.57	4.1	4.02
3	First Degree Burns (10s - 8.5 kW/m2) (30s - 3.7 kW/m2)	10	8.66	2.86	4.324	4.47
		30	17.33	5.96	9	9.15

** NR: Not Reachable*

TABLE 7.12 (B)
DAMAGE DISTANCES DUE TO SPILLED PRODUCT FIRE AT TLF PUMP HOUSE

SN	Damage		Product			
			Class A		Class B	
			MS	Ethanol	HSD	SKO
1	100 % Lethality-Severe Damage to Life and Property		Within Spilled Product			
		Exposure Time in Sec		Damage Distance in Meters From TT Gantry		
2	1% Lethality (10s - 21.2 kW/m2) (30s - 9.3 kW/m2)	10	5.57	2.08	2.614	2.376
		30	12.13	4.78	6.24	5.7
3	First Degree Burns (10s - 8.5 kW/m2) (30s - 3.7 kW/m2)	10	13.06	5.1	6.88	6.1
		30	25.9	10.5	13.79	12.8

TABLE 7.12 (C)
DAMAGE DISTANCES DUE TO SPILLED PRODUCT FIRE AT TANK TRUCK

SN	Damage	Product			
		Class A		Class B	
		MS	Ethanol	HSD	SKO
1	100 % Lethality- Severe Damage to Life and Property	Within Spilled Product			

		Exposure Time in Sec		Damage Distance in Meters From TT Gantry		
2	1% Lethality (10s - 21.2 kW/m2) (30s - 9.3 kW/m2)	10	3.188	0.82	NR	NR
		30	6.748	1.92	3.57	2.86
3	First Degree Burns (10s - 8.5 kW/m2) (30s - 3.7 kW/m2)	10	7.27	2.08	3.78	3.056
		30	14.725	3.94	7.85	6.15

** NR: Not Reachable*

TABLE 7.12 (D)

RESULTS OF SPILLED PRODUCT FIRE SCENARIO FOR TT GANTRY/TLF PUMP HOUSE & TANK TRUCK

SN	Location of Spillage	Name of Product	Maximum Intensity of Heat Radiation Calculated Using Spilled Fire Model (kW/m^2)	Damage Distance Calculated For Exposure Time of 10s		Damage Distance Calculated For Exposure Time of 30s	
				1% Lethality (21.2 kW/m^2)	First Degree Burn (8.5 kW/m^2)	1% Lethality (9.3 kW/m^2)	First Degree Burn (3.7 kW/m^2)
1	TT Gantry	MS	94.1	3.68	8.66	7.93	**17.33**
	TLF P/H			5.57	13.06	12.13	**25.9**
	Tank Truck			3.188	7.27	6.748	**14.725**
2	TT Gantry	HSD	63.1	NR	4.324	4.1	9
	TLF P/H			2.614	6.88	6.24	13.79
	Tank Truck			NR	3.78	3.57	7.85
3	TT Gantry	SKO	78.1	NR	4.47	4.02	9.15
	TLF P/H			2.376	6.1	5.7	12.8
	Tank Truck			NR	3.056	2.86	6.15
5	TT Gantry	Ethanol	68.4	NR	2.86	2.57	5.96
	TLF P/H			2.08	5.1	4.78	10.5
	Tank Truck			0.82	2.08	1.92	3.94

** NR: Not Reachable*

From the observations it can be concluded that effect of spilled fire will be for a lesser distance & will not affect the Terminal properties or surrounding area. Chances of any severe lethality will be least in case of spill fire, however there can be first degree burns to the people. As soon as such spillage is observed the effort must be taken to stop the leakage and remove the spilled product. And if ignition of spilled product takes place necessary emergency procedure must be followed as soon as possible to avoid damage to other property due to secondary effect accidents.

Note: NR in above table represents that radiation of that particular heat intensity will be limited to spilled fire area only.

POOL FIRE SCENARIO:

In IOCL, Sangrur POL Terminal, handling petroleum products (MS, HSD & SKO) for any leakage or spillage from liquid space from any of the storage units, there will be formation of pool in case of less volatile or non-volatile liquid. If the liquid does not overflow firebreak wall, then the pool will be limited to the respective unit. However if the liquid overflows the firebreak wall, it may engulf all the storage units present in the surrounding area. In both of the cases if it catches fire depending on availability of potential ignition source in the vicinity, it will take form of a Pool fire.

Result of MCA analysis for the storage tanks indicating the distance for various damage levels for pool fires scenarios are as follows:

TABLE 7.13
DAMAGE DISTANCES DUE TO POOL FIRE SCENARIO FOR VARIOUS TANK FARM/DYKE WALLS

SN	Description		Product						
			Class A		Class B				
			MS		HSD				SKO
1	Dyke No.		Dyke 1	Dyke 4	Dyke 2	Dyke 3	Dyke 4	Dyke5	Dyke 2
2	Tank No.		TF-1 TF-2 TF-3	TF-11	TF-4	TF-7 TF-8 TF-9	TF-10	TF-21 TF-22 TF-23 TF-24	TF-5 TF-6
3	Maximum Storage Capacity in (KL)		5500	8250	4010	16300	10000	25000	3610
4	Pool Size (m2)		10553	5807	10553	11256	18150		11256
5	100% Lethality ---- Severe Damage to Life & Property		Within Pool	Within Pool	Within Pool	Within Pool	Within Pool		Within Pool
	Damage	**Exposure Time in Sec.**			**Damage Distance in Meters From Dyke Wall of Individual Tank Farm**				
6	1%Lethality (10s-21.2 KW/m2) (30s-9.3KW/m2)	10s	9.95	11.235	4.67	15.57	6.67	18.57	3.26
		30s	22.48	24.486	13.32	25.32	14.32	26.32	11.03
7	First Degree Burns (10s-8.5 KW/m2) (30s-3.7 KW/m2)	10s	23.57	25.57	15.57	28.37	16.57	29.37	10.2
		30s	42.96	44.96	24.77	54.67	27.77	57.67	27.98

TABLE 7.14

RESULTS OF POOL FIRE SCENARIO (DYKE WALLS 1, 2, 3 & 4)

SN	Dyke No. Considered For Pool Fire	Tank No.	Name of product	Maximum Intensity of Heat Radiation Calculated Using Pool Fire Model (KW/m2)	Damage Distance Calculation for Exposure Time of 10 sec		Damage Distance Calculation for Exposure Time of 30 sec	
					1% Lethality	First Degree Burn	1% Lethality	First Degree Burn
1	Dyke 1	TF-1 TF-2 TF-3	MS	72	9.95	22.48	23.57	42.98
2	Dyke 2	TF-4	HSD	48.2	**4.67**	**13.32**	**15.57**	**24.77**
		TF-5 TF-6	SKO	22.48	**3.26**	**11.03**	**10.2**	**27.98**
3	Dyke 3	TF-7 TF-8 TF-9	MS	99.2	**15.57**	**25.32**	**28.37**	**54.67**
4	Dyke 4	TF-11 TF-10	HSD	76.7	**6.67**	**14.32**	**16.57**	**27.77**
5	Dyke 5	TF-21 TF-22 TF-23 TF-24	HSD	86.7	**18.57**	**26.32**	**29.37**	**57.67**

From Above Table, It can be noted that, MS (class A Product) tank farm will yield maximum heat radiation of 99.2 KW /m^2 in case of pool fire. Existing Storage Tanks for MS Product are enclosed in Dyke 3, whereas the proposed MS Storage Tanks will be enclosed in proposed Dyke 4.

Hence here we have two distances for Pool Fire Scenario in case of MS. 1% Lethality can occur at a distance of 9.95 & 15.57 meters in case of exposure for 10 seconds, and 23.57 & 28.37 meters in case of 30 seconds respectively. First degree burn can take place at a distance of 22.48 & 25.32 meters in case of 10 seconds and **42.98 & 67 57** meters in case of 30 seconds respectively.

TANK ON FIRE SCENARIO:

The Tank failure scenarios were identified to assess the effect on people and property inside the Terminal area and as well as outside surrounding area.

Each tank was examined for these scenario and the results were scrutinized. The effect of fire on people and property outside and inside the Terminal is in the form of thermal radiations. A criterion was selected for deciding the maximum level of thermal radiation to which the outside population can be subjected. Thermal radiation levels from fire scenarios of each tank were worked out at various distances and their effects evaluated against the set criteria.

Thermal radiation due to tank on fire may cause various degrees of burns on exposed human bodies. Moreover their effects on piping and equipment are to be evaluated to assess their impact. Table gives type of damage due to various heat radiation intensities.

SN	Radiation Load (kW/m^2)	Type of Damage
1	37.5	Sufficient To Cause Damage to process Equipment
2	12.5	Minimum Energy Required For Piloted Ignition of Wood, Molting of plastic etc.
3	4.5	Sufficient to cause pain to personnel if unable to reach cover within 20 seconds, however blistering of skin (1st Degree Burn) is Likely

In IOCL, SANGRUR POL Terminal each product tanks (MS, HSD, Ethanol& SKO) were examined for Tank on fire scenario. The result of the above scenario is as follows:

TABLE 7.15
DAMAGE DISTANCES DUE TO TANK ON FIRE SCENARIO

T. No.	Product	Capacity (KL)	Damage Distance (m) From Tank Surface For Radiation Intensity KW/m2		
			37.5 KW.m2	12.5 KW/m2	4.5 KW/m2
01	MS	5500	6.75	22.34	57.50
02	MS	5500	6.75	22.34	57.50
03	MS	5500	6.75	22.34	57.50
05	SKO	3610	2.98	8.947	21.42
06	SKO	3610	2.98	8.947	21.42
07	HSD	16300	14.9	24.78	42.35
08	HSD	16300	14.9	24.78	42.35
09	HSD	16300	14.9	24.78	42.35
11	MS	8250	8.75	38.62	62.03
21	HSD	25,000	16.78	26.45	46.34
22	HSD	25,000	16.78	26.45	46.34
23	HSD	25,000	16.78	26.45	46.34
24	HSD	25,000	16.78	26.45	46.34
25	Ethanol	600	3.75	20.87	56.10
26	Ethanol	600	3.75	20.87	56.10
10	HSD	12,000	12.78	23.45	41.34
4	HSD	4,010	5.9	16.121	39.59

** NR: Not Reachable*

From above table, it is concluded that fire in MS tank of the Terminal has maximum damage potential than fire in any other tanks.

UNCONFINED VAPOUR CLOUD EXPLOSION (UVCE)

Vapour Cloud can ignite and burn as deflagration or fire balls causing lot of damage by radiation starting secondary fires at some distance. Vapour Cloud ignites and explodes causing high over pressures and very heavy damage. The later is termed as “Percussive unconfined Vapour Cloud Explosion” i.e. PUVCE in short.

Various meteorological conditions (as mentioned above) have been considered for analyzing drifting & dilution of a vapor cloud, so that all probable consequences of a vapor cloud explosion can be foreseen.

Worst come worst, there may be instantaneous release of the entire MS/Ethanol vapor present in the unit. If it comes in to contact of an ignition source during or immediately after the release or as in a case of backfire resulting in jet fire, it may lead to a BLEVE.

Otherwise, the second MCA scenario is drifting & dilution of a vapor cloud along the wind and then coming into contact of an ignition source (i.e., case of delayed ignition), leading to a VCE. This scenario is particularly important to identify unforeseen OFF-SITE emergencies. Two kinds of vapor release scenarios have been considered, i.e. instantaneous and continuous.

Instantaneous Release:

As the vapor cloud drifts in the wind direction, it may explode depending on the quantity of MS/Ethanol present within flammability limits and availability of ignition source. Applying the pertinent models, quantity of MS/Ethanol within flammability limits for various downwind distances have been calculated for below mentioned wind conditions.

As the Ethanol Tanks at Terminal are Underground Tanks, hence Ethanol tanks are not considered here for VCE calculation. The catastrophic failure of vessel is one of the major accidental scenarios whose effect is felt beyond Terminal boundary. The over pressure distance are shown in table. Over pressure remain largely unaffected by wind direction. The distances shown are for rupture of vessel filled up to its maximum capacity. The hazard distances indicated will be much lower if the Tank of MS contain fewer inventory at the time of accidents.

The hazard distances for overpressure and flash fire due to MS Tank failure for wind velocities 1m/s and very stable atmosphere, 2m/s & Neutral atmosphere, 4m/s & unstable atmosphere are given in below **table.**

Wind Conditions:

I	II	III
Very Stable Atmosphere	Neutral Atmosphere	Unstable Atmosphere
Velocity = 1 m/s	Velocity = 2 m/s	Velocity = 4 m/s

For MS Storage Tank

At SANGRUR POL Terminal, class A petroleum products viz MS Ethanol are stored.VCE Scenario is studied for Both Existing & Proposed Tanks. At Terminal, MS is received through multiproduct cross-country Pipeline).

TABLE 7.16
DAMAGE DISTANCES FOR VAPOUR CLOUD EXPLOSION DUE TO FAILURE OF MS STORAGE TANK HAVING MAXIMUM STORAGE CAPACITY 8250 KL BY CONSIDERING THAT CLOUD HAS COVERED 75 M DISTANCE FROM TANK/TANK TRUCK

Unit/Facility	Chosen Wind Condition	Quantity Within UEL	Duration of Fire Ball	Diameter of Cloud	Maximum Intensity of	Damage Distances in Meter Due to Heat Radiation in KW/m^2					
						Severe	100% Leth	50% Leth	1% Leth	First Deg	No Disco

	(m/sec)	& LEL (Kg)	(seconds)	(m)	Heat Radiation at Center of the Cloud (KW/m^2)	Damage to Life & Property (100 % Lethality)	ality (37.5 KW/m^2)	ality (25 KW/m^2)	ality (12.5 KW/m^2)	ree Burn (4.5 KW/m^2)	mfort (1.6 KW/m^2)
MS Tank (max. Capacity: 8250 KL)	1	1512	5.7	70	198.4	35	68.95	87.92	117.31	197.92	331.47
	2	3007	6.8	87.5	198.4	43.75	85.66	108.82	144.92	241.73	408.71
	4	4847	7.7	102.2	198.4	51.1	99.61	126.22	168.01	282.29	477.28
MS Tank Truck	1	1911	6.1	75.5	198.4	37.75	74.18	94.49	126.05	213.62	357.63
	2	3167	6.9	89	198.4	44.5	87.06	110.48	146.98	245.82	415.62
	4	5831	8.1	108.5	198.4	54.25	105.56	133.60	177.58	293.28	505.85

TABLE 7.17

HAZARD DISTANCES DUE TO PRESSURE WAVES IN CASE OF MS STORAGE TANK FAILURE HAVING MAXIMUM STORAGE CAPACITY 8250 KL

SN	Failure Cases	Wind Speed / Stability	Hazard Distances (m)			
			0.3 bar	0.1 bar	0.03 bar	0.01 bar
1	MS Tank (Max. Capacity:8250 KL)	1 m/s F	9.5	60.5	247	678
		2 m/s D				
		4 m/s B				
2	MS Tank Truck Failure (18 KL)	1 m/s F	11.5	49	163	490
		2 m/s D				
		4 m/s B				

The amount of turbulence in the ambient atmosphere has a major effect on the dispersion of air pollution plumes because turbulence increases the entrainment and mixing of unpolluted air into the plume and thereby acts to reduce the concentration of pollutants in the plume (i.e., enhances the plume dispersion). It is therefore important to categorize the amount of atmospheric turbulence present at any given time.

The most commonly used method of categorizing the amount of atmospheric turbulence present was the method developed by Pasquill. He categorized the atmospheric turbulence into six stability classes

named A, B, C, D, E and F with class A being the most unstable or most turbulent class, and class F the most stable or least turbulent class.

SN	Stability Class	Definition
1	A	Very Stable
2	B	Unstable
3	C	Slightly Stable
4	D	Neutral
5	E	Slightly Stable
6	F	Stable

1 Spillage of product when road tanker meets with an accident enroute resulting in fire

This kind of eventualities comes under NDMA and guideline/ruling (for POL tankers) has been prescribed to deal with such situations.

2 Fire In Parking Area Outside Terminal Premises

Parking area for lorry loading usually having empty Tank Trucks and in waiting mode for their turns to get in for loading. All loaded Lorrie's leaves immediately after security/statuary clearance. If there is by any chance of fire in tonnage/spillage etc due to ignorance/mischief /unknown reason etc will be of miner nature and can be checked conveniently with available resources in -house.

3 STORAGE TANK HIT BY A FLYING OBJECT/UNDER FIRE DUE TO SOME EXPLOSION IN CLOSE VICINITY AREAS

When storage Tank hit by a flying object, worst of worst total failure of tank will be possible as an outcome or leakage of product through hole/rupture made in tank after hitting by a flying object. As a result the product will accumulate within the Dyke, if this leaked product catches fire it will results in Pool Fire accident which is already considered in MCA Scenarios. Tank on Fire scenario is also possible which is covered in MCA's.

Tank under fire due to some explosion in close vicinity areas is the Tank on fire scenario which is covered under Tank on Fire Scenario.

4 CATAGORIZATION OF RISK BASED ON ABOVE IDENTIFIES MCA'S

Risk category as per incidents mentioned above is as per below:

TABLE 7.18
CATEGORIZATION OF RISK AS PER IDENTIFIED MCA SCENARIOS

SN	Risk Source	Risk Category
1	Spilled product Fire	Low
2	Pool Fire	Intermediate
3	Tank On Fire	Intermediate

SN	Risk Source	Risk Category
4	Unconfined Vapour Cloud Explosion	Intermediate
5	Spillage of product when road tanker meets with an accident enroute resulting in fire	Low
6	fire in parking area outside Terminal premises	Low
7	storage tank hit by a flying object/under fire due to some explosion in close vicinity areas	Intermediate

5 CONSEQUENCES OF THE IDENTIFIED ACCIDENT SCENARIO

6 POSSIBILITY OF FIRE & IT'S PROPAGATION AT THE POL TERMINAL, SANGRUR

Primarily there could be fire (ignition of spilled or leaked petroleum Product), flare (jet fire) or pool fire in the Terminal. Pool fire is possible at the tank farm only whereas fire and flare are possible at any pipeline containing MS, HSD & SKO Tank farm, Pump shed, TLF Shed and Road Tank Truck.

Pool Fire due to HSD or SKO will not be as violent as that of MS tanks. In addition, the extent of damage for SKO/ HSD will not be more than that due to MS tank. Therefore, it is concluded that Pool Fire due to MS Tank present & Proposed Dyke would be the worst credible accident scenario as compared to pool fire in the other tanks of the Terminal.

7 SPILLED PRODUCT FIRE

The Product may get spilled and come in contact with a potential ignition source. In this case, it will catch fire. Extent of fire will depend on quantity of Petroleum Products (MS, HSD & SKO) released and profile of the surface on which it has been spilled. Such fire may also cause fire in the nearby flammable/combustible material, if any. This type of fire must be extinguished immediately and propagation of fire should be stopped.

8 JET FIRE IN POL PIPELINE/PRODUCT PUMP HOUSE/TANK FARM/TLF SHED/TT DECANTING AREA/TANK TRUCK

If there is a leakage in the pipeline and there is availability of any ignition source, jet fire may occur. In such cases the leaked product may travel up to the ignition source and the fire may travel back to the place of leakage or the leaked Product may catch fire at the place of leakage itself. Considering the worst possible cases uch a jet fire may cause direct damage up to 10 to 35 m for a leak size of 2 to 5 cm diameter and Product being released with the head of 5 to 10 m. The flame impingement and may cause further damage.

In this case also there would be sufficient time available for the persons to come out from the affected area, if any. In such cases isolating the affected pipeline should be given first priority than extinguishing the fire. The affected equipment (being heated by the heat) should be kept cool with flow of water from monitor/hydrant.

9 ANALYSIS FOR PROPENSITY TOWARDS PREDICTED CONSEQUENCES

Risk of operation of any activity involving hazardous chemicals consists of the following two elements:

1. Consequences of certain unwanted event &
2. Propensity that these consequences will occur.

Propensity or likelihood of the predicted consequence for the Installation will depend upon the following items:

1. Propensity of the Terminal towards occurrence of initiating event.
2. Propensity that the designed counter measures provided in the Installation would fail.
3. Propensity of certain consequence of an accident.

10 PROPENSITY OF THE TERMINAL TOWARDS OCCURANCE OF SUCH INITIATING EVENT

The event could be a single component failure, for example, leakage of product from pipeline or any equipment or any tank. To evaluate this aspect for the POL terminal, Hazard and Operability Studies (HAZOP) should to be carried out.

11 PROPENSITY OF FAILURE OF THE DESIGNED COUNTER MEASURES

Upon occurrence of the initiating event, certain designed counter measures in the Terminal would start functioning for example isolation of the affected area from other areas by the personnel by closing the valves to restrict the quantity of escaping petroleum product; on hearing the emergency alarm the emergency team would immediately start functioning and take the necessary action to restrict or limit the damage. On the contrary these counter measures may fail also. Therefore, a lot would depend on response of the emergency team. Hazards & Operability Studies, (HAZOP) needs to be carried out to evaluate this aspect in detail.

12 PROPENSITY

Any initiating event would take place first, there after the designed counter measures would attempt to limit the effects of the initiating event. Such deviations from the intended operation may lead to an accident. In reality, accident scenario and severity of the consequences will depend on type of product leaked, quantity of the product leaked, location of the incident (tank farm/pump shed/T/T plate form), availability of ignition source, response of emergency systems and emergency team, weather conditions (wind velocity & direction), etc. Further propensity of being killed or injured would also depend on the aspects like time of accident and number of people in damage area at that time.

13 PROBABILITY ESTIMATION FOR OCCURANCE OF MCA SCENARIO

Applying equipment failure rate data and ignition probability data probability values have been estimated for consequences of various MCA scenarios, which are as follows:

TABLE 7.19
PROBABILITY OF OCCURRENCES OF IDENTIFIED MCA SCENARIOS

For the following accident scenarios the categorization is as follows, which is inferred on the basis of past accident analysis, information & approach provided in Green Book & Purple Book of EFFECTS, TNO:

SN	Categorization	Probability Range
1.	Low	< 10^{-3} To< or = 10^{-4} per year
2.	Very Low	< 10^{-4} To< or = 10^{-6} per year
3.	Extremely Low	< 10^{-6} per year on wards

The probabilities for various accident scenarios have been estimated as follows:

SN	Accident Scenario	Probability
4.	Spilled Product catching fire	Very Low (about 10^{-5} per year)
5.	Jet Fire in POL Pipeline/Product Pump House/Tank Farm/TLF Shed/T/T Decanting Area/Tank Truck	Very Low (about 10^{-5} per year)
6.	Pool Fire in MS/Hexane tank, in Main Tank farm	Very Low (about 10^{-6} per year)
7.	Pool Fire in SKO/HSD tank in Main Tank farm	Very Low (about 10^{-6} per year)
8.	Tank On Fire	Very Low (about 10^{-7} per year)
9.	Vapor Cloud Explosion due to major release of Class A product from storage unit	Extremely Low (about 10^{-8} per year)

RISK ACCEPTABILITY CRITERIA

There is no clearly numerical value defined and prescribed as to the risk acceptability criterion in our country. However mostly accepted criteria for an accident scenario having significant damage potential is “Frequency should not be more than 10-6” as prescribed in other standard text (TNO, Purple Book & US standard published text).

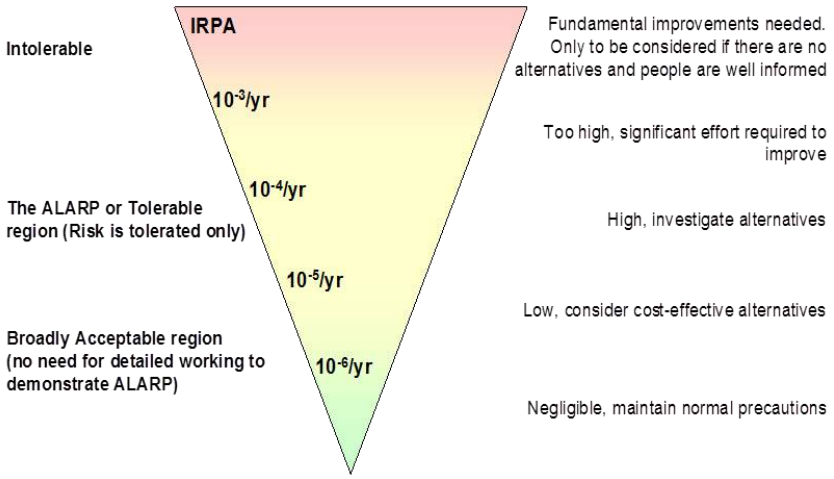
Risk can be seen as relating to the Probability of uncertain future events. Risk is defined as “multiplication of the probable frequency and probable magnitude of future loss” (combined effect).

The risk is also made "as low as reasonably practicable" (ALARP) and it is having reasonable impact on neighbourhood. Hence, considerable measures being taken to mitigate the possible accident scenarios. While conducting the risk analysis, a quantitative determination of risk involves three major steps:-

IRPA (Individual Risk per Annum):

NOTE- A risk of 10 per million per year or 10-5/Year; effectively means that any person standing at a point of this level of risk would have a 1 in 100 000 chance of being fatally injured per year.

From table No. 32, it can be seen that, the probability / frequency of occurrence of BLEVE in storage unit or transporting unit is 8.9 x 10-6. Hence, as per IRPA, the risk is coming under “Broadly Acceptable region” which require maintaining normal precautions within the plant (Occurrence rarest of rare).



Individual Risk Criteria for Public

Societal Risk

It is the risk experience in a given time period by the whole group of personnel exposed, reflecting the severity of the hazard and the number of people in proximity to it. It is defined as the relationship between the frequency and the number of people suffering a given level of harm (normally taken to refer to risk of death) from the realization of the specified hazards. It is expressed in the form of F-N curve. There is no locality/residence surrounding to the LPG plant. The risk is coming under "Broadly Acceptable region" which require maintaining normal precautions within the plant (Occurrence rarest of rare).

14 UNCERTAINTY SURROUNDING CONSEQUENCE ANALYSIS

Analytical and mathematical models employed in quantification of damage distances are based on many considerations, which have been discussed earlier.

In many cases, very general data is available on component and equipment failures, for which statistical accuracy is often poor. Probability data has been found quite subjective, so that, when combined in a fault tree or event tree the incident frequencies thus computed may not have a higher confidence range. Further more, it is difficult to infer the comparison between frequencies of two catastrophic events, for example propensity of 10^{-4} and 10^{-5} per annum.

15 CONCLUSION

From MCA calculations shown in above Tables, it is concluded that, for IOCL SANGRUR POL Terminal, Pool Fire accident in MS Tank of Dyke 3 have maximum damage potential than pool Fire in any other Tanks (HSD or SKO). For Tank on Fire Scenario, Fire in MS tank No. 20 & 21 of Dyke-3 has maximum damage potential than fire in any other tanks.

Amongst all, Vapour Cloud Explosion in MS Tank will be the most Credible accident. Damage due to Vapour Cloud explosion in MS Tank will be more than the Damage due to Pool Fire & tank On Fire. However VCE can occur as secondary effect only and frequency of occurrence of VCE is rarest of rare.

16 MITIGATION/PREVENTIVE MEASURES FOR MCA SCENARIOS

In order to mitigate/prevent any minor incident from becoming a major accident **following measures along with Onsite and if required Offsite Emergency (Disaster) Management Plan should be followed**:

1. *Spillage in tank area/pump house area/TT Gantry Area:* small leakage through tank valves/joints will take a form of spillage if not identified immediately. If this spillage gets on contact with ignition source will take a form of fire and lead to an accident. In order to prevent it from becoming a major accident, stop the operation immediately. Remove the spillage with proper corrective method from that area. REMOVE SPILLED PRODUCT using Sand or Fire Extinguishers (By Spreading Foam Solution)). Do not touch or walk through spilled material, stop leak if possible. Use water spray to reduce vapor, **do not** put water directly on leak or spill area. And if ignition of spilled product takes place necessary emergency procedure must be followed as soon as possible to avoid damage to other property due to secondary effect accidents. For small spillage, flush area with flooding amounts of water.

2. *Pool Fire in Dyke Area:* Failure of outlet valve of tanks or any one of valve will lead to leakage of product. This will form a pool inside dyke area if not identified immediately. This pool if comes in contact with an ignition source will lead to an major accident. In order to mitigate it, stop the operation immediately. Be ready will all fire fightingequipments at the site. Start sprinkler system to cool the surrounding tanks. Immediately follow both onsite and offsite emergency plan.

3. *Tank On Fire:* For preventing tank on fire, cool the surrounding tanks by means of sprinkler system and foam system. Bring all fire fighting equipment at the site and start fighting with fire following proper onsite emergency plan.

Unconfined Vapor Cloud Explosion: UVCE is a secondary domino effect. Vapors releasing into atmosphere are not in so much quantity that it lead to an explosion. For an ignition, a proper mixture of fuel to air is required, if this mixture between UEL & LEL comes in contact with an ignition source, it will lead to an explosion. In order to prevent it, immediately stop the leakage from the source by identifying it or by isolation the system in case of failure of tank. For this, it is recommended to install hydrocarbon Detector in Pump House area, Tank Farm area and TT Gantry area.

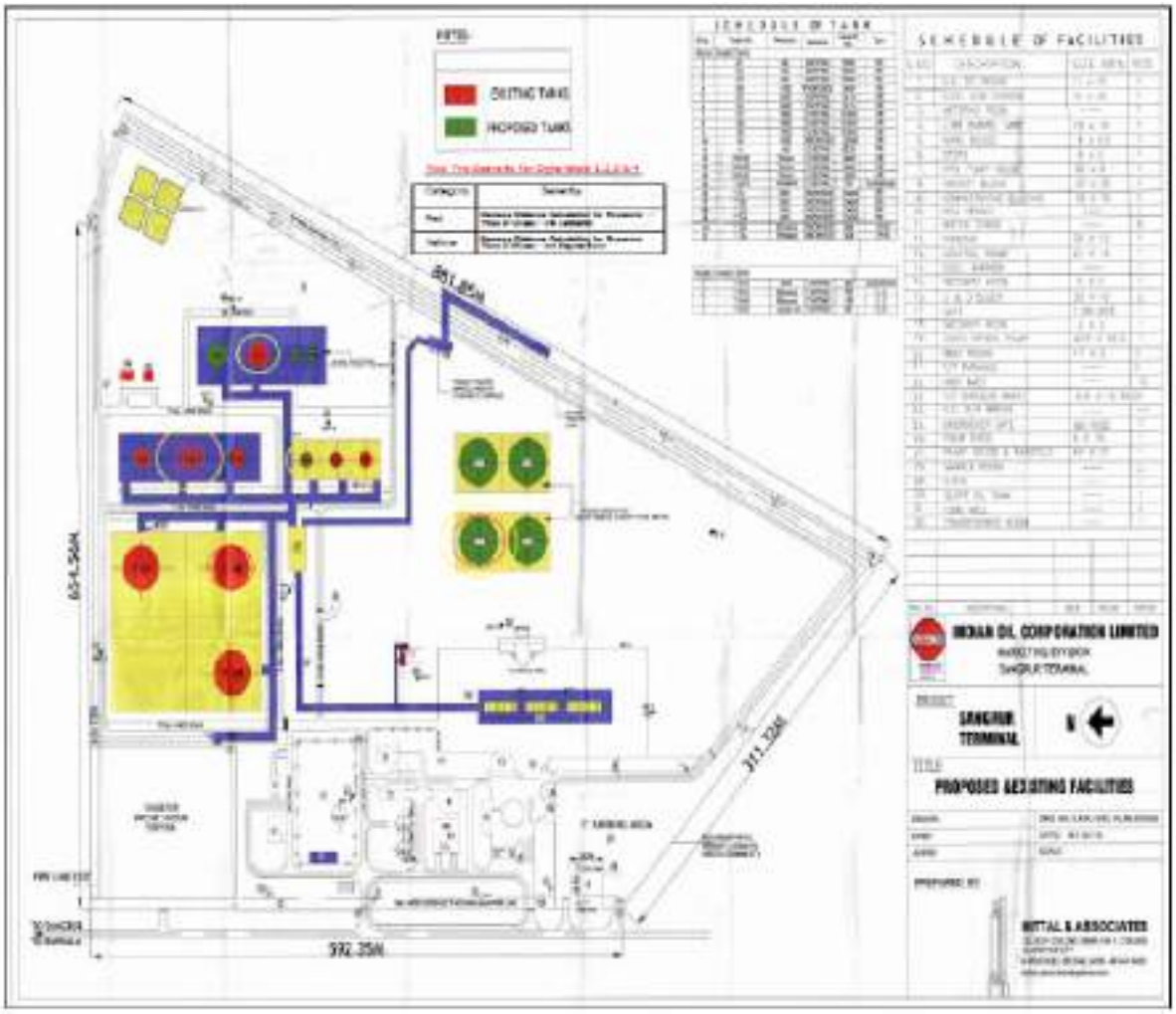


FIGURE 7.2: POOL FIRE SCENARIO FOR DYKE 1,2,3 & 4 - DAMAGE DISTANCE CALCULATED FOR EXPOSURE TIME OF 10S

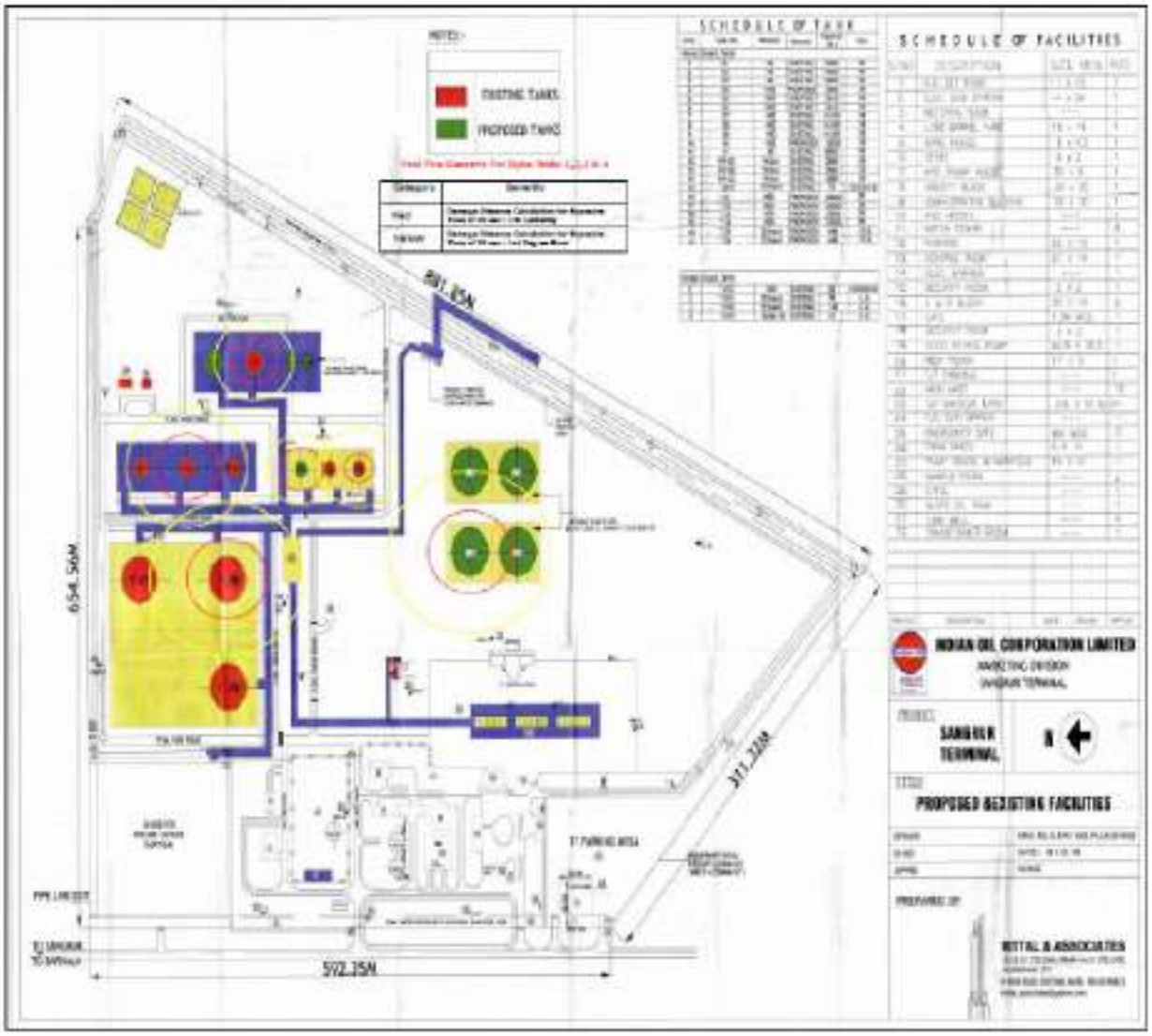


FIGURE 7.3: POOL FIRE SCENARIO FOR DYKE 1,2,3 & 4 - DAMAGE DISTANCE CALCULATED FOR EXPOSURE TIME OF 30S

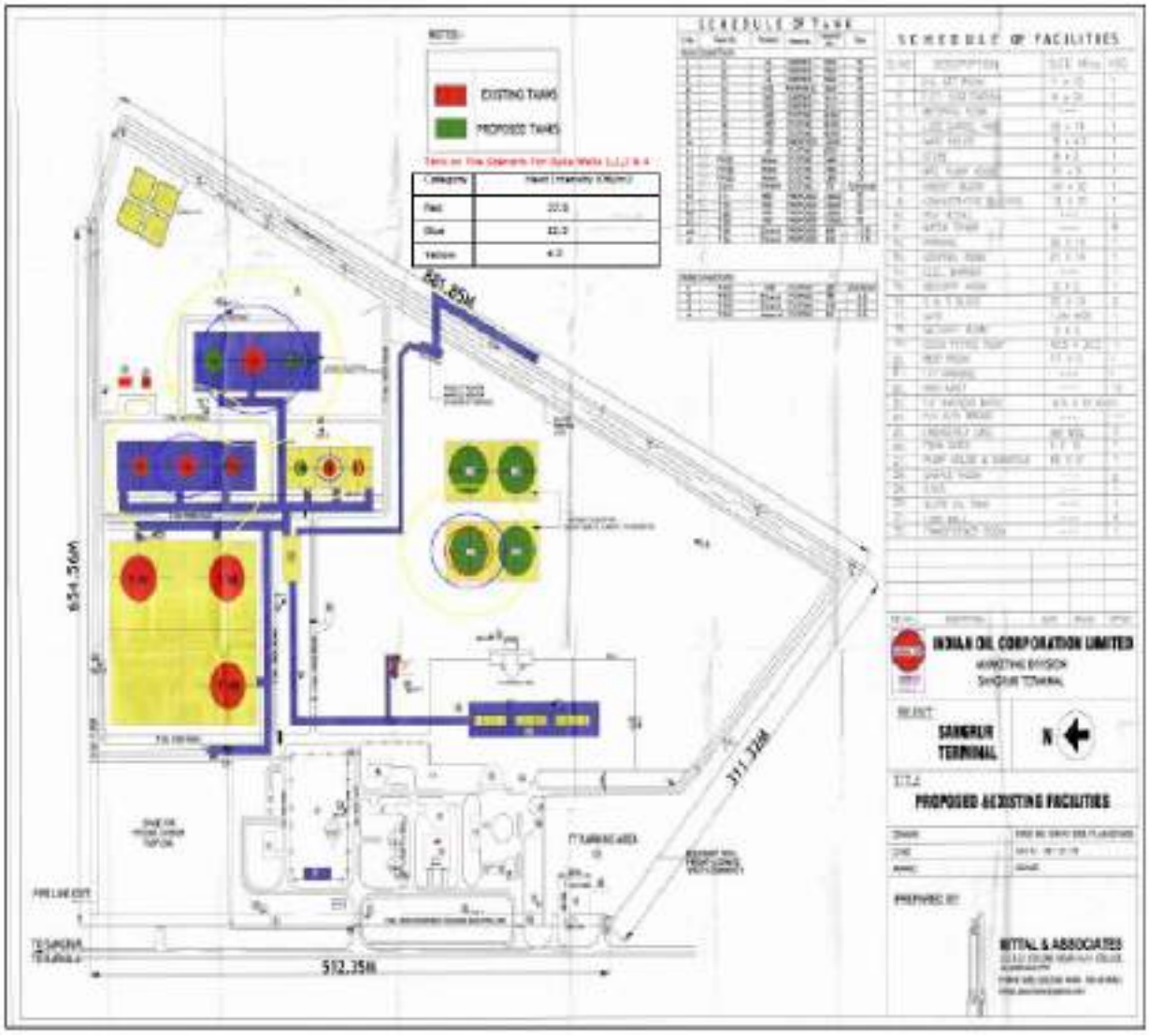


FIGURE 7.4: TANK ON FIRE SCENARIOS FOR MS, HSD, SKO

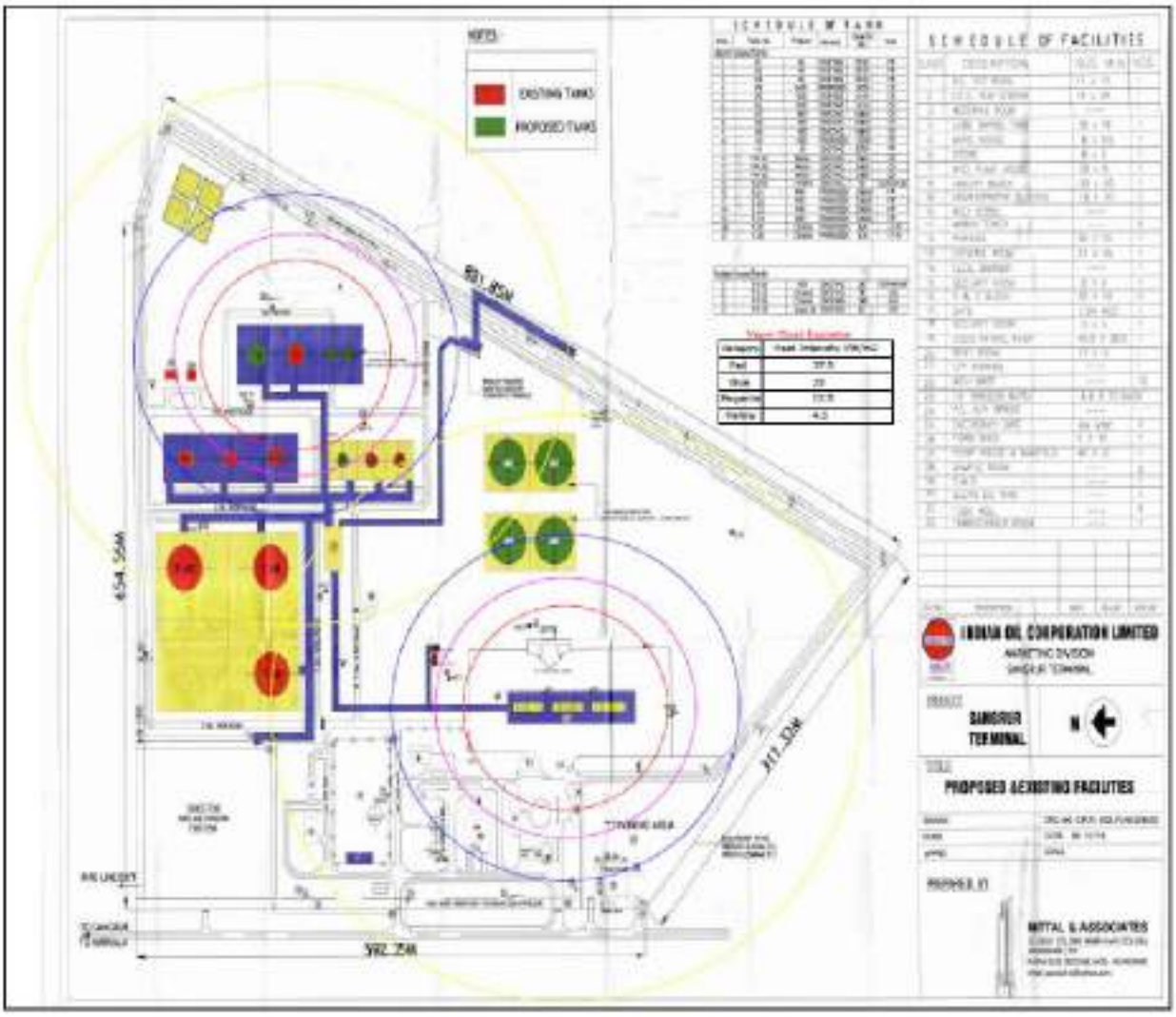


FIGURE 7.5: VAPOR CLOUD EXPLOSION DUE TO MS

7.3 ON-SITE EMERGENCY PLAN IN STATUTORY FRAMEWORK

7.3.1 Accident Hazard Site

The requirement of an ON-SITE EMERGENCY PLAN with detailed disaster control measures was embodied for the first time in Section 41B (4) of THE FACTORIES (AMENDMENT) ACT, 1987 (23rd May, 1987) and came into force subsequently. The requirement is applicable to IOCL, Sangrur Terminal as per the First Schedule of the said Act, item 29 entitled "Highly Flammable Liquids and Gases". Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989, notified and enforced by Union Ministry of Environment & Forests on 27th November, 1989 under Sections 6, 8 and 25 of THE ENVIRONMENT (PROTECTION) ACT, 1986 concurrently provide the requirement of a 0N-SITE EMERGENCY PLAN, by the occupier of accident hazard site, under Rule 13 Sub-rule 1.

7.3.2 Emergency Control Philosophy

The principal strategy of emergency control at Sangrur, POL terminal is prevention of the identified major hazards. Since hazards can occur only in the event of loss of containment, one of the key objectives of

detail engineering, construction, commissioning and operating of the Terminal is total and consistent quality assurance. IOCL is committed to this philosophy, so that the objectives of prevention can have ample opportunities to mature and be realized in practice.

The second control strategy adopted for potential emergencies is surveillance of handling and storage of hazardous substances.

Yet another control measure to be adopted is early detection of any accidental leak of Petroleum product by trained and vigilant operating staff and activation of well-structured, resourced and rehearsed emergency plan to intercept the incident with speed and ensure safety of employees, assets, public and environment as a matter of priority.

7.3.3 Content of On-Site Emergency Plan Information

In the departmental "Guide of MSIHC Rules, 1989", published in 1992, the Union Ministry of Environment & Forests (MOEF), Government of India, specified broadly the content of an on-site emergency plan (Page 39). This report on emergency plan has been prepared, in so far as is practicable, in accordance with those guidelines. The guidelines were subsequently notified in October 1994 in Official Gazette (SO-2882) of Ministry of Environment & Forests, Government of India and are reproduced below:

Details that need to be furnished in the on-site emergency plan as per schedule- 11 of MSIHC Rule 1989 are –

(i) Name and address of the person furnishing the information.
(ii) Key personnel of the Organization and responsibilities assigned to them in case of an emergency.
(iii) Outside Organization if involved in assisting during an on-site emergency:
- Type of accidents
- Responsibility assigned.

(iv) Details of liaison arrangement between the Organizations.
(v) Information on the preliminary hazard analysis:
- Type of accidents.
- System elements or events that can lead to a major accident.
- Hazards.
- Safety relevant components.

(vi) Details about the site:
- Location of dangerous substances.
- Seat of key personnel.
- Emergency control room.

(vii) Description of hazardous chemicals at Terminal site:
- Chemicals (quantities and toxicological data).
- Transformation if any, which could occur.
- Purity of hazardous chemicals.

(viii) Likely dangers to the Terminal
(ix) Enumerate effects of -
- Stress and strain caused during normal operation.
- Fire and explosion inside the Terminal and effect, if any, of fire and explosion outside.

(x) Details regarding

- Warning, alarm, safety and security systems.
- Alarm and hazard control plans in the line with disaster control and hazard control planning, ensuring the necessary technical and organizational precautions.
- Reliable measuring instruments, control units and servicing of such equipments.
- Precautions in designing of the foundations and load bearing parts of the building.
- Continuous surveillance of operations.
- Maintenance and repair work according to the generally recognized rules of good engineering practices.

(xi) Details of communication facilities available during emergency and those required for an offsite emergency.

(xii) Details of firefighting and other facilities available and those required for an offsite emergency.

(xiii) Details of first aid and hospital services available and its adequacy.

An outline of these details is provided in the pages following under the headings stated above, in so far as the headings apply to Sangrur Terminal.

7.4 KEY PERSONNEL OF ORGANIZATION AND RESPONSIBILITIES IN THE EVENT OF AN EMERGENCY

It is to be understood that the first few minutes after the start of an incident are most vital in prevention of escalation. Therefore the personnel available at the site on round the clock basis play an important role. Some of them are the **"KEY PERSONS**". Since the POL terminal is operated by trained operators and contract personnel with four officer IOCL has envisaged that emergency in POL terminal will be handled by operation in-charge of POL terminal i.e. Chief Terminal Manager with the help of other officers & workers of POL terminal. Chief Terminal Manager will nominate different Emergency Coordinators to control emergency situation.

The role of various coordinators is to assess the situation form time to time, take appropriate decisions in consultation with the **CHIEF CONTROLLER** and to provide timely resources and instructions to the Key Persons to fight the emergency. Key Persons as far as possible are available on a round the clock basis. An organogram of the officers at the POL terminal during emergency is presented in this section.

TABLE 7.20

ORGANISATION CHART FOR ON-SITE EMERGENCY MANAGEMENT

CHIEF INCIDENT CONTROLLER - CHIEF TERMINAL MANAGER - ALTERNATE INCHARE- OPERATION MANAGER		
ASSEMENT OF SITUATION AND DECLARATION OF EMERGENCY, MOBILISATION OF DIFFERENT TEAM LEADERS, ACTIVATION OF FIRE ORGANISATION CHART / ONSITE EMERGENCY PLAN, CONTINUOUS REVIEW OF SITUATION AND DECIDE APPROPRIATE RESPONSE STRATERGY, TAKING DECISION ON SEEKING ASSISTANACE FROM MARG OR DISTRICT AUTHORITIES, ORDERING EVACUATION OF PERSONNEL AS & WHEN NECESSARY.		
FIRE COMBAT TEAM	**AUXILLARY TEAM**	**RESCUE TEAM**
INCHARGE -SHIFT INCHARGE	**INCHARGE - DEPUTY MANAGER / LEAD ENGINEER**	**INCHARGE S&D HEAD / PLANNING OFFICER**
OPERATE ESD AND MCP & INSTRUCT TEAM TO TAKE UP POSITION FOR FIRE FIGHTING ALONG WITH FF EQUIPMENTS AS NEEDED	RUSH TO SPOT OF EMERGENCY AND INSTRUCT TEAM MEMBEBERS TO TAKE RESPECTIVE POSITION AS PER DIRECTION FROM CIC	CONTROL OFFICE BUILDING, IN & OUT COMMUNICATION, SAFE GAURDING OF ALL CONCERNED DOCUMENTS
GANTRY OFFICER 1- / ELETRICIAN	**SEALING OFFICER / SEALING OPERATOR**	**DOCUMENT EXECUTIVE-1**
START FIRE ENGINE & MONITOR FIRE ENGINE & COMMUNICATE WITH THE LEAD ENGINEER/SHIFT INCHARGE	TAKE OUT THE TTs FROM GANTRY SAFELY & SLOWLY AND DIVERT THE TTS TO EMRGENCY EXIT GATE. ALSO INSTRUCT THE SECURITY OFFICER AT MAIN GATE TO STOP ENTRANCE AND EXIT OF TTS AT MAIN GATE AND KEEP THE GATE CLOSED.	INFORM FIRE BRIGADE ,POLICE, DOCTOR, MUTUAL AND MEMBERS, FACTORY INSPECTORS, WILL REMAIN IN S&D OFFICE AND WILL COMMUNICATE WITH OUTSIDE AGENCIES AS PER INSTRUCTION OF CIC
GANTRY OFFICER-2 /CALIBRATION OFFICER	**LEAD ENGINEER /OPERATION ENGINEER (MAINTENANCE) / MIS OFFICER**	**GUARD-3 / GARDNER 01 / PANTRY OPERATOR**
STOP LOADING CLOSE ALL DELIVERY VALVES AT FILLING BAY INSTRUCTION TT CRB/VTO REMOVE LOADING ARMS AND RUSH TO THE SPOT TO FIGHT FIRE	WILL REMAIN IN CONTROL ROOM & ACT AS PER DIRECTION FROM CHIEF INCIDENT CONTROLLER, WILL REMAIN IN CONSTANT TOUCH WITH CIC, MDPL CONTROL ROOM & MAIN GATE SECURITY GUARD	GUARD-3 & GARDNER 01: ARRANGE STRECHER AND FIRE PROXIMITY SUIT IF REQUIRED. PANTRY OPERATOR WILL IMMEDIATELTY HAND OVER MEGAPHONE TO CIC
GANTRY OFFICER-3 / GANTRY OPERATOR-1	**SECURITY SUPERVISOR & MAIN GATE GUARD**	**DOCUMENT EXECUTIVE-2**
STOP LOADING CLOSE ALL TANK VALVES /MANUAL ISOLATION VALVES AND RUSH TO THE SPOT FIGHT FIRE .	SOUND ALARM AS PER INSTRUCTION FROM CHIEF INCIDENT CONTROLLER, INDICATE FIRE ZONE & GUARD GATE & CONTROL THE MOVEMENT OF LABOURS & VISITORS AND IMMEDIATELY SEND ONE GUARD TO EMERGENCY GATE TO CONTROL THE MOVEMENTS.	WILL REMAIN IN S&D OFFICE AND COLLECT/KEEP RECORDS IN SAFE CUSTODY
SEALING OPERATOR & GANTRY OPERATOR -2	**GUARD-1**	**S & D OPERATOR**
RUSH TO THE SPOT WIT EXTRA DCP, HOSES, FOAM CANS ,EXTRA NOZZELS & OPERATE FIRE HYDRANT, MONITORS IF REQUIRED OR AS PER INSTRUCTIONS OF LEAD ENGINEER	IMMEDIATELY RUSH THE EMERGENCY GATE TO CONTROL THE TTs MOVEMENT & WILL ENSURE THAT TT CREW REMAINS IN CABIN UNTILL CALLED SO .	WILL HELP IN COLLECTION OF DOCUMENT / RECORDS WITH DOCUMENT EXECUTIVE AND ACT THERE AFTER AS PER INSTRUCTIONS OF CIC
HSSE OFFICER 1&2	**GUARD-2**	**FINANCE EXECITIVE**
RUSH TO SPOT OF EMERGENCY & COORDINATE WITH FIRE COMBAT TEAM, DIRECT AVAILABLE MAN POWER IN HOSE LAYING & FOAM APPLICATION	WILL TAKE THE FLAG FROM SECURITY CABIN AND INDICATE THE FIRE LOCATION FOR FIRE FIGHTING AND RESCUE OPERATIONS	WILL IMMEDIATELY PUT ALL CASH, CHEQUES & DEMAND DRAFT IN SAFE CHEST & HELP TO AUXILIARY TEAM AS PER DIRECTION OF CIC
OPERATION ENGG. (ELECTRICAL)	**LAB-INCHARGE / LAB ANALYST / LAB OPERATOR 1&2**	**GUARD 4 & FITTER**
ENSURE SMOOTH RUNNING OF FIRE ENGINES & DG SETs AS PER INSTRUCTION OF CIC	WILL MAINTAIN SUPPLY OF FIRE FIGHTING EQUIPMENTS LIKE DCP, CO2 FE, NOZZLES, FOAM CANS etc, & WILL ENSURE CONTINUOUS SUPPLY OF ADDITIONAL FIRE FIGHTING EQUIPMENT TO FIRE COMBAT TEAM AS PER DIRECTION OF CIC	WILL IMMEDIATELY TAKE ROUND OF TERMINAL FOR CHECKING OTHER FACILTIES FOR ANY OTHER EMERGENCY /FIRE & REPORT TO CIC

7.4.1 Key Personnel Chart

The senior most officers in the POL terminal is the Chief Terminal manager, who will be the Chief Emergency Controller. In pre Emergency period he will delegate responsibility to other officers as other Coordinators as per suitability and the job to be done by them. During emergency, if Chief Terminal manager is not present at site, the senior most officers in the Terminal will assume the responsibility of Chief Emergency Controller and inform Terminal Manager to be present at site at shortest possible time.

7.5 DUTIES & RESPONSIBILITIES OF KEY PERSONS & COORDINATORS

The duties and responsibilities of Chief Controller and other Coordinator are as follows:

7.5.1 Main Incident Coordinator

For On-Site Emergency Preparedness Plan (EPP), the Location-in-Charge (Chief Terminal manager) shall be the Main Incident Controller to coordinate the execution of the plan during an emergency or a mock drill. He is responsible for preparation/updating of the plan, getting approval from the District authorities/Factory Inspectorate; and its implementation in the hour of need. His duties are:

a) Assess the magnitude of the situation and declare state of emergency. Activate EPP and ensure its implementation.
b) Mobilize the Coordinators/Key Personnel and exercise direct operational control of areas, other than those affected.
c) Declare danger zones and activate Emergency Control Centre.
d) Ensure calling in Mutual aid members and District emergency agencies like Fire Brigade, Police, and Medical authorities.
e) Maintain a speculative continuous review of possible developments and assess these to determine most probable course of events and appropriate response.
f) Inform Area Office, Head Quarters, Police, Statutory authorities, District authorities about the magnitude of the emergency casualties and rescue operations.
g) Ensure casualties are receiving required attention and their relatives are informed.
h) Ensure accounting of personnel.
i) Issue authorized statements to Press, Radio, TV etc., regarding the emergency and its possible impact on the surroundings.
j) Authorize procurement of emergency material.
k) Log important developments in chronological order and preserve material evidence for investigation. Direct isolation of power supply, Terminal shutdown, and evacuation of personnel inside the premises as deemed necessary.
l) Advise Police, District authorities regarding evacuation of public in the near vicinity/vulnerable zone. Ensure raising the siren in EMERGENCY mode till All Clear Signal.
m) When effects are likely to be felt outside, get in touch with District Authorities,who will take over the management and declare "Off-Site Emergency".
n) Control rehabilitation of affected areas on cessation of emergency.

7.5.2 Administration & Communication Coordinator

a) Liaise with Chief and other coordinators.
b) Inform and coordinate with External agencies and Mutual aid members foragreed assistance. Direct them on arrival to the respective coordinators.
c) In case communication means fail, send messengers to Mutual aid members/Emergency departments. Coordinate with Police in controlling the traffic andmob outside the premises.
d) Activate the medical Centre and mobilize medical team. Arrange ambulanceand transfer casualties to hospitals. Also coordinate with police in case of fatalities.
e) Arrange for head count at the assembly points.
f) Arrange procurement of spares for firefighting and additional medical drugs/appliances.
g) Mobilize Transport as and when required by various coordinators. Arrange toprovide spark arrestors to emergency vehicles entering the premises.
h) Monitor entry/exit of personnel in the premises. Permit only authorizedpersonnel/ vehicles inside the premises.

i) Control and disperse crowd from the emergency site. Regulate traffic insidethe location.
j) Arrange food, beverages and drinking water for all those involved inexecution of EPP in case the emergency prolongs.
k) Communicate with relatives of persons injured/involved in firefighting activities.
l) Arrange evacuation of premises as directed by Main incident controller.Coordinate with civil authorities for evacuating public from the danger zone andarrange for refreshments at the evacuation center.

7.5.3 Safety Coordinator

a) Ensure safe stoppage of the Operations, shut off valves on product lines, and isolation of affected area.
b) Demarcate Danger and Safe zones by putting RED and GREEN flags.
c) Mobilize the Firefighting crew and direct the Fire Fighting operation.
d) Effectively deploy manpower, both internal and external.
e) Direct & utilize the Fire Brigade personnel.
f) Arrange the replacement of various Fire Fighting Squads with the Mutual and External aid members on need basis.
g) Ensure/maintain sufficient pressure in the Hydrant mains.
h) Assess water level in the storage tank/reservoir and plan replenishment.
i) Monitor the requirements of Fire equipment and coordinate for procurement of spares.
j) Arrange for flood lighting of the affected areas and dewatering of the Firefighting area, if required.
k) Arrange to remove and park the tank Lorries (Bulk & Packed) to a safer place, as necessary.

7.5.4 INFORMATION ON PRELIMINARY HAZARD ANALYSIS

7.5.1.1 Types of Accident

Sangrur POL terminal has potential for FIRE AND EXPLOSION in the event of leakage of POL product. Failure cases may be considered as follows:

SN	T. No.	Product & Class	MCA Scenario
Existing Tankage			
1	01	MS-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
2	02	MS-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
3	03	MS-A	Pool Fire, Spilled product Fire, Tank on Fire & Vapour Cloud Explosion
4	05	SKO-B	Pool Fire, Spilled product Fire & Tank on Fire
5	06	SKO-B	Pool Fire, Spilled product Fire & Tank on Fire
6	07	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
7	08	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
8	09	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
9	11	MS-A	Pool Fire, Spilled product Fire, Tank on Fire &Vapour Cloud Explosion
10	12	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
11	13	ETHANOL-A	Pool Fire, Spilled product Fire, Tank on Fire &Vapour Cloud Explosion
12	14	ETHANOL-A	Pool Fire, Spilled product Fire, Tank on Fire &Vapour Cloud

SN	T. No.	Product & Class	MCA Scenario
			Explosion
13	18	ETHANOL-A	Pool Fire, Spilled product Fire, Tank on Fire &Vapour Cloud Explosion
Proposed Tankage			
14	21	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
15	22	HSD–B	Pool Fire, Spilled product Fire & Tank on Fire
16	23	HSD–B	Pool Fire, Spilled product Fire & Tank on Fire
17	24	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
18	25	Ethanol-A	Pool Fire, Spilled product Fire, Tank on Fire &Vapour Cloud Explosion
19	26	Ethanol-A	Pool Fire, Spilled product Fire, Tank on Fire &Vapour Cloud Explosion
20	10	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire
21	4	HSD-B	Pool Fire, Spilled product Fire & Tank on Fire

7.5.4.2 System elements or events that can lead to major accident

Equipment failure, Tank failure, Tank rupture, over-filling etc. can give rise to a major loss of containment and a major accident.

Human error can also cause a major accident.

7.5.4.3 Hazards

Sangrur Terminal has been characterized in the form of –

1. Spill Fire.
2. Pool Fire
3. Tank on Fire
4. Vapour Cloud Explosion.

Tank On Fire, Pool Fire and Vapor Cloud explosion are also potential hazards, which can cause widespread damage very quickly. After consequence analysis done with the help of world renowned SOFTWARE i.e. EFFECT it has been found that damage distances in case of non-credible scenario extend beyond 0.5 KM.

7. 5.4.4 Safety relevant components

The hazardous working areas of terminal should have a number of sensitive flammable gas detectors strategically located downwind to detect any VOC and raise alarm.

These detectors shall be supplemented by manually operated break-glass type fire alarm call points linked to electric sirens and a centralized and manned alarm annunciation panel**.**

All strategic areas should be fitted with 'heat-bulb' actuated medium velocity water sprinkler systems supported by fire fighting water pumps. An extensive network of pressurized fire hydrant system has been installed to fight fire anywhere within Terminal and to cool vessels and structures to ensure their safety during an incident, involving incidence of dangerous heat flux.

Adequate on-site manpower shall be suitably trained and equipped to carry out fire fighting operation efficiently. A number of diverse fire fighting media such as DCP, CO2 Fire extinguishers etc. are

strategically located in various parts of the Terminal in suitable dispensers. Foam or any other equivalent substance should be used in adequate measure to cut-down evaporation from a pool and thus inhibit fire and formation of a flammable gas cloud.

Fire and explosion inside the Terminal and effect, if any, outside

Based on Consequence Analysis it has been found that the effect distances and areas of fire and explosion reach more than 0.5 Km in case of non-credible failure scenario like VCE in and pressure waves and 0.3 Km from tank.

7.5.5 DETAILS REGARDING WARNING ALARM, SAFETY & SECURITY SYSTEMS

One 3.0 Km range Electric Siren, Six Hand Sirens have been installed to announce the on-set of an emergency. This can be triggered manually as and when a gas leak is detected.

7.5.5.1 Other Alarms

High-level alarms are to be provided in the storage tanks to provide a warning to the filling operator if more than safe filling heights.

a) Precautions in designing of the foundation & load bearing parts of the building

Foundations and load bearing parts are designed by competent Engineering Agency as per approved Codes of Practice and take into account operational loads and extremes of storm, lighting and flood. All storage tanks are electrically grounded to a network of earth stations with buried electrodes.

b) Continuous surveillance operations

The POL storage and handling operations will be continually under surveillance to prevent major incidents and to intercept one at the developing stage. Leakage condition should be continuously scanned by the gas detectors to be provided at vulnerable places.

c) Maintenance and repair work according to the generally recognized rules of good engineering practice

Preventive and breakdown maintenance and repair work are be carried out under the supervision of Terminal Manager / Dy. Manager. Equipment and criticality oriented inspection, periodic non-destructive testing and maintenance schedules are prepared with specialist inputs from within terminal, OISD and equipment manufacturers.

Details of communication facilities provided for emergency

(i) One 3.0 Km range Electric Siren to announce nature of emergency.
(ii) Six hand sirens are also provided.
(iii) An interTerminal paging system in Non-flame proof areas and as well as in flameproof areas are provided for normal and emergency announcements and communication with master control in the control room.
(iv) For inter-location communications and requisite number of P&T telephones including tie lines and hot lines for communication with district emergency services, authorities, hospitals etc.
(v) The interTerminal paging and public address system are having the following features-
- All call with answer back
- Group call with answer back

- Interfacing with walkie talkies
- Field call stations

(vi) Walkie Talkies and mobile phones are deployed for mobile-to-mobile and mobile-to-stationary communication.

(vii) A broad communication diagram outlining interactions between various role players

7.5.5.2 Details of Fire Fighting & Other Facilities Available

The Sangrur, POL terminal is provided with following fire fighting system & other preventive measures:

1. Fire Fighting Facilities

Following Fire Fighting Facilities will be provided.

- Water Sprinkler system on proposed MS and HSD as per prevailing safety guidelines issued by OISD
- Foam fighting system on proposed Diesel (HSD) and Petrol (MS) tanks as per prevailing safety guidelines issued by OISD
- Provision of Fire hydrant piping network for the new product tank farms.

The Fire Water tanks have been provided as shown in **Table 7.21** and Schedule of Fire pumps have been provided in **Table 7.22.**

TABLE 7.21
DETAILS OF FIRE TANKS

Sr. No	T. No.	Nos	Capacity(kl)
1	FW-01	1	2550
2	FW-02	1	2550
3	FW-03	1	3280
3	Total Fire Water Storage :8380 KL		

TABLE 7.22
SCHEDULE OF FIRE WATER PUMPS

Sr. No.	Type of Pump	Location of Pump / Area	Make of Engine/Pump	Pump Capacity in LPM	Pump Head in mts	H. P. of motor/ engine	Speed (RPM)
1	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
2	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
3	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
4	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
5	Fixed	Fire Engine Room	Cummins/Kirloskar	6833	88	250	2100
6	Fixed	Fire Engine Room	Kirloskar/Varat	6833	88	250	2100

Sr. No.	Type of Pump	Location of Pump / Area	Make of Engine/Pump	Pump Capacity in LPM	Pump Head in mts	H. P. of motor/ engine	Speed (RPM)
7	Fixed	Fire Engine Room	Kirloskar/Varat	6833	88	250	2100
8	Fixed	Fire Engine Room	Crompton Greaves	167	88	20	
9	Fixed	Fire Engine Room	Crompton Greaves	167	88	20	--

2. Instrumentation and Automation

Instrumentation and Automation will be provided through the following:

- Tank Farm Management system: These shall comprise of automation of receipt of products from Panipat-Bhatinda Pipeline.
- Valve Automation system: All the Tank Body Valves and exchange pit valves shall be automated including remote operation with necessary safety interlocks. Further, the tank body Valves shall be fitted with Remote Operated Shut Off Valves (ROSOV) to be closed by a safety PLC in case of emergency.
- Radar guages on all tanks: The gauges shall function in remote for the tank inventory and tank shut down procedures
- Tank Lorry Filling System: The entire process of filling of the Tank Lorries shall be automated along with necessary safety interlocks
- Access Control System: The system shall permit only authorized personnel to carry out the operations within the terminal. The access shall be both role and application based system.
- Control Room with equipment: The control room shall monitor and log all event pertaining to the operation of the terminal on real time basis.
- Emergency Shut Down Procedures for various terminal operation activities.

7.6 SAFETY MEASURES

Following safety and mitigation measures are proposed.

A. All product tank dyke wall/enclosure designed with 110% of the largest tank capacity.

➢ As per OISD standards, all tanks are provided with an enclosure wall to contain any leak from the tanks or in case of failure/rupture of the tank shell.

➢ The dyke provided is designed to contain the 110% of volume of the tank & a free board of 200 mm to take care of containment of oil in case of any leakage of tanks.

➢ The dyke enclosure designed as mentioned above facilitates to fight fire caused by a pool of oil

B. All product tanks to be provided with 2 nos. exclusive SIL 2 certified Radar gauges and 1 no additional over spill protection device to avoid any overflow of tanks.

- ➢ All the proposed and existing product storage tanks shall be provided with 2 nos. separate radar gauges with SIL 2 certification, which is an internationally accepted standard.
- ➢ Provision of 2 separate radar gages and monitoring of the same from control room/PLC system helps to avoid any overflow of product. The radar gauges are linked to the control room and shall give audio visual alarms at the control room in case of the product level reaches higher than the specified level.
- ➢ In addition to the above, 1 no exclusive and independent Automatic Overspill Protection device is hard wired to the Remote Operated Shut Off Valve and Safety PLC of the automation system. When the product level in the storage tanks rise beyond a pre-defined and safe filling capacity, the Automated Overspill Protection System (AOPS) is triggered and it overrides all operations and logics built in the system to implement total shut down of the operations and closure of all valves of all tanks.
- ➢ The above safety features prevent any overflow of petroleum product from the storage tanks.

C. All product tanks to be provided with pneumatic fire and fail safe Remote Operated Shut off Valves.

- ➢ All body valves of tanks shall be provided with Fire Safe and Fail Safe Pneumatic actuated Remote Operated Shut Off Valves (ROSOV).
- ➢ The ROSOVs shall be interlinked with the SIL 2 certified radar gauges, AOPS and Safety PLC. Upon the product level reaching the set trip point of a tank, the ROSOVs shall automatically close overriding all operational logics.

D. All body valves of tanks to be provided with Remote Open and Close facility outside the dyke enclosure to operate during emergencies.

- ➢ All valves of tanks shall be provided with an open and close push button just outside the tank enclosure.
- ➢ The same shall be used to close a particular valve of a tank in case of exigencies, thereby eliminating man entry in to hazardous zone (dyke area) during spillage etc.
- ➢ This system shall save human lives during emergencies and hazards due to proximity

to petroleum vapour.

E. Fire water storage to fight fire for a period of 4 hours as per OISD guidelines has been planned for 2 simultaneous contingencies with full coverage of fire hydrant facilities to the entire plant area and positioning of fire fighting equipments as per OISD standards.

- ➢ Permanent fire water storage and fire hydrant system to cover the entire terminal operating area shall be provided.
- ➢ The water storage and pumping facilities shall be designed to cater 2 simultaneous emergencies inside the terminal as mentioned below.

- Fire water storage: 8380 m3
- Fire pumps –7 X 410 m^3/hr

- Jockey pumps – 2x62 m^3/ hr.
- Fire hydrant line network – 6200 m approx.
- Fire fighting equipments – as per OISD 117 & OISD 244

F. High Volume Long Range remote operated monitors to be provided for all Class A storage tanks.

➢ In case of a fire, fire fighting can be done from the proposed High Volume Long Range Monitors (HVLR).

➢ The HVLRs shall have motorized valves with provision to operate remote from control room.

➢ As per OISD 117, 6nos of fixed type HVLR and 1no Mobile type HVLR with 1000 US GPM capacity are being proposed for the terminal to cover tank farm fires.

G. Hydro carbon detection system to be provided for all tanks, drain valve and manifold in Class A service.

➢ To detect any leak and potential fire hazard, Hydro-Carbon Detection (HCD) system is proposed for all tanks with Class A service, tank enclosure drain valves and product piping manifolds.

➢ The proposed HCD system shall be linked to the control room and shall alert the Control room officer with audio visual alarm when the concentration of the petroleum vapour exceed beyond pre-defined limits.

➢ The following equipment are being planned for the terminal as part of the HCD system.

- Point type Infra-Red (IR) sensor – at each drain valve in tank farm.
- Open path IR sensor (range: 0 to 40 m and 0 to 120 m) – at valves and manifold of Class A product.
- Portable Gas detector – 1 no.
- Test filter – 1no.

H. Fixed water spray and fixed foam pourer system has been provided for all Class A Tanks and for Class B tanks above 18 m diameter.

➢ The fixed foam pourer system shall apply foam solution to the surface of fire to create smothering effect and extinguishing of fire.

I. Flow switches shall be provided for all water draw off lines.

➢ In order to have effective monitoring of water draining from product tanks, a flow switch shall be installed on all drain valves of all tanks to alert the Control room.

J. Proposed Class A tank shall be constructed as floating roof tank.

➢ In order to prevent exposure of petroleum vapour to open environment, the proposed tank on Class A service shall be constructed as an floating roof tank with an Aluminum floating deck and a fixed roof. This shall act as an additional safety feature and shall minimize fires due to lightning etc.

K. Manual call points shall be provided at strategic places within the terminal.

➢ Manual call points are proposed at strategic places inside the terminal to raise alarming case of any exigency.

L. L. Receipt and delivery operation shall be done based on in built logic developed in SCADA with site specific interlocks.

➢ Tank operations like receipt and delivery shall be based on pre-defined logic and controlled by PLC and SCADA systems.

➢ This shall prevent wrong operations and risks like overflow of tanks.

M. Tank truck loading shall have interlocks to monitor grounding of the truck, position of the loading arm and over flow protection system.

➢ Tank truck operation shall be designed with the following interlocks to avoid fire hazards.

➢ Grounding interlock – To stop loading in the absence of proper grounding and to prevent fire due to static electricity.

➢ Position sensor/ level switch on loading arm – The batch controller commences tank truck loading based on the feedback from loading arm's position sensor is inserted in to the tank truck compartment. Similarly, the batch controller shall stop loading based on a feedback from a level switch of loading arm to prevent any overflow of tank truck.

N. Separate Safety PLC planned for interlinking of all safety features and for ensuring total shut down of the plant.

O. CCTV system shall be provided as per security guidelines applicable and shall be linked with Safety PLC.

7.6.1 Personal Protective Equipment

The following of personal protective equipment will be available during an emergency.

(i) Fire proximity suit - 1 no
(ii) Fire entry suit - Nil
(iii) Water gel blanket - 2 no.
(iv) Safety helmet - 70 nos.
(v) Rubber hand gloves for use in electrical jobs -2 pair.
(vi) BA Set - 1 no.

The quantities available are sufficient to meet the needs of emergency handling personnel.

7.6.2 Rehearsal and Testing

'Fire Drills' are arranged periodically to test out the laid down system and facilities. The emergency handlers also "act out" their individual roles in accordance with the emergency procedures laid down to demonstrate that the entire emergency response system can perform efficiently and accurately. A mock drill for emergency is to be conducted twice in a year.

7.7 SALIENT FEATURES OF ON-SITE EMERGENCY

Effect distances for various ranges of distances against a heat flux of 4.5 KW/M2. People will have to be evacuated in the event of fire.

7.8 OFF-SITE EMERGENCY PLAN

An integral part of the Disaster Management Plan is the Off-Site Emergency Plan. The plan is mainly dependent upon a very close co-ordination and assistance from the Local Administration like Police, Fire Brigade, Medical Services (hospitals) etc.

7.8.1 Off-Site Action

The Chief Controller will inform about the incident like Fire, Explosions to –

(i) Police and District Collector.
(ii) Fire Brigade.
(iii) Medical Services.
(iv) Technical/Statutory Bodies.
(v) Rehabilitation Agencies.
(vi) Electricity Board.

7.8.2 Responsibilities of the Services

1] Police

1. To control traffic & mob by cordoning off the area.
2. Arrange for evacuation of people on advice from the Site Controller/District Collector.
3. Broadcast/communicate through public address systems to the community on advise from the District/Sub Collector.
4. Inform relatives about details of injured and casualties.

2] Fire Brigade

1. Fighting fire & preventing its spread.
2. Rescue & salvage operation.

3] Medical/Ambulance

1. First Aid to the injured persons.
2. Shifting critically injured patients to the hospitals.
3. Providing medical treatment.

4] Technical/Statutory Bodies

(Constitutes Factory Inspectorate, Pollution Control Board, Technical Experts from Industries)

1. Provide all technical information to the emergency services, as required.
2. Investigate the cause of the disaster.

5] Rehabilitation

1. Arrange for evacuation of persons to nominated rescue centre and arrange for their food, medical and hygienic requirements.
2. Coordinating with the Insurance Companies for prompt disbursement of compensation to the affected persons.

3. Maintain communication channels of the affected industry like telephone, telex etc. in perfect working condition.

6] Electricity Board

To put off the power supply to the Terminal, if specifically asked for by IOCL.

7] Important Telephone Numbers Who May be

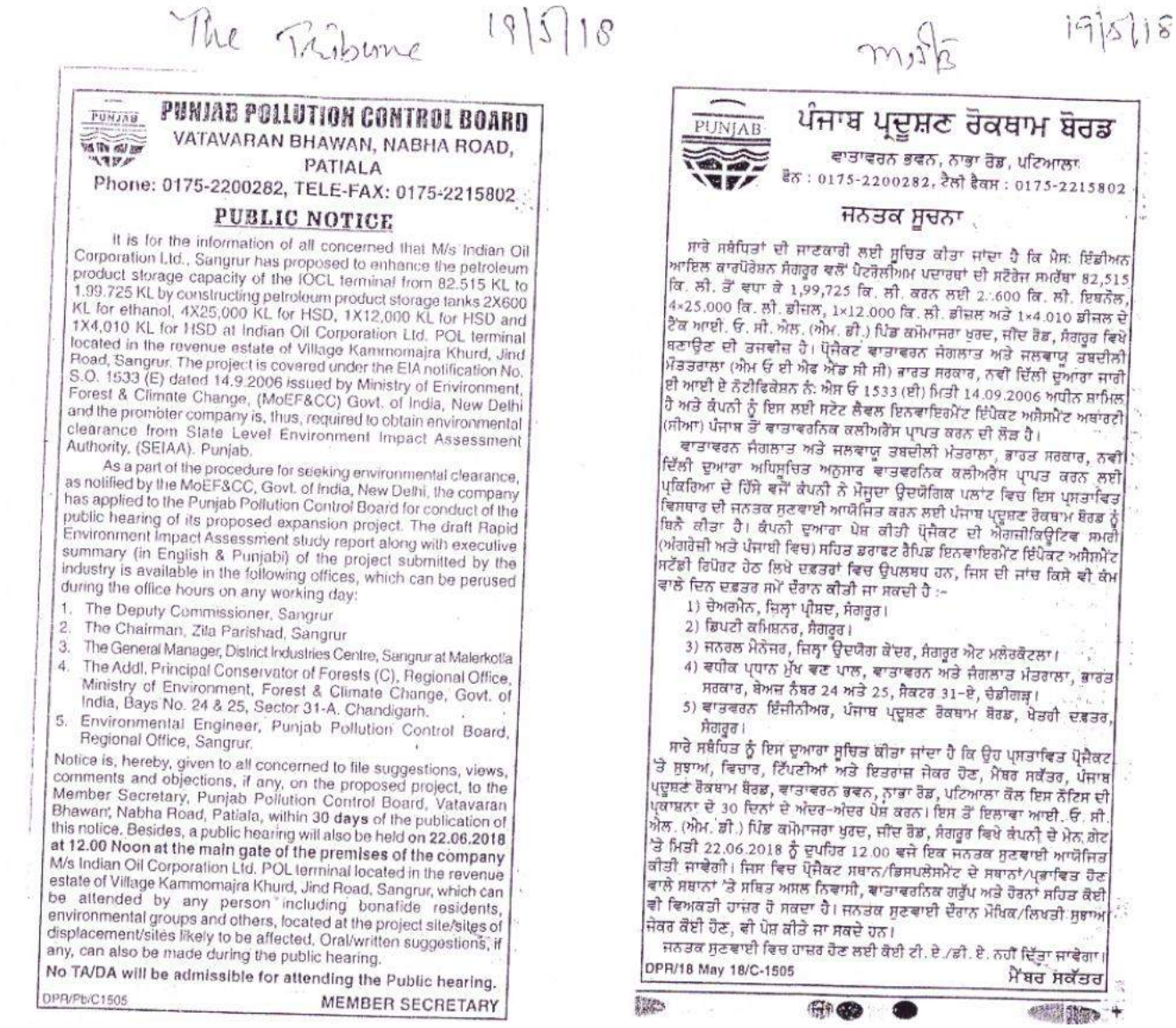
Contacted during Emergency:

1. Police station 100
2. Hospital 108
3. Fire Brigade 101
4. DC
5. Terminal manager

7.9 PUBLIC CONSULTATION

The public hearing for the M/s Indian Oil Corporation of Ltd., for enhancing the petroleum product storage capacity of the terminal from 82,515 KL to 1,99,725 KL held at **the main gate of premises of the company** M/s Indian Oil Corporation of Ltd. POL terminal located in the revenue estate of Village Kammomajra Khurd, Jind Road, Sangrur, Punjab State was conducted on **22.6.2018 at 12.00 noon** as per the EIA Notification dated 14th September 2006, as amended by the Ministry of Environment and Forest, New Delhi. This was conducted by complying Terms of Reference issued.

The press notification of public hearing was published in two prominent newspapers namely, 'The Tribune' (English Daily) and 'Ajit' (Punjabi Daily) on **19.05.2018** to make the public aware of the date, time & venue of the public hearing and about the places/offices where the public could access the draft EIA report and its executive summary report inviting suggestions, views, comments and objections before the said hearing. The copies of the notification issued in newspapers for public hearing are given in **Figure 7.6.**



The Tribune 19/5/18

PUNJAB POLLUTION CONTROL BOARD
VATAVARAN BHAWAN, NABHA ROAD,
PATIALA
Phone: 0175-2200282, TELE-FAX: 0175-2215802

PUBLIC NOTICE

It is for the information of all concerned that M/s Indian Oil Corporation Ltd., Sangrur has proposed to enhance the petroleum product storage capacity of the IOCL terminal from 82.515 KL to 1,99,725 KL by constructing petroleum product storage tanks 2X600 KL for ethanol, 4X25,000 KL for HSD, 1X12,000 KL for HSD and 1X4,010 KL for HSD at Indian Oil Corporation Ltd. POL terminal located in the revenue estate of Village Kammomajra Khurd, Jind Road, Sangrur. The project is covered under the EIA notification No. S.O. 1533 (E) dated 14.9.2006 issued by Ministry of Environment, Forest & Climate Change, (MoEF&CC) Govt. of India, New Delhi and the promoter company is, thus, required to obtain environmental clearance from State Level Environment Impact Assessment Authority, (SEIAA). Punjab.

As a part of the procedure for seeking environmental clearance, as notified by the MoEF&CC, Govt. of India, New Delhi, the company has applied to the Punjab Pollution Control Board for conduct of the public hearing of its proposed expansion project. The draft Rapid Environment Impact Assessment study report along with executive summary (in English & Punjabi) of the project submitted by the industry is available in the following offices, which can be perused during the office hours on any working day:

1. The Deputy Commissioner, Sangrur
2. The Chairman, Zila Parishad, Sangrur
3. The General Manager, District Industries Centre, Sangrur at Malerkotla
4. The Addl. Principal Conservator of Forests (C), Regional Office, Ministry of Environment, Forest & Climate Change, Govt. of India, Bays No. 24 & 25, Sector 31-A. Chandigarh.
5. Environmental Engineer, Punjab Pollution Control Board, Regional Office, Sangrur.

Notice is, hereby, given to all concerned to file suggestions, views, comments and objections, if any, on the proposed project, to the Member Secretary, Punjab Pollution Control Board, Vatavaran Bhawan, Nabha Road, Patiala, within 30 **days** of the publication of this notice. Besides, a public hearing will also be held on **22.06.2018 at 12.00 Noon at the main gate of the premises of the company** M/s Indian Oil Corporation Ltd. POL terminal located in the revenue estate of Village Kammomajra Khurd, Jind Road, Sangrur, which can be attended by any person including bonafide residents, environmental groups and others, located at the project site/sites of displacement/sites likely to be affected. Oral/written suggestions, if any, can also be made during the public hearing.

No TA/DA will be admissible for attending the Public hearing.

DPR/Pb/C1505 MEMBER SECRETARY

m/s 19/5/18

ਪੰਜਾਬ ਪ੍ਰਦੂਸ਼ਣ ਰੋਕਥਾਮ ਬੋਰਡ
ਵਾਤਾਵਰਨ ਭਵਨ, ਨਾਭਾ ਰੋਡ, ਪਟਿਆਲਾ
ਫੋਨ : 0175-2200282, ਟੈਲੀ ਫੈਕਸ : 0175-2215802

ਜਨਤਕ ਸੂਚਨਾ

ਸਾਰੇ ਸਬੰਧਿਤਾਂ ਦੀ ਜਾਣਕਾਰੀ ਲਈ ਸੂਚਿਤ ਕੀਤਾ ਜਾਂਦਾ ਹੈ ਕਿ ਮੈਸ: ਇੰਡੀਅਨ ਆਇਲ ਕਾਰਪੋਰੇਸ਼ਨ ਸੰਗਰੂਰ ਵਲੋਂ ਪੈਟਰੋਲੀਅਮ ਪਦਾਰਥਾਂ ਦੀ ਸਟੋਰੇਜ ਸਮਰੱਥਾ 82,515 ਕਿ. ਲੀ. ਤੋਂ ਵਧਾ ਕੇ 1,99,725 ਕਿ. ਲੀ. ਕਰਨ ਲਈ 2.600 ਕਿ. ਲੀ. ਇਥਨੌਲ, 4×25.000 ਕਿ. ਲੀ. ਡੀਜ਼ਲ, 1×12.000 ਕਿ. ਲੀ. ਡੀਜ਼ਲ ਅਤੇ 1×4.010 ਡੀਜ਼ਲ ਦੇ ਟੈਂਕ ਆਈ. ਓ. ਸੀ. ਐਲ. (ਐਮ. ਡੀ.) ਪਿੰਡ ਕਮੋਮਾਜਰਾ ਖੁਰਦ, ਜੀਂਦ ਰੋਡ, ਸੰਗਰੂਰ ਵਿਖੇ ਬਣਾਉਣ ਦੀ ਤਜਵੀਜ਼ ਹੈ। ਪ੍ਰੋਜੈਕਟ ਵਾਤਾਵਰਨ ਜੰਗਲਾਤ ਅਤੇ ਜਲਵਾਯੂ ਤਬਦੀਲੀ ਮੰਤਰਾਲਾ (ਐਮ ਓ ਈ ਐਂਡ ਸੀ ਸੀ) ਭਾਰਤ ਸਰਕਾਰ, ਨਵੀਂ ਦਿੱਲੀ ਦੁਆਰਾ ਜਾਰੀ ਈ ਆਈ ਏ ਨੋਟੀਫਿਕੇਸ਼ਨ ਨੰ: ਐਸ ਓ 1533 (ਈ) ਮਿਤੀ 14.09.2006 ਅਧੀਨ ਸ਼ਾਮਿਲ ਹੈ ਅਤੇ ਕੰਪਨੀ ਨੂੰ ਇਸ ਲਈ ਸਟੇਟ ਲੈਵਲ ਇਨਵਾਇਰਮੈਂਟ ਇੰਪੈਕਟ ਅਸੈਸਮੈਂਟ ਅਥਾਰਟੀ (ਸੀਆਈ) ਪੰਜਾਬ ਤੋਂ ਵਾਤਾਵਰਨਿਕ ਕਲੀਅਰੈਂਸ ਪ੍ਰਾਪਤ ਕਰਨ ਦੀ ਲੋੜ ਹੈ।

ਵਾਤਾਵਰਨ ਜੰਗਲਾਤ ਅਤੇ ਜਲਵਾਯੂ ਤਬਦੀਲੀ ਮੰਤਰਾਲਾ, ਭਾਰਤ ਸਰਕਾਰ, ਨਵੀਂ ਦਿੱਲੀ ਦੁਆਰਾ ਅਧਿਸੂਚਿਤ ਅਨੁਸਾਰ ਵਾਤਾਵਰਨਿਕ ਕਲੀਅਰੈਂਸ ਪ੍ਰਾਪਤ ਕਰਨ ਲਈ ਪ੍ਰਕਿਰਿਆ ਦੇ ਹਿੱਸੇ ਵਜੋਂ ਕੰਪਨੀ ਨੇ ਮੌਜੂਦਾ ਉਦਯੋਗਿਕ ਪਲਾਂਟ ਵਿਚ ਇਸ ਪ੍ਰਸਤਾਵਿਤ ਵਿਸਥਾਰ ਦੀ ਜਨਤਕ ਸੁਣਵਾਈ ਆਯੋਜਿਤ ਕਰਨ ਲਈ ਪੰਜਾਬ ਪ੍ਰਦੂਸ਼ਣ ਰੋਕਥਾਮ ਬੋਰਡ ਨੂੰ ਬਿਨੈ ਕੀਤਾ ਹੈ। ਕੰਪਨੀ ਦੁਆਰਾ ਪੇਸ਼ ਕੀਤੀ ਪ੍ਰੋਜੈਕਟ ਦੀ ਅੰਗਰੇਜ਼ੀ ਕਿਊਟਿਵ ਸਮਰੀ (ਅੰਗਰੇਜ਼ੀ ਅਤੇ ਪੰਜਾਬੀ ਵਿਚ) ਸਹਿਤ ਡਰਾਫਟ ਰੈਪਿਡ ਇਨਵਾਇਰਮੈਂਟ ਇੰਪੈਕਟ ਅਸੈਸਮੈਂਟ ਸਟੱਡੀ ਰਿਪੋਰਟ ਹੇਠ ਲਿਖੇ ਦਫਤਰਾਂ ਵਿਚ ਉਪਲਬਧ ਹਨ, ਜਿਸ ਦੀ ਜਾਂਚ ਕਿਸੇ ਵੀ ਕੰਮ ਵਾਲੇ ਦਿਨ ਦਫਤਰ ਸਮੇਂ ਦੌਰਾਨ ਕੀਤੀ ਜਾ ਸਕਦੀ ਹੈ :-

1) ਚੇਅਰਮੈਨ, ਜ਼ਿਲ੍ਹਾ ਪ੍ਰੀਸ਼ਦ, ਸੰਗਰੂਰ।
2) ਡਿਪਟੀ ਕਮਿਸ਼ਨਰ, ਸੰਗਰੂਰ।
3) ਜਨਰਲ ਮੈਨੇਜਰ, ਜ਼ਿਲ੍ਹਾ ਉਦਯੋਗ ਕੇਂਦਰ, ਸੰਗਰੂਰ ਐਟ ਮਲੇਰਕੋਟਲਾ।
4) ਵਧੀਕ ਪ੍ਰਧਾਨ ਮੁੱਖ ਵਣ ਪਾਲ, ਵਾਤਾਵਰਨ ਅਤੇ ਜੰਗਲਾਤ ਮੰਤਰਾਲਾ, ਭਾਰਤ ਸਰਕਾਰ, ਬੇਅਜ਼ ਨੰਬਰ 24 ਅਤੇ 25, ਸੈਕਟਰ 31-ਏ, ਚੰਡੀਗੜ੍ਹ।
5) ਵਾਤਾਵਰਨ ਇੰਜੀਨੀਅਰ, ਪੰਜਾਬ ਪ੍ਰਦੂਸ਼ਣ ਰੋਕਥਾਮ ਬੋਰਡ, ਖੇਤਰੀ ਦਫਤਰ, ਸੰਗਰੂਰ।

ਸਾਰੇ ਸਬੰਧਿਤ ਨੂੰ ਇਸ ਦੁਆਰਾ ਸੂਚਿਤ ਕੀਤਾ ਜਾਂਦਾ ਹੈ ਕਿ ਉਹ ਪ੍ਰਸਤਾਵਿਤ ਪ੍ਰੋਜੈਕਟ 'ਤੇ ਸੁਝਾਅ, ਵਿਚਾਰ, ਟਿੱਪਣੀਆਂ ਅਤੇ ਇਤਰਾਜ਼ ਜੇਕਰ ਹੋਣ, ਮੈਂਬਰ ਸਕੱਤਰ, ਪੰਜਾਬ ਪ੍ਰਦੂਸ਼ਣ ਰੋਕਥਾਮ ਬੋਰਡ, ਵਾਤਾਵਰਨ ਭਵਨ, ਨਾਭਾ ਰੋਡ, ਪਟਿਆਲਾ ਕੋਲ ਇਸ ਨੋਟਿਸ ਦੀ ਪ੍ਰਕਾਸ਼ਨਾ ਦੇ 30 ਦਿਨਾਂ ਦੇ ਅੰਦਰ-ਅੰਦਰ ਪੇਸ਼ ਕਰਨ। ਇਸ ਤੋਂ ਇਲਾਵਾ ਆਈ. ਓ. ਸੀ. ਐਲ. (ਐਮ. ਡੀ.) ਪਿੰਡ ਕਮੋਮਾਜਰਾ ਖੁਰਦ, ਜੀਂਦ ਰੋਡ, ਸੰਗਰੂਰ ਵਿਖੇ ਕੰਪਨੀ ਦੇ ਮੇਨ ਗੇਟ 'ਤੇ ਮਿਤੀ 22.06.2018 ਨੂੰ ਦੁਪਹਿਰ 12.00 ਵਜੇ ਇਕ ਜਨਤਕ ਸੁਣਵਾਈ ਆਯੋਜਿਤ ਕੀਤੀ ਜਾਵੇਗੀ। ਜਿਸ ਵਿਚ ਪ੍ਰੋਜੈਕਟ ਸਥਾਨ/ਡਿਸਪਲੇਸਮੈਂਟ ਦੇ ਸਥਾਨਾਂ/ਪ੍ਰਭਾਵਿਤ ਹੋਣ ਵਾਲੇ ਸਥਾਨਾਂ 'ਤੇ ਸਥਿਤ ਅਸਲ ਨਿਵਾਸੀ, ਵਾਤਾਵਰਨਿਕ ਗਰੁੱਪ ਅਤੇ ਹੋਰਨਾਂ ਸਹਿਤ ਕੋਈ ਵੀ ਵਿਅਕਤੀ ਹਾਜ਼ਰ ਹੋ ਸਕਦਾ ਹੈ। ਜਨਤਕ ਸੁਣਵਾਈ ਦੌਰਾਨ ਮੌਖਿਕ/ਲਿਖਤੀ ਸੁਝਾਅ ਜੇਕਰ ਕੋਈ ਹੋਣ, ਵੀ ਪੇਸ਼ ਕੀਤੇ ਜਾ ਸਕਦੇ ਹਨ।

ਜਨਤਕ ਸੁਣਵਾਈ ਵਿਚ ਹਾਜ਼ਰ ਹੋਣ ਲਈ ਕੋਈ ਟੀ. ਏ./ਡੀ. ਏ. ਨਹੀਂ ਦਿੱਤਾ ਜਾਵੇਗਾ।

DPR/18 May 18/C-1505 ਮੈਂਬਰ ਸਕੱਤਰ

FIGURE 7.6: NOTIFICATION IN NEWSPAPERS FOR PUBLIC HEARING

The copies of draft EIA report along with executive summary (English & Punjabi) were made available by the Regional Officer, Punjab Pollution control board office, Patiala, Punjab for reference at the offices of following authorities during normal office hours till the date of public hearing:

1. The deputy commissioner, Sangrur
2. The Chairman Zila Parishad, Sangrur
3. The General Manager, District Industries Center, Sangrur at Malerkotla
4. The Addl. Principal Conservator of Forest (C), Regional Office, Ministry of Environment, Forest and Climate Change, Govt. India, Bays No. 24 & 25, Sector 31-A. Chandigarh
5. Environmental Engineer, Punjab Pollution Control Board, Regional Office, Sangrur

The following were present to supervise the proceedings:

1. S. Upkar Singh, Addl. District Commissioner (G), Sangrur

2. Er. Harjit Singh, Environmental Engineer, Punjab Pollution Control Board, Regional Office, Sangrur.

3. Er.Parveen Kumar, Asstt. Environmental Engineer, Punjab Pollution Control Board, Head Office, Patiala

Assistant Environmental Engineer, Punjab Pollution Control Board, Head Office, Patiala welcomed the officers supervising and presiding over the hearing and people from adjoining towns/villages, who came to attend the public hearing. Approximately 81 people attended the public hearing. The list of people, who attended the public hearing and duly signed in the attendance register, is given in **Annexure XII**.

Accordingly on behalf of M/s IOCL, Sangrur plant Sh. Sukhbir Singh, Senior Manager briefed to the public about the proposed project in local vernacular language i.e Punjabi. Then Environmental Consultant, Anacon Laboratory Private Limited Nagpur, has presented the brief summary of the project. CSR and policy plans were discussed jointly by IOCL representative and Consultant. The entire Public Consultation was conducted in a harmonious and healthy manner. The minutes of the public hearing and the issues raised by the Public and reply given on behalf of the project proponent which are enclosed as Annexure XIII.

7.10 ISSUES RAISED DURING PUBLIC HEARING AND COMMITMENT

The responses of M/s Indian Oil Corporation Ltd., Sangrur towards the written objections have been given in **Table-7.1**.

7.11 CONCLUSION ON PUBLIC HEARING

Public hearing was conducted on **dtd. 22.06.2018 at 12.00 noon** and issues raised during meeting were discussed systematically and representations received were answered satisfactorily on proponent side. As there is no further representation from the public present during public hearing, Regional Officer concluded the Proceedings of the Public hearing and the Chairman Additional District Commissioner (G), declared the Public Hearing as over. The entire proceeding of public hearing was completed by 1.30 pm.

TABLE 7.23
DETAILS OF EXPLAINATION TOWARDS THE SUGGESTIONS/OBJECTIONS

Sr. No.	Name & Address of the person	Query / statement / information / clarification by the person present at hearing	Proponent Response	Action/ compliance status
1.	Sh. Balwinder Singh S/o Piara Singh (Former Sarpanch) Village Kamomajra Khurd,	1) During the presentation, it was stated that RO system has been installed at village Kamomajra but, actually it has not been installed?	The representatives of the company informed that RO system has been installed by Divisional office of M/s IOCL in Village Kammomajra as per information available to	The raised issue is being analyzed and if deficiencies are found in planned CSR activity the same shall be addressed on priority.

Sr. No.	Name & Address of the person	Query / statement / information / clarification by the person present at hearing	Proponent Response	Action/ compliance status
	Sangrur		them. However, they assured to obtain information regarding when the RO system was installed in village Kamomajra and whether Now the same is in operational condition or not?	
		2) If an emergency occurs in the adjoining village due to project expansion or there is a war like emergency, then what arrangements has been by the IOCL made to control it so that people save their lives?	The representative of the company informed that reply to this question can be given in two parts:- First part relates to the onsite emergency which may occurs within the project site due to some miss-happening such as Fire, Blasting, Gas leakages etc. In response to this, he informed that full arrangements have been made to control the emergencies like situations i.e. preparation of onsite and offsite emergency plans, firefighting facilities such as fire extinguishers, water sprinkler system, foam fighting system, fire hydrant piping network, personal protective equipment, basic medical facilities. Besides above measures, Mock drills have been conducted time to time to handle the onsite emergency situations wherein participation of the local village people has	The onsite and offsite disaster management plan is prepared with adherence to PNGRB norms and updated regularly. As per suggestion made by Sh. Upkar Singh, ADC (G) the proposal is under consideration by higher authority of IOCL.

Sr. No.	Name & Address of the person	Query / statement / information / clarification by the person present at hearing	Proponent Response	Action/ compliance status
			also been ensured. Second part relates to emergency which may arise from the war like conditions for which unit has not much information to handle it. However, the government has arranged Arial Safety which the army does not share with them. He will also make efforts to meet the Army official to give them a special training to control emergency situations arising from the war like conditions. If the Army officials agree to provide a special training, they will make the necessary arrangements for the said training. On this, Sh. Upkar Singh, ADC (G) has suggested the representative of the company that after preparing a survey of nearby 29 villages at their own level to identify the anticipated emergency conditions and action plan shall be made for the disaster management and same will be implemented in the villages jointly with the help of village people. In addition to this, a seminar on the subject of Disaster Management should be organized with the help of village Sarpanch's for the village	

Sr. No.	Name & Address of the person	Query / statement / information / clarification by the person present at hearing	Proponent Response	Action/ compliance status
			people. The company representative replied that they will complete both the aforesaid task at the earliest.	
		3) Whether expansion of the project will create more job opportunities? In the possibilities of jobs, it has been demanded that new jobs be given to the eligible candidates of the nearest villages	The people working in the plant will also work in the proposed project. This expansion will not generate any direct new job opportunities. However, indirect employment may be generated and this area will be developed which cannot be presented in figures at this time. However, it has been assured that in future whenever there is any new opportunities of job, the candidates of the nearest villages will be given preference according to the merit.	No action required.
2.	Sh. Kamalpreet Singh S/o Karnail Singh (Sarpanch) Village Kammomajra, Sangrur	1) There is no job for the young educated & graduated persons of our village. They have to do small works to earn their livelihoods. Further, with the establishment of M/s IOCL, the youth of the nearby villages have not got employment so, it has been demanded that candidate of the nearby villages should be offered jobs according to their	The representative of the company replied that this public hearing has been called for expansion of proposed POL storage capacity as already explained that no new employment will be created from the expansion of the project. But in future, due to any new expansion, if any new employment generates then priority will be given to the youth of nearest village as per their qualification.	No action required.

Sr. No.	Name & Address of the person	Query / statement / information / clarification by the person present at hearing	Proponent Response	Action/ compliance status
		qualifications. If our demand was not accepted, then we have strong objection for the expansion of unit. The Government during the election has also promised that they will generate employments for the youth but the promise has not been fulfilled.		
		2) With the establishment of the company, the pond of village Kammomajra has been filled up with water and they have piped out the water towards other side. The village has not benefited from the establishment of the company. Adoption of one or two villages for the company is not a big deal. After adopting the village, company is required to work for the development of the village. They can upgrade their village school and install solar lights in their village.	The representative of the company informed that after making resolution passed from the village panchayat, they give their suggestion to them so that company can give preference to their suggestions to put the same in the CSR activities.	The suggestion for CSR activity are invited from villagers, which are if in line with company's CSR policy shall be fulfilled as per norms.
3.	Sh. Gurcharan Singh S/o Sohan Singh, Village	1) He told that there is no sewerage system or cremation ground in his village. He requested	The representative of the company informed that company has made some budget reserved for CSR	The suggestion for CSR activity are invited from villagers, which are if in line with company's CSR

Sr. No.	Name & Address of the person	Query / statement / information / clarification by the person present at hearing	Proponent Response	Action/ compliance status
	Kammomajra Khurd, Sangrur.	that company should make some efforts for the development of the village.	activities. The company will have to spent this budget for the development of village. It would be appropriate to mention here that the Government of India have given priority to installation of solar lights to save energy and construction toilets under Swachh Bharat Abhiyaan. They can give resolution passed from village panchayat for installation of solar lights & construction of toilets in their village school. The company will take appropriate action on it.	policy shall be fulfilled as per norms.
		2) When the company was being established during year 1993-94, at that time we objected for environmental damage to be caused by the air pollution generated from the project. Village Road had also been damage by the company. The company was also requested to give employment to the youth of the village. But nothing has been done in this regard yet.	The representative of the company replied that company will definitely do CSR activities for the development of the villages. S. Upkar Singh,(G) asked the people that are they know the meaning of the CSR. He explained that the meaning of the word is a Corporate Social Responsibility, which means the responsibility of the company towards society. The company has to spend a certain percentage of its profits for CSR activities and the company has to work according to the existing policy. If the	The suggestion for CSR activity are invited from villagers, which are if in line with company's CSR policy shall be fulfilled as per norms.

Sr. No.	Name & Address of the person	Query / statement / information / clarification by the person present at hearing	Proponent Response	Action/ compliance status
			Panchayat passes a resolution for making toilets in the school or installation of solar street lights in their village then send it to the company so that the appropriate decision can be taken.	
		3) They do not need RO and lights have already been installed in their village. Therefore, they have strong objection for the expansion of the company till company do not take necessary initiatives for the development of the village.	The representative of the company informed that their objections have been noted and the company will consider the matter and take appropriate action.	The suggestion for CSR activity are invited from villagers, which are if in line with company's CSR policy shall be fulfilled as per norms.

Asstt. Environmental Engineer, Punjab Pollution Control Board, Head office, Patiala further requested the persons present at the venue of hearing that if anyone else wants to seek any information/ clarification on the proposed project, but no one came forward. Thereafter, he requested the persons present in the hearing to confirm, by raising their hands, as to whether they are in favour of expansion plan of the Company at this site. In response to this, about 60-70 % of the persons present at the venue of public hearing raised their hands in favour of expansion plan of the Company.

No information / clarifications / comments / views / suggestions / objections on the project have been received from the public in writing to the Board, so far.

The hearing ended with vote of thanks to the Supervisor-Cum- Presiding Officer and the public present in the hearing.

7.12 REHABILITATION & RESETTLEMENT ACTION PLAN

The proposed expansion activities will be within the existing plant. Total area occupied by the terminal is approx 103.81 Acres. The proposed project does not have any displaced persons, due to acquisition of land. There are also no oustees or project affected persons or home oustees, thus R & R plan is not required for this project. However the priority for employment will be given to as per qualification to local persons living in the adjoining villages. In addition to this, promoter will also contribute for the welfare of the people of local surrounding.

7.13 SOCIAL IMPACT ASSESSMENT

The total employment potential of plant is 100 people which will include 30 direct and 70 indirect that includes contract labours and even security personnel's.

All attempts will be made to employ locally available skilled personnel from the study area. The project proponent will provide welfare activities, recreational facilities in the surrounding villages. The management will conduct regular health checkups in the surrounding villages. There will be enhancement of educational standards of people in the study area. There will be positive and beneficial impacts by way of economic improvements, transportation, aesthetic environment and business generation. There will be an overall upliftment of socio-economic status of people in the area.

7.14 BIODIVERSITY CONSERVATION

The biological survey for M/s. IOCL conducted during winter season 2016. The details about species observed/reported through the limited survey conducted at project site (core zone) along with selected areas within 10 km radial distance from the project site was considered as buffer zone. The details baseline survey results are provided in **Chapter 3.**

There is no any scheduled flora have been found in the study area but the Peacock is commonly sighted around the agriculture land near the plant site which belongs to Schedule –I as per Wild life protection Act (1972) so the conservation plan is given in environmental management plan.

Biodiversity Conservation

Peacock or Indian peafowl one of the birds reported from the study area comes under the scheduled-I category. Hence, conservation measures are provided below.

Conservation Measures for Peacock or Indian Peafowl (Pavo cristatus) Schedule – I bird species

A Indian peafowl or Peacock or Mor (Pavo cristatus) is a large pheasant justifiably declared as the National Bird of India in 1963 due to its flagship value founded on its glorious position in mythology and its widespread distribution and grandeur. In India, it is given the utmost protection by inclusion in Schedule I of Indian Wildlife Act, 1972. Being a wide spread species, apart from the various urban habitats, it is also found in agriculture fields, along streams with good vegetation and close to human habitations in a semi-feral condition (Johnsgard 1986).

Appearance

Male peacock has a spectacular glossy green long tail feathers that may be more than 60 percent of the bird's total body length. These feathers have blue, golden green and copper colored ocelli (eyes). The long tail feathers are used for mating rituals like courtship displays.

The feathers are arched into a magnificent fan shaped form across the back of the bird and almost touching the found on both sides. Females do not have these graceful tail feathers. They have the fan like crest with whitish face and throat, chestnut brown crown and hind neck, metallic green upper breast and mantle, white belly and brown back rump and tail. Their primaries are dark brown.

Study Approach

Since the buffer zone of the proposed site reported with Schedule I species Pavo cristatus commonly known as peacock, a systematic study was conducted to assess their status in term of movements and habitat use of the species.

Sightings and Habitat Use

In core zone (Project site within IOCL plant near sludge pit area), two nos. of peacock was sighted/reported.

Food and Feeding Habits

Peafowls are omnivores, eating plant parts, flower petals, seed heads, insects and other arthropods, reptiles and amphibians. In the study area, dense tree canopy cover supports good insect diversity which is very common food for peafowls.

Threats in the Study Area

In the study area, no any threat was observed for peacock or its habitats. However, habitat improvement program is recommended for improvement of population status of this national bird “Peacock”.

Habitat Improvement Action Plan

Habitat improvement programme will include plantation of various plant species like, Madhuca indica (Maha), Mangifera indica (Amba), Lagerstroemia parviflora (Seja), Tamarindus indica (Chinch), Tectona grandis (Sagaon), Terminalia arjuna (Arjun), Anogeissus laifolia (Dhaora), Anogeissus pendula (Kardhai), Butea monosperma (Palas), Aegle marmelos (Bel) and other species reported from the study area should be taken in to priority. In order to improve vegetation cover, it is suggested to carry out extensive afforestation program in different phases. These species will help to provide habitat for faunal species, and also increase the species diversity and maintain the naturalness of the surrounding area.

Seed distribution among the villagers: During this habitat improvement programme the seeds of local fruit bearing trees like Mango, Jamun, Sitafal will be distributed in the various villages of the study area. Compost packets will be also provided at the intervals of the every six months by the proponent (in consultation of forest department).

Water feeling in the existing water bodies during summer: Water will be filled in the existing (selected by forest department) water bodies through water tankers (six numbers in each water body).

Inference - Buffer Zone as a Peacock Habitat

Present survey of the peafowl in the buffer zone of the project site shows that, peafowl is well adapted within the RF as well as fringes of forest of the study area. However, the following points can give an insight on the overall status of peafowl in the study area and thereby plan for better management strategies related to proposed project activities.

Local residents of the study area were well aware of the movement, pattern of peafowl in their surrounding habitats

Peafowl uses agriculture and various rural habitats as a feeding ground during day time while during night time they take shelter on the trees as well as on the roof of the houses. It clearly indicates peafowl normally uses ecosystems or habitats adjacent to village.

From the above said facts, it can be inferred that, some villages of the buffer zone provide roosting and feeding ground for the peafowl, while core zone do not have potential habitat for roosting or feeding ground for peacock. Therefore, it has been visualized that, the proposed project will not have any significant impact on peacock in terms of their normal movements and other activities. However, it is necessity to take some management options like habitat improvement in the villages located in the immediate vicinity of the project site.

So, habitat improvement program (plantation of recommended and local plant species) will be undertaken in (consultation of forest department) different villages located in the close vicinity of the project area. Under this program, saplings will be distributed in the nearby villages with the consultation of the local forest department.

In consultation of the forest department, following conservation measures will be adopted for peacock conservation:

Habitat improvement program in different villages will be undertaken in the buffer zone area for shelter and roosting of peacocks. This will be achieved by plantation of local varieties of the tree species near villages in buffer area. Plantation will also be carried in some forest patches identified by local forest department.

Further Suggestions/recommendations

Restricting use of pollutants in their habitats, stopping the increased vehicle pollution, wildlife road fatalities and damage to precious habitat by people to start movement towards these areas. To carry annual census research projects to ecology and habitat use by peacock. By making provision of veterinary care and cages for injured or sick deformed birds. The proponent has proposed a sum of Rs. 2,00,000/- for the “Peacock” conservation plan under the following heads up to three years in consultation of local forest department.

EXPENDITURE BUDGET FOR FIVE YEARS FOR PEACOCK CONSERVATION

S. No.	Work or Activity	1st year	2nd year	3rd year	4th year	5th year	Budget (INR)
1.	Plantation	12,000	12,000	12,000	12,000	12,000	60,000/-
2.	Small water hole	10,000	10,000	10,000	10,000	10,000	50,000/-
3.	Awareness program	6000	6000	6000	6000	6000	30,000/-
4.	Water Supply and seed distribution	12,000	12,000	12,000	12,000	12,000	60,000
Total Budget							**Rs. 2,00,000**
(Two Lakhs Rupees only)							

1. **Plantation**- approximately 500 tree/year up to five years. Plants species / verities will be suggested by the local forest department and plant saplings will be distributed in project villages as per the above mentioned schedule (year wise)

2. **Awareness program** for “Peacock” conservation will be scheduled in a year in five schools every year. During awareness program following activities will be arranged at the various village level schools as mentioned above (year wise),

- "Essay writing on Peacock"
- "Drawing competition (Peacock picture)

3. Water Supply and seed distribution

Water will be supplied during summer season to the various villages as mentioned above (year wise). Water will be catered through tankers in the village ponds or water holes. Seeds of local plant verities such as Madhuca indica (Maha), Mangifera indica (Aam), Lagerstroemia parviflora (Seja), Tamarindus indica (Imali), Tectona grandis (Sagaon), Terminalia arjuna (Arjun), Anogeissus laifolia (Dhaora), Anogeissus pendula (Kardhai), Butea monosperma (Palas), Aegle marmelos (Bel), Annona squamosal (Sitaphal), Sygygium cumini (Jabhul), etc. will be distributed above mentioned villages (as per year wise schedule).