Risk Assessment and Disaster Management Plan

1 Introduction

Hazard analysis involves the identification and quantification of the various hazards (unsafe conditions) that exist in the proposed power plant operations. On the other hand, risk analysis deals with the recognition and computation of risks, the equipment in the plant and personnel are prone to, due to accidents resulting from the hazards present in the plant.

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighboring population is exposed to as a result of hazards present. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population etc. Much of this information is difficult to get or generate. Consequently, the risk analysis is often confined to maximum credible accident studies.

In the sections below, the identification of various hazards, probable risks in the proposed power plant, maximum credible accident analysis, consequence analysis are addressed which gives a broad identification of risks involved in the plant. The Disaster Management Plan (DMP) has been presented.

2 Approach to the Study

Risk involves the occurrence or potential occurrence of some accidents consisting of an event or sequence of events. The risk assessment study covers the following:

- Identification of potential hazard areas;
- Identification of representative failure cases;
- Visualization of the resulting scenarios in terms of fire (thermal radiation) and explosion;
- Assess the overall damage potential of the identified hazardous events and the impact zones from the accidental scenarios;
- Assess the overall suitability of the site from hazard minimization and disaster mitigation point of view;
- Furnish specific recommendations on the minimization of the worst accident possibilities; and
- Preparation of broad Disaster Management Plan (DMP), on-site and off-site emergency plan, which includes occupational and health safety plan.

3 Hazard Identification

Identification of hazards in the proposed power plant expansion is of primary significance in the analysis, quantification and cost effective control of accidents involving chemicals and process. A classical definition of hazard states that hazard is in fact the characteristic of system/plant/process that presents potential for an accident. Hence, all the components of a system/plant/process needs to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. The following two methods for hazard identification have been employed in the study:

- Identification of major hazardous units based on Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 of Government of India (GOI Rules, 1989); and

- Identification of hazardous units and segments of plants and storage units based on relative ranking technique, viz. Fire-Explosion and Toxicity Index (FE&TI).

3.1 Classification of Major Hazardous Units

Hazardous substances may be classified into three main classes; namely flammable substances, unstable substances and toxic substances. The ratings for a large number of chemicals based on flammability, reactivity and toxicity have been given in NFPA Codes 49 and 345 M. The major hazardous materials to be stored, transported, handled and utilized within the facility have been summarized in the **Table-1**. The fuel storage details and properties are given in **Table-2** and **Table-3** respectively.

TABLE-1
HAZARDOUS MATERIALS PROPOSED TO BE STORED/TRANSPORTED

Materials	Hazardous Properties
LDO	UN 1203. Dangerous Goods class 3 – Flammable Liquid

TABLE-2
CATEGORY WISE SCHEDULE OF STORAGE TANKS

Sr. No.	Material	No. of Tanks	Design Capacity (KL)	Classification
1	LDO	2	2000 (each)	Non-dangerous Petroleum

TABLE-3
PROPERTIES OF FUELS USED IN THE PLANT

Chemical	Codes/Label	TLV	FBP	MP	FP	UEL	LEL
			°c			%	
LDO	Flammable	5 mg/m^3	400	-	98	7.5	0.6

TLV	:	Threshold Limit Value	FBP	:	Final Boiling Point
MP	:	Melting Point	FP	:	Flash Point
UEL	:	Upper Explosive Limit	LEL	:	Lower Explosive Limit

3.2 Identification of Major Hazard Installations Based on GOI Rules, 1989

Following accidents in the chemical industry in India over a few decades, a specific legislation covering major hazard activities has been enforced by Govt. of India in 1989 in conjunction with Environment Protection Act, 1986. This is referred here as GOI Rules 1989. For the purpose of identifying major hazard installations the rules employ certain criteria based on toxic, flammable and explosive properties of chemicals.

A systematic analysis of the fuels/chemicals and their quantities of storage has been carried out, to determine threshold quantities as notified by GOI Rules, 1989 and the applicable rules are identified. Applicability of storage rules are summarized in **Table-4**.

TABLE-4
APPLICABILITY OF GOI RULES TO FUEL/CHEMICAL STORAGE

Sr. No.	Chemical/ Fuel	Listed in Schedule	Total Quantity (KL)	Threshold Quantity (T) for Application of Rules	
				5,7-9,13-15	10-12
1	LDO	3(1)	2 X 2000	25 MT	200 MT

4 Hazard Assessment and Evaluation

4.1 Methodology

An assessment of the conceptual design is conducted for the purpose of identifying and examining hazards related to feed stock materials, major process components, utility and support systems, environmental factors, proposed operations, facilities, and safeguards.

4.2 Preliminary Hazard Analysis (PHA)

A preliminary hazard analysis is carried out initially to identify the major hazards associated with storages and the processes of the plant. This is followed by consequence analysis to quantify these hazards. Finally, the vulnerable zones are plotted for which risk reducing measures are deduced and implemented. Preliminary hazard analysis for fuel storage area and whole plant is given in **Table-5** and **Table-6**.

TABLE-5
PRELIMINARY HAZARD ANALYSIS FOR STORAGE AREAS

Unit	Capacity (KL)	Hazard Identified
LDO	2X2000	Fire/Explosion

TABLE-6
PRELIMINARY HAZARD ANALYSIS FOR THE WHOLE PLANT IN GENERAL

PHA Category	Description of Plausible Hazard	Recommendation	Provision
Environ-mental factors	If there is any leakage and eventuality of source of ignition.	--	All electrical fittings and cables will be provided as per the specified standards. All motor starters are flame proof.
Environ-mental factors	Highly inflammable nature of the liquid fuels may cause fire hazard in the storage facility.	A well designed fire protection including foam, dry powder, and CO_2 extinguisher should be provided.	Fire extinguisher of small size and big size will be provided at all potential fire hazard places. In addition to the above, fire hydrant network also provided.

4.3 Fire Explosion and Toxicity Index (FE&TI) Approach

Fire, Explosion and Toxicity Indexing (FE & TI) is a rapid ranking method for identifying the degree of hazard. The application of FE & TI would help to make a quick assessment of the nature and quantification of the hazard in these areas. However, this does not provide precise information.

The degree of hazard potential is identified based on the numerical value of F&EI as per the criteria given below:

Sr. No.	F&EI Range	Degree of Hazard
1	0-60	Light
2	61-96	Moderate
3	97-127	Intermediate

4	128-158	Heavy
5	159 and above	Severe

By comparing the indices F&EI and TI, the unit in question is classified into one of the following three categories established for the purpose (**Table-7)**.

TABLE-7
FIRE EXPLOSION AND TOXICITY INDEX

Category	Fire and Explosion Index (F&EI)	Toxicity Index (TI)
I	F&EI < 65	TI < 6
II	65 < or = F&EI < 95	6 < or = TI < 10
III	F&EI > or = 95	TI > or = 10

Certain basic minimum preventive and protective measures are recommended for the three hazard categories.

4.3.1 Results of FE and TI for Storage/Process Units

Based on the GOI Rules 1989, the hazardous fuels used by the proposed power plant were identified. Fire and explosion are the likely hazards, which may occur due to the fuel storage. Hence, fire and explosion index has been calculated for in plant storage. Estimates of FE&TI are given in **Table-8.**

TABLE-8
CAPACITY OF THE FUEL USED FOR FIRE EXPLOSION AND TOXICITY INDEX

Sr. No.	Chemical / Fuel	Total Capacity (KL)	F&EI	Category	TI	Category
1	LDO	2X2000	2.6	Light	Nil	-

4.4 Conclusion

Results of FE&TI analysis show that the storage of LDO falls into ***Light*** category of fire and explosion index with a ***Nil*** toxicity index.

4.5 Maximum Credible Accident Analysis (MCAA)

Hazardous substances may be released as a result of failures or catastrophes, causing possible damage to the surrounding area. This section deals with the question of how the consequences of the release of such substances and the damage to the surrounding area can be determined by means of models. Major hazards posed by flammable storage can be identified taking recourse to MCA analysis. MCA analysis encompasses certain techniques to identify the hazards and calculate the consequent effects in terms of damage distances of heat radiation, toxic releases, vapour cloud explosion etc. A host of probable or potential accidents of the major units in the complex arising due to use, storage and handling of the hazardous materials are examined to establish their credibility. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed. The reason and purpose of consequence analysis are many folds like:

- Part of risk assessment;
- Plant layout/code requirements;
- Protection of other plants;
- Protection of the public;
- Emergency planning; and

- Design criteria.

The results of consequence analysis are useful for getting information about all known and unknown effects that are of importance when some failure scenario occurs in the plant and also to get information as how to deal with the possible catastrophic events. It also gives the workers in the plant and people living in the vicinity of the area, an understanding of their personal situation.

- **Selected Failure Cases**

The purpose of this listing (Table-7.16) is to examine consequences of such failure individually or in combination. It will be seen from the list that a vast range of failure cases have been identified. The frequency of occurrence of failure also varies widely.

4.5.1 Damage Criteria

The fuel storage and unloading at the storage facility may lead to fire and explosion hazards. The damage criteria due to an accidental release of any hydrocarbon arise from fire and explosion. The vapors of these fuels are not toxic and hence no effects of toxicity are expected.

Tank fire would occur if the radiation intensity is high on the peripheral surface of the tank leading to increase in internal tank pressure. Pool fire would occur when fuels collected in the dyke due to leakage gets ignited.

- **Fire Damage**

A flammable liquid in a pool will burn with a large turbulent diffusion flame. This releases heat based on the heat of combustion and the burning rate of the liquid. A part of the heat is radiated while the rest is convected away by rising hot air and combustion products. The radiations can heat the contents of a nearby storage or process unit to above its ignition temperature and thus result in a spread of fire.

The radiations can also cause severe burns or fatalities of workers or fire fighters located within a certain distance. Hence, it will be important to know beforehand the damage potential of a flammable liquid pool likely to be created due to leakage or catastrophic failure of a storage or process vessel. This will help to decide the location of other storage/process vessels, decide the type of protective clothing the workers/fire fighters, the duration of time for which they can be in the zone, the fire extinguishing measures needed and the protection methods needed for the nearby storage/process vessels. The damage effect on equipment and people due to thermal radiation intensity is given in **Table-9**. Similarly, the effect of incident radiation intensity and exposure time on lethality is given in **Table-10.**

TABLE-9
DAMAGE DUE TO INCIDENT RADIATION INTENSITIES

Sr. No.	Incident Radiation (kW/m^2)	Type of Damage Intensity	
		Damage to Equipment	**Damage to People**
1	37.5	Damage to process equipment	100% lethality in 1 min., 1% lethality in 10 sec.
2	25.0	Minimum energy required to ignite wood at indefinitely long exposure without a flame	100% Lethality in 1 min., Significant injury in 10 sec.
3	12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing	1% lethality in 1 min. First degree burns in 10 sec

Sr. No.	Incident Radiation (kW/m²)	Type of Damage Intensity	
		Damage to Equipment	Damage to People
4	4.0	--	Causes pain if duration is longer than 20 sec, however blistering is un-likely (First degree burns)
5	1.6	--	Causes no discomfort on long exposures

Source: Techniques for Assessing Industrial Hazards by World Bank.

TABLE-10
RADIATION EXPOSURE AND LETHALITY

All values are given in KW/m²

Radiation Intensity (KW/m²)	Exposure Time (seconds)	Lethality (%)	Degree of Burns
1.6	--	0	No Discomfort even after long exposure
4.5	20	0	1st
4.5	50	0	1st
8.0	20	0	1st
8.0	50	<1	3rd
8.0	60	<1	3rd
12.0	20	<1	2nd
12.0	50	8	3rd
12.5	Inst	10	--
25.0	Inst	50	--
37.5	Inst	100	--

4.6 Risk Analysis for Oil Fuel Storage

4.6.1 Introduction

NTPC Singrauli Super Thermal Power Plant is based on coal as the main fuel for the boilers. Light diesel oil (LDO) is used for start-up and auxiliary fuel in Stage–II and the same will be applicable for Stage–III project. The fuel oil system used in Stage–I will be discontinued after commissioning the Stage–III plants. This risk analysis covers the LDO storage tanks provided for Stage–II and Stage–III.

4.6.2 Oil Fuel Storage Tanks

Details of storage tanks in the Stage–II and Stage–III are shown in Table-**11**.

TABLE-11
DETAILS OF STORAGE TANKS

Storage Tank	Capacity	Temperature (°C)	Pressure (kg/cm²g)	Type
LDO Storage Tanks (Stage - II)	2 x 2,000 KL	30	Atm	Cone roof tanks
LDO Storage Tanks (Stage - III)	2 x 2,000 KL	30	Atm	Cone roof tanks

4.6.3 Hazard Identification

LDO is a Class B petroleum product with flammability hazard. Properties of LDO relevant to this risk analysis study are listed in **Table-12**

TABLE-12
HAZARDOUS PROPERTIES OF MATERIALS

Materials	Normal Boiling Point (°C)	Flash Point (°C)	Lower Flammable Limit (%)	Upper Flammable Limit (%)	Auto Ignition Temperature (°C)
LDO	215-366	74	0.6	6.0	210

4.6.4 Consequence Analysis

Damage Effects of Jet/ Pool Fire Radiation

The effect from jet fire and pool fire is thermal radiation intensity on the receptor surface as shown in Table-**13.**

TABLE-13
DAMAGE EFFECTS DUE TO JET/ POOL FIRE RADIATION

Heat Radiation Intensity (kW/m^2)	Observed Effect
4	Sufficient to cause pain to personnel if unable to reach cover within 20 seconds; 0% lethality.
12.5	Minimum energy required for piloted ignition of wood, melting of plastic tubing.
37.5	Sufficient to cause damage to process equipment.

- Thermal radiation intensity exceeding 37.5 kW/m^2 may cause escalation due to damage of other equipment.
- Thermal radiation intensity exceeding 12.5 kW/m^2 may cause ignition of combustibles on buildings and impairment of escape route.
- Thermal radiation intensity exceeding 4 kW/m^2 may cause burn injury on personnel injury.

Damage Effects of Vapour Cloud Explosion (VCE)

When a large quantity of flammable vapour or gas is released, mixes with air to produce sufficient mass in the flammable range and is then ignited, the result is a vapour cloud explosion (VCE). In the LDO installation large release of LDO from equipment or piping has potential for vapour cloud explosion. The damage effect of vapour cloud explosion is due to overpressure as shown in Table-7.14.

TABLE14
VCE OVER PRESSURE LIMIT AND OBSERVED EFFECT

Over-pressure Effect		Observed Damage
bar(g)	psig	
0.021	0.3	"Safe distance" (probability 0.95 of no serious damage below this value); projectile limit; some

		damage to house ceilings; 10% of window glass broken.
0.069	1	Repairable damage; partial demolition of houses; steel frame of clad building slightly distorted.
0.138	2	Partial collapse of walls of houses.
0.207	3	Heavy machines in industrial buildings suffered little damage; steel frame building distorted and pulled away from foundations.

Failure Scenarios for Risk Analysis

The failure scenarios for cone roof type tanks relevant to the installation covered by this study identified by review of published data base for storage tank failures are listed in **Table-15.**

TABLE 15
FAILURE SCENARIOS FOR CONE ROOF TYPE STORAGE TANKS

Sr. No.	Description	Failure Rate per Tank Year
1	Liquid spill outside the tank	2.8×10^{-3}
2	Full surface fire with roof failure	9.0×10^{-5}
3	Tank rupture	3.0×10^{-6}

Hazard analysis to estimate the extent of damage for the following identified failure scenarios.

A. Credible Failure Scenarios

- Liquid spill outside the tank
  Liquid spill from the tank into surrounding dyke area may occur due to the following causes:
  - Tank overfill event
  - Leak from flange joint connected to the tank
- Full surface fire
  In case of tank roof damage, the liquid surface will be exposed, and if ignited, this will result in surface fire.

B. Worst case Failure Scenario

- Tank rupture

In case of major damage to tank shell, the spilled tank contents may fill the main dyke.

C. Multiple Failure Scenario

- Surface fire on both tanks in a dyke

4.6.5 Consequence Analysis Results

Consequence analysis for the identified failure scenarios is carried out using the renowned PHAST software of DNV-GL.

Results of consequence analysis are summarized in **Table-16.**

TABLE-16
SUMMARY OF CONSEQUENCE ANALYSIS RESULTS

Sr. No.	Description	Parameter Value	Downwind Distance (meters)	
			Weather (Wind speed & Stability)	
			3 m/s; D	5 m/s; D
1	**Credible Failure Scenarios**			
1.1	**Small Bund Fire**			
1.1.1	Stage–II LDO Storage – Dyke Spill – Small Bund Fire			
	Pool Fire Radiation Intensity	4 kW/m^2	60	64
		12.5 kW/m^2	25	26
		37.5 kW/m^2	Not reached	Not reached
1.1.2	Stage–III LDO Storage – Dyke Spill – Small Bund Fire			
	Pool Fire Radiation Intensity	4 kW/m^2	49	53
		12.5 kW/m^2	20	21
		37.5 kW/m^2	Not reached	Not reached
1.2	**Tank Surface Fire**			
1.2.1	Stage–II LDO Storage – Tank Surface Fire			
	Pool Fire Radiation Intensity	4 kW/m^2	35	37
		12.5 kW/m^2	16	18
		37.5 kW/m^2	Not reached	Not reached
1.2.2	Stage–III LDO Storage – Tank Surface Fire			
	Pool Fire Radiation Intensity	4 kW/m^2	35	37
		12.5 kW/m^2	16	18
		37.5 kW/m^2	Not reached	Not reached

Sr. No.	Description	Parameter Value	Downwind Distance (meters) Weather (Wind speed & Stability)	
			3 m/s; D	5 m/s; D
2	**Worst Case Failure Scenarios**			
2.1	**Full Bund Fire**			
2.1.1	Stage–II LDO Storage – Full Bund Fire			
	Pool Fire Radiation Intensity	4 kW/m^2	73	79
		12.5 kW/m^2	32	33
		37.5 kW/m^2	Not reached	Not reached
2.1.2	Stage–III LDO Storage – Full Bund Fire			
	Pool Fire Radiation Intensity	4 kW/m^2	63	67
		12.5 kW/m^2	26	27
		37.5 kW/m^2	Not reached	Not reached
3	**Multiple Failure Scenarios**			
3.1	Surface Fire on Both Tanks in a Dyke			
3.1.1	Stage–II LDO Storage - Both Tanks on Fire			
	Pool Fire Radiation Intensity	4 kW/m^2	40	43
		12.5 kW/m^2	17	18
		37.5 kW/m^2	Not reached	Not reached
3.1.2	Stage–III LDO Storage - Both Tanks on Fire			
	Pool Fire Radiation Intensity	4 kW/m^2	40	43
		12.5 kW/m^2	17	18
		37.5 kW/m^2	Not reached	Not reached

In none of the scenarios, vapor cloud explosion hazard is indicated by PHAST software.

Graphical results of consequence analysis plotted on plant layout diagram are shown in the following **Figure-1** to **Figure-13**.

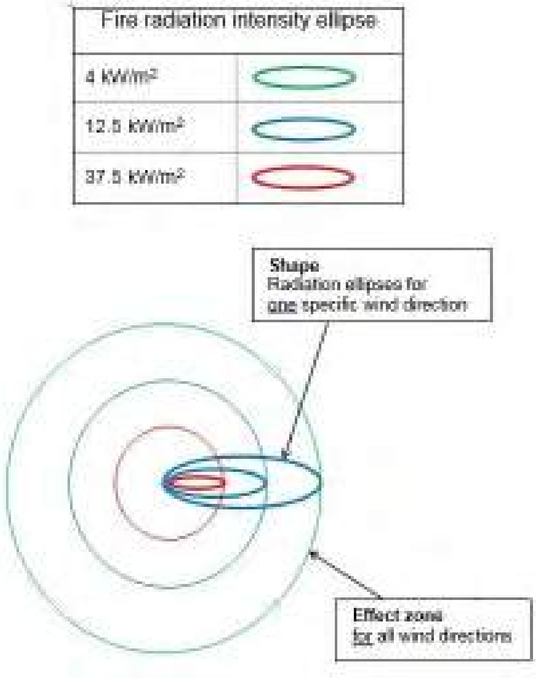

FIGURE-1
LEGEND FOR CONSEQUENCE ANALYSIS GRAPHS

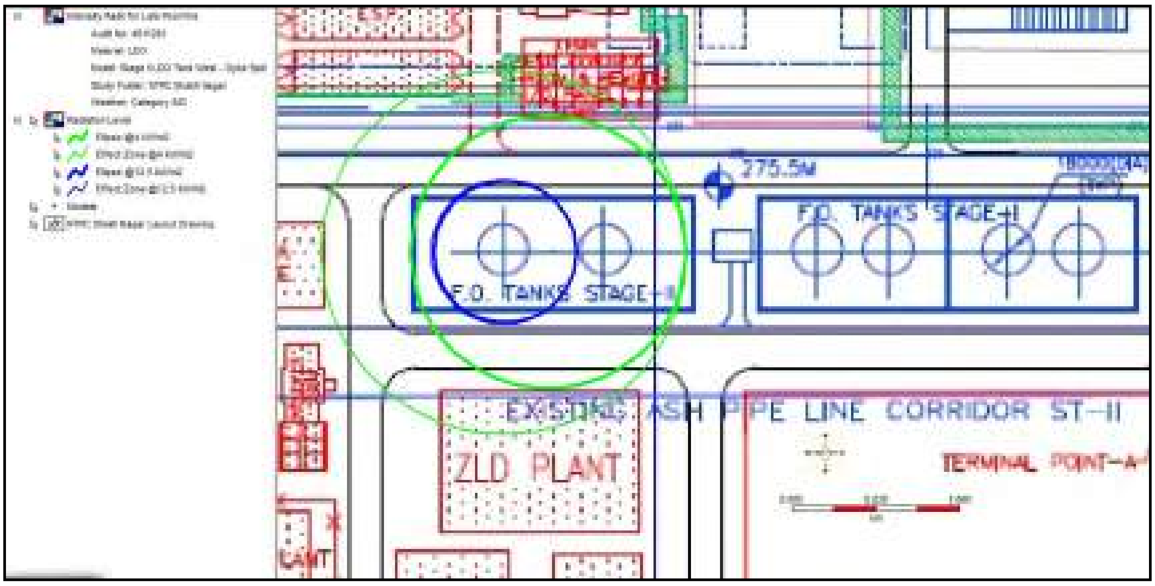

FIGURE-2
STAGE–II LDO TANK (WEST) – SMALL BUND FIRE

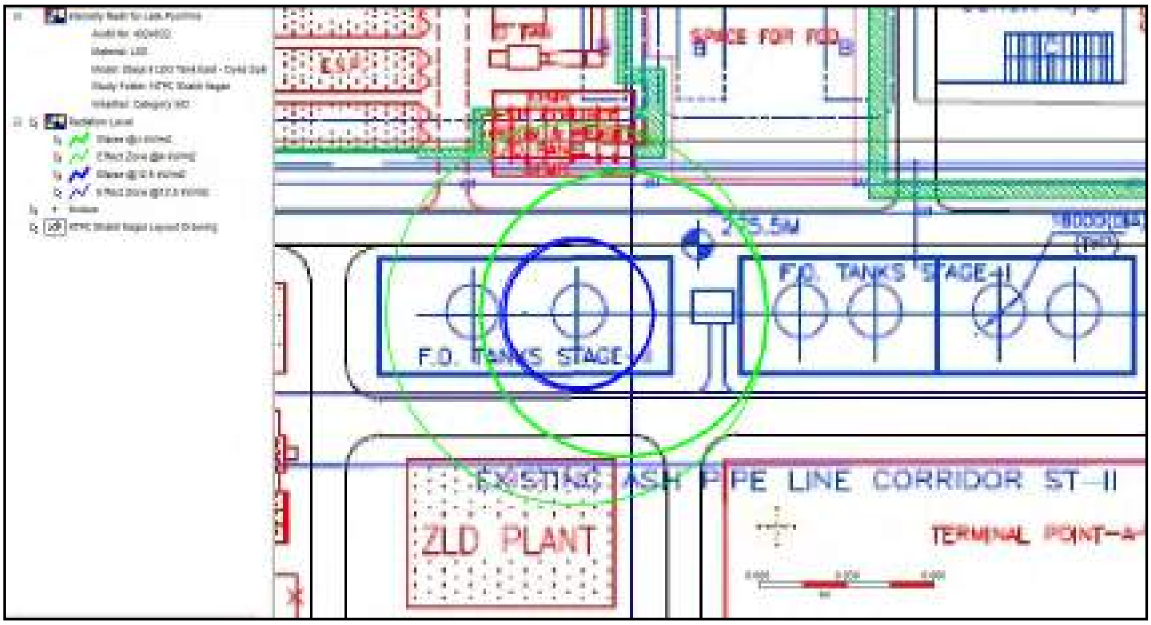

FIGURE-3
STAGE–II LDO TANK (EAST) – SMALL BUND FIRE

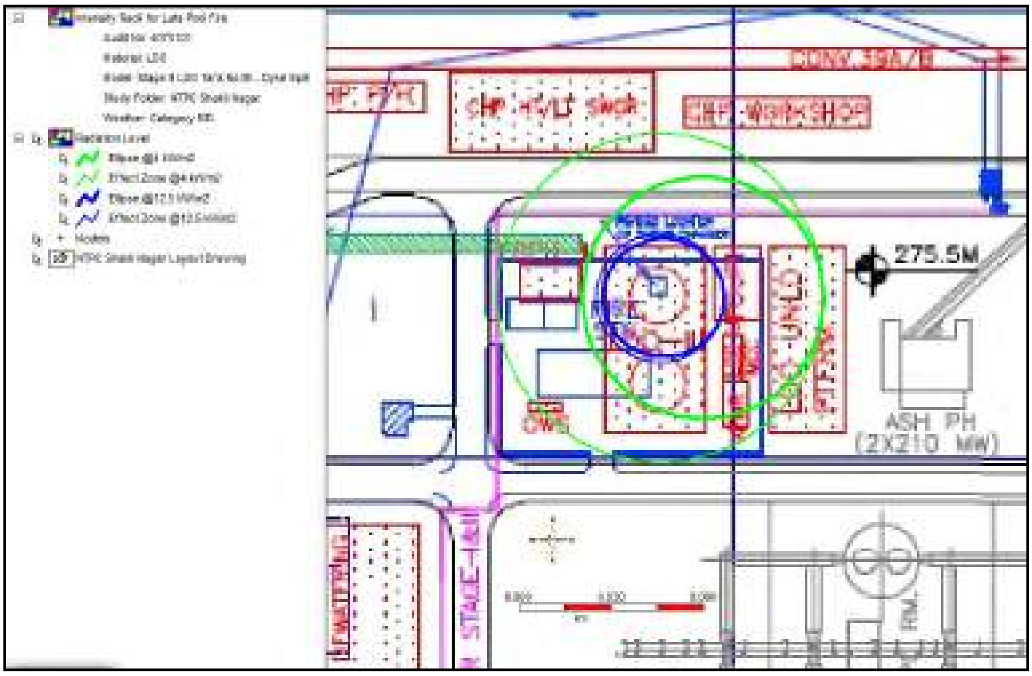

FIGURE-4
STAGE–III LDO TANK (NORTH) – SMALL BUND FIRE

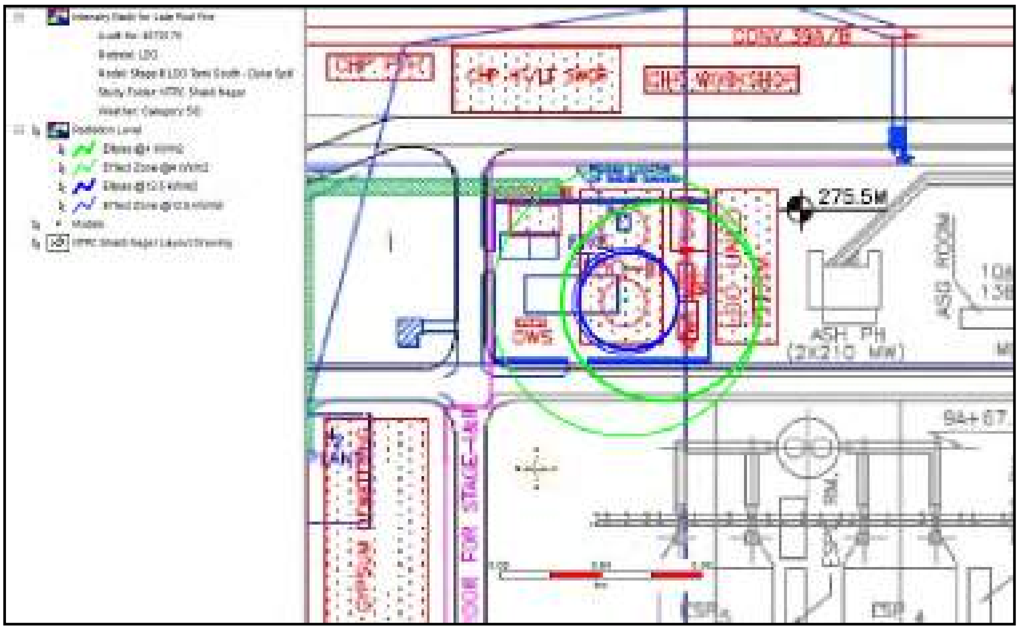

FIGURE-5
STAGE–III LDO TANK (SOUTH) – SMALL BUND FIRE

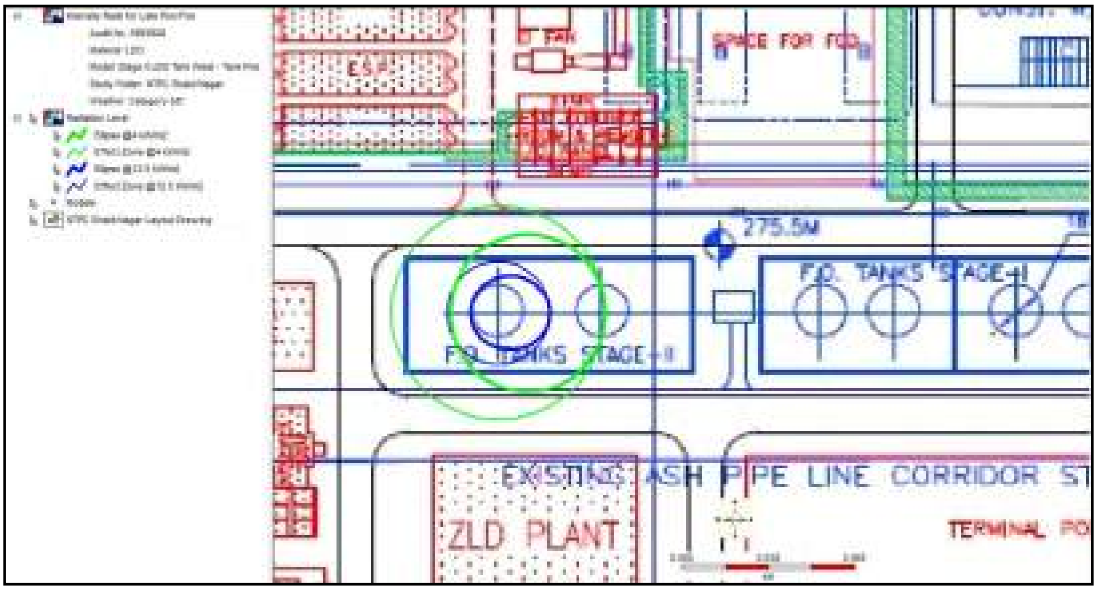

FIGURE-6
STAGE–II LDO TANK (WEST) – TANK SURFACE FIRE

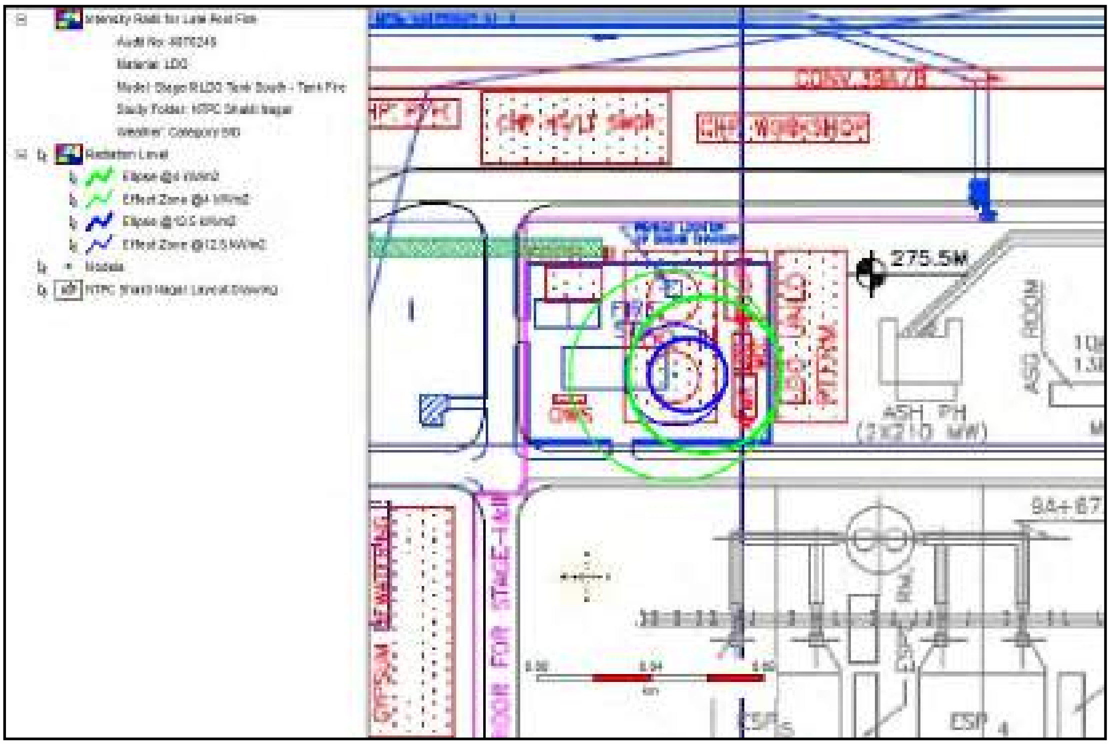

FIGURE-7
STAGE–II LDO TANK (EAST) – TANK SURFACE FIRE

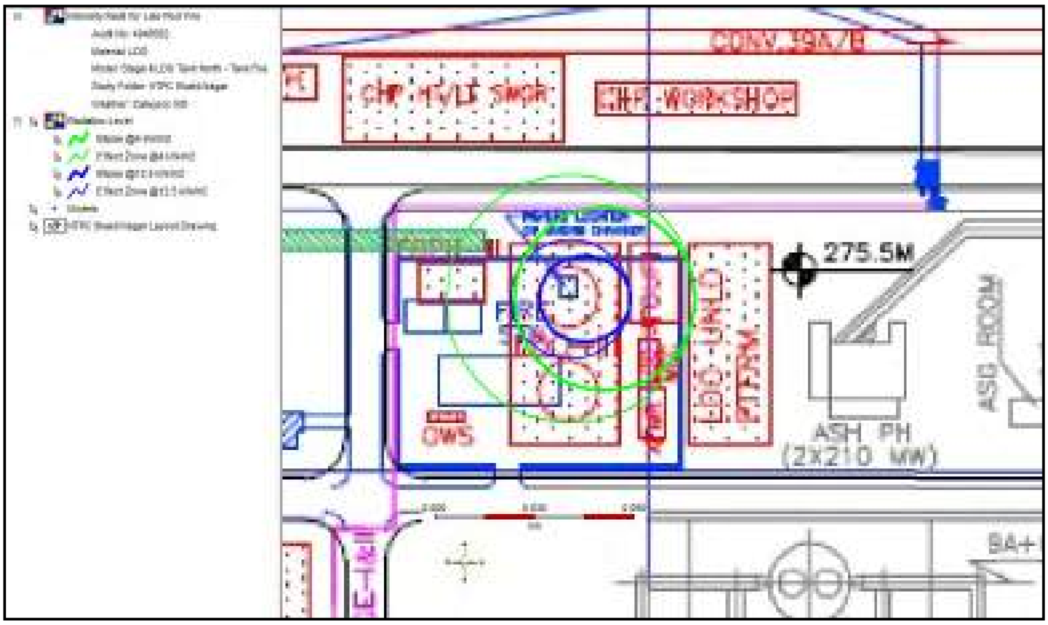

FIGURE-8
STAGE–III LDO TANK (NORTH) – TANK SURFACE FIRE

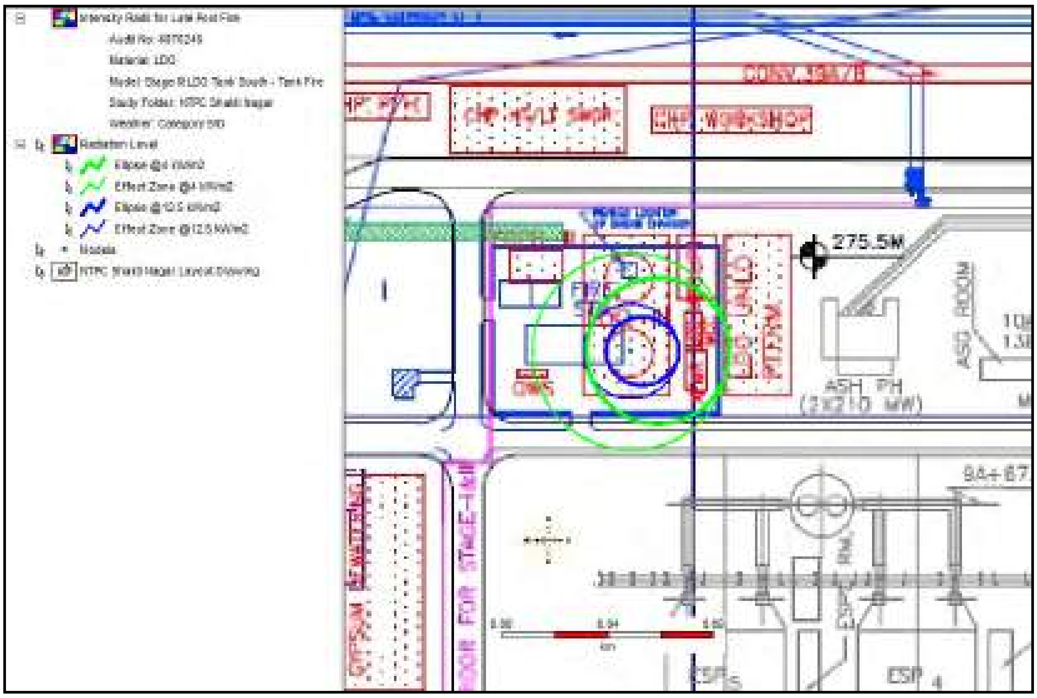

FIGURE-9
STAGE–III LDO TANK (SOUTH) – TANK SURFACE FIRE

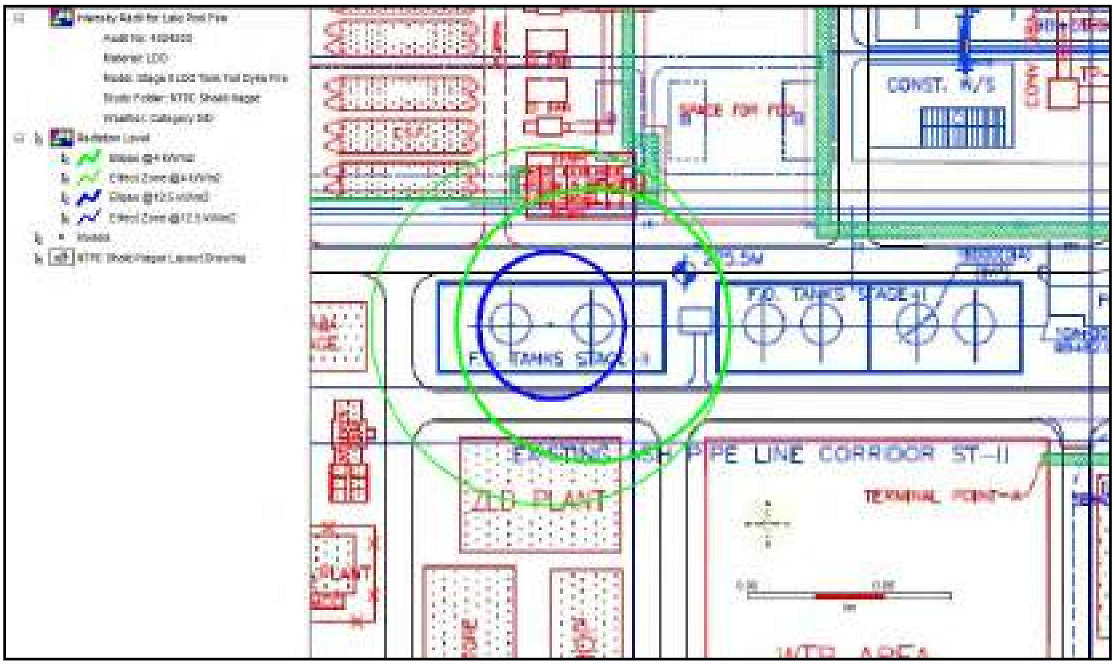

FIGURE-10
STAGE–II LDO TANKS - FULL BUND FIRE

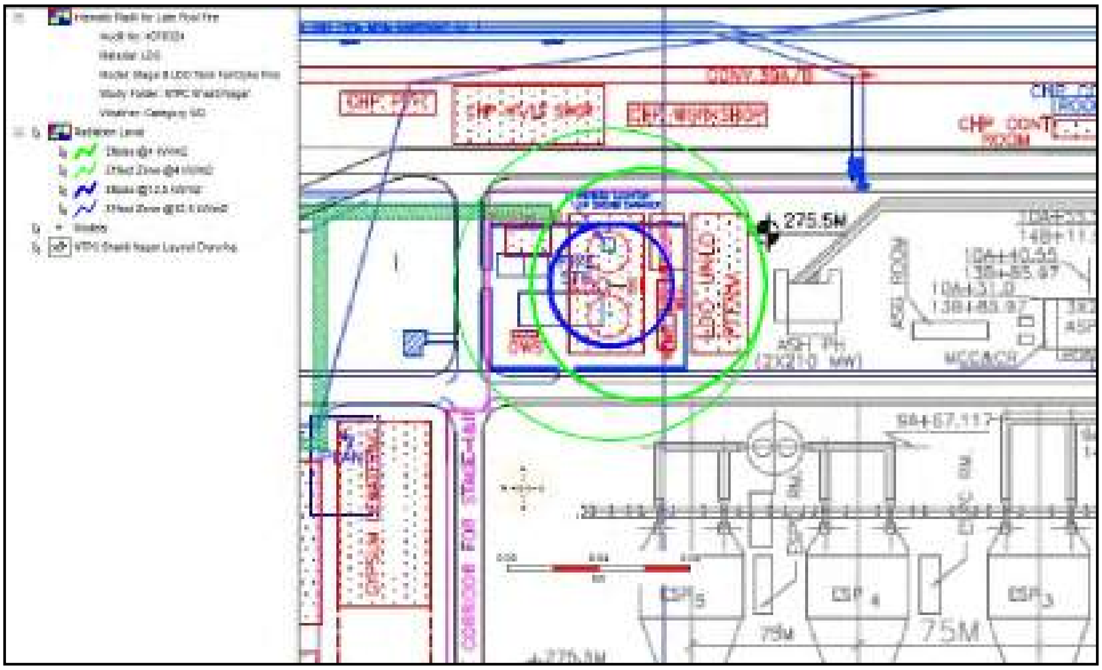

FIGURE11
STAGE–III LDO TANKS - FULL BUND FIRE

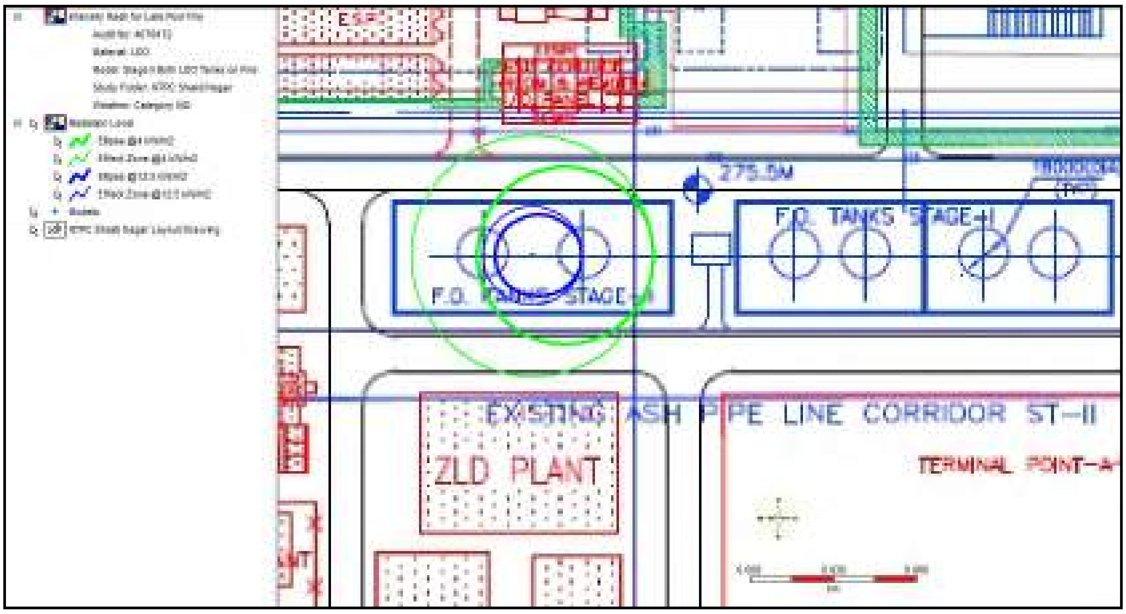

FIGURE-12
STAGE–II LDO TANKS – BOTH TANKS ON FIRE

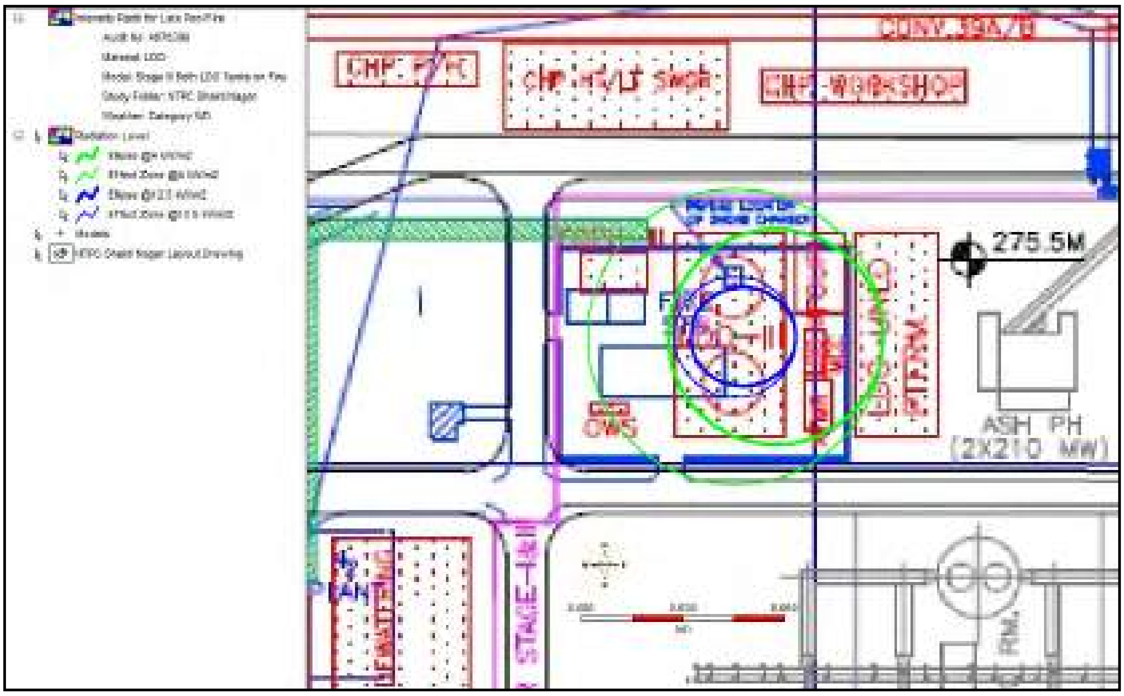

FIGURE-13
STAGE–III LDO TANKS – BOTH TANKS ON FIRE

4.7 Conclusions

Review of the results of consequence analysis for maximum credible failure scenarios in the LDO storage tanks in Stage–II and Stage–III of NTPC Singrauli STPP has indicated the following points.

- LDO is Class B petroleum product with flash point more than 70°C. The hazards in the storage tank area due to accidental release of LDO is mainly pool fire.
- In case of credible failure scenarios including small bund fires and tank surface fires, the pool fire radiation intensity of 37.5 kW/m^2, which will cause serious damage, is not reached.
- In case of worst case failure scenario, namely full bund fire due to major damage of tank, the pool fire radiation intensity of 37.5 kW/m^2, which will cause serious damage, is not reached. Pool fire radiation intensity of 12.5 kW/m^2, which will not cause structural damage remains within the storage tank area.
- In case of multiple failure scenario, namely surface fire in both tanks in a dyke, the pool fire radiation intensity of 37.5 kW/m^2, which will cause serious damage, is not reached. Pool fire radiation intensity of 12.5 kW/m^2, which will not cause structural damage remains within the storage tank area.

4.8 Recommendations

1. In the dykes for LDO storage in Stage–II and Stage–III, fire break walls are to be provided to limit spread of LDO and prevent full dyke fire situation in the event of small spillage.
2. Dyke area provided for Stage–II appears to be much larger than the area specified by OISD / PESO norms. It may be considered to reduce the dyke area for Stage–II LDO tanks.
3. Foam system should be provided for fire protection in LDO storage as per OISD standards.
4. LDO tank dyke drains are to be provided with isolation valves, which should be kept closed except during rain.
5. LDO tank dyke drains are to be connected to oil-water separator system to prevent oil contamination o storm water and possible spread of fire.

4.9 Coal Handling Plant - Dust Explosion

Coal dust when dispersed in air and ignited would explode. Crusher house and conveyor systems are most susceptible to this hazard. To be explosive, the dust mixture should have:

- Particles dispersed in the air with minimum size (typical figure is 400 microns);
- Dust concentrations must be reasonably uniform; and
- Minimum explosive concentration for coal dust (33% volatiles) is 50 gm/m^3.

Failure of dust extraction and suppression systems may lead to abnormal conditions and may increase the concentration of coal dust to the explosive limits. Sources of ignition present are incandescent bulbs with the glasses of bulkhead fittings missing, electric equipment and cables, friction, spontaneous combustion in accumulated dust.

Dust explosions may occur without any warnings with Maximum Explosion Pressure upto 6.4 bar. Another dangerous characteristic of dust explosions is that it sets off secondary explosions after the occurrence of the initial dust explosion. Many a times the secondary explosions are more damaging than primary ones.

The dust explosions are powerful enough to destroy structures, kill or injure people and set dangerous fires likely to damage a large portion of the Coal Handling Plant including collapse of its steel structure which may cripple the lifeline of the power plant.

Stockpile areas shall be provided with automatic garden type sprinklers for dust suppression as well as to reduce spontaneous ignition of the coal stockpiles. Necessary water distribution network for drinking and service water with pumps, piping, tanks, valves etc will be provided for distributing water at all transfer points, crusher house, control rooms etc.

A centralized control room with microprocessor based control system (PLC) has been envisaged for operation of the coal handling plant. Except for locally controlled equipment like traveling tripper, dust extraction/ dust suppression / ventilation equipment, sump pumps, water distribution system etc, all other in-line equipment will be controlled from the central control room but will have provision for local control as well. All necessary interlocks, control panels, MCC's, mimic diagrams etc will be provided for safe and reliable operation of the coal handling plant.

4.9.1 Control Measures for Coal Yards

The total quantity of coal shall be stored in separate stockpiles, with proper drains around to collect washouts during monsoon season.

Water sprinkling system shall be installed on stocks of coal in required scales to prevent spontaneous combustion and consequent fire hazards. The stock geometry shall be adopted to maintain minimum exposure of stock pile areas towards predominant wind direction.

4.10 Identification of Hazards

The various hazards associated, with the plant process apart from fuel storage have been identified and are outlined in **Table-17.**

TABLE-17
HAZARD ANALYSIS FOR PROCESS IN POWER PLANT

Sr. No.	Blocks/Areas	Hazards Identified
1	Coal storage in open yard	Fire, Spontaneous Combustion
2	Coal Handling Plant including Bunker area	Fire and/or Dust Explosions
3	Boilers	Fire (mainly near oil burners), Steam Explosions, Fuel Explosions
4	Steam Turbine Generator Buildings	Fires in – a) Lube oil system b) Cable galleries c) Short circuits in: i)Control rooms ii) Switch-gears Explosion due to leakage of Hydrogen and fire following it.
5	Switch-yard Control Room	Fire in cable galleries and Switch-gear/Control Room
6	LDO Tank Farms	Fire

4.11 Hazardous Events with Greatest Contribution to Fatality Risk

The hazardous event scenarios likely to make the greatest contribution to the risk of potential fatalities are summarized in **Table-18**. 'Onsite facility' refers to the operating site at plant site, whereas 'offsite facility' refers to transport and handling systems, which are away from the operating site.

TABLE-18
HAZARDOUS EVENTS CONTRIBUTING TO RISK AT ON-SITE FACILITY

Hazardous Event	Risk Rank	Consequences of Interest
Onsite vehicle impact on personnel	3	Potential for single fatalities, onsite impact only
Entrapment/struck by Machinery	3	Potential for single fatalities, onsite impact only
Fall from heights	3	Potential for single fatalities, onsite impact only
Electrocution	3	Potential for single fatalities, onsite impact only
Storage tank rupture and fire	3	Potential for multiple fatalities, onsite impact only

4.12 Risk Assessment Summary

The preliminary risk assessment has been completed for the proposed power plant and associated facilities and the broad conclusions are as follows:

- There will be no significant community impacts or environmental damage consequences; and
- The hazardous event scenarios and risks in general at this facility can be adequately managed to acceptable levels by performing the recommended safety studies as part of detailed design, applying recommended control strategies and implementing a safety management system.

4.13 Risk Reduction Opportunities

The following opportunities shall be considered as a potential means of reducing identified risks during the detailed design phase:

- Buildings and plant structures shall be designed for floods and seismic events to prevent structural collapse and integrity of weather (water) proofing for storage of dangerous goods;

- Provision for adequate water capacity to supply fire protection systems and critical process water;

- Isolate people from load carrying/mechanical handling systems, vehicle traffic and storage and stacking locations;

- Installation of fit-for-purpose access ways and fall protection systems to facilitate safe access to fixed and mobile plant;
- Provision and integrity of process tanks, waste holding tanks and bunded areas as per relevant standards;

- Containment of hazardous materials;

- Security of facility to prevent unauthorized access to plant, introduction of prohibited items and control of onsite traffic; and

- Development of emergency response management systems commensurate with site specific hazards and risks (fire, explosion, rescue and first aid).

5 Disaster Management Plan

Disasters

A serious disruption of the functioning of a community or a society causing widespread human, material, economic, or environmental losses that exceed the ability of the affected community or society to cope using its own resources.

Disasters could be categorized into:

1. Natural Disasters:

A natural disaster is the result of a natural phenomenon (e.g., flood, tornado, earthquake, land slide etc). It leads to financial, environmental or human losses. The resulting loss depends on the vulnerability of the affected population to resist the hazard, also called their resilience. The vulnerability of Singrauli area for natural disasters are as follow:

a) *Earth Quake:* Whole Sonbhadra district including Singrauli area falls under Zone-III (Moderate risk zone)

Hence following measures has been suggested.

- Identify places in the Plant as well as house that can provide cover during an earthquake.
- Take shelters under strong things like table, bed etc. during earth quake.
- If you are not certain about the damage to your building, evacuate carefully.

b) *Flood:* Singrauli region is not vulnerable from flood.
However, as precautionary measures, the provision of well-designed Storm Water Drainage System in plant and township will be made to prevent flood. Arrangements including stocking of disinfectants for disinfecting water sources after the flood should be done.

c) *Cyclone, Storm and T-Sunami:* As the Singrauli region is not located near sea shore, there is no history of Cyclone, Storm or T-Sunami in study area nor it has vulnerability from it. The plant structure is designed to withstand forces of cyclones and storm.

In view of above, it may be concluded that Singrauli region is not highly vulnerable from natural disasters.

2. Man-made Disasters

Man-made disasters are of an anthropogenic origin, and exemplify some of the terrible accidents that have resulted from human being's interaction with artificial environment, which they themselves have created.

Industrial accidents are one good example of manmade disasters.

5.1 Industrial Disasters

Industrial hazards are threats to people and life-support systems that arise from the mass production of goods and services. When these threats exceed human coping capabilities or the absorptive capacities of environmental systems they give rise to industrial *disasters*. Industrial hazards can occur at any stage in the production process, including processing, manufacture, transportation, storage, use, and disposal. Losses generally involve the release of damaging substances (e.g. chemicals, radioactivity, and genetic materials) or damaging levels of energy from industrial facilities or equipment into surrounding environments. This usually occurs in the form of explosions, fires, spills, leaks, or wastes. Releases may occur because of factors that are internal to the industrial system (e.g. engineering flaws) or they may occur because of external factors (e.g. extremes of nature).

Disasters occur throughout the world, but their economic and social impacts have been increasing and are generally much greater in developing countries than in developed ones. The disproportionate effect on developing countries has many explanations. Lack of development itself contributes to disaster impacts, both because the quality of construction often is low and building codes, land registration processes, and other regulatory mechanisms are lacking, as well as because numerous other development priorities displace attention from the risks presented by natural or man-made events.

5.2 Objectives of DMP

The objective of the industrial DMP is to make use of the combined resources of the plant and the outside services to achieve the following:

1. Effect the rescue and medical treatment of casualties;
2. Safeguard other people;
3. Minimize damage to property and the environment;
4. Initially contain and ultimately bring the incident under control;
5. Identify any dead;
6. Provide for the needs of relatives;
7. Provide authoritative information to the news media;
8. Secure the safe rehabilitation of affected area;
9. Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the Emergency.

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

5.3 Emergencies

5.3.1 General Industrial Emergencies

The emergencies that could be envisaged in the plant and fuel storage are as follows:

- A situation of fire at the hydrogen plant;
- A situation of fire at the fuel oil tank farm;
- Slow isolated fires;
- Fast spreading fires;
- Structural failures;
- Contamination of food/water; and
- Sabotage/social disorder.

5.3.2 Specific Emergencies Anticipated

- ***Fire and Explosion***

Fire consequences can be disastrous, since they involve huge quantities of fuel either stored or in dynamic inventory in pipelines or in nearby areas. Preliminary hazard analysis has provided a basis for consequence estimation. Estimation can be made by using various pool fire, tank fire consequence calculations. During the study of risk assessment, the nature of damages is worked out and probability of occurrence of such hazards is also drawn up.

5.4 Emergency Organization

It is recommended to setup an emergency organization. A senior executive who has control over the affairs of the plant should lead the emergency organization. He shall be designated as site controller. General Manager [O&M] can be designated as the incident controller. In the case of stores, utilities, open areas, which are not under the control of the production heads, senior executive responsible for maintenance of utilities would be designated as incident controller. All the incident controllers would be reporting to the site controller.

Each incident controller, for himself, organizes a team responsible for controlling the incidence with the personnel under his control. Shift-in-charge would be the reporting officer, who would bring the incidence to the notice of the incidence controller and site controller.

Emergency coordinators would be appointed who would undertake the responsibilities like firefighting, rescue, rehabilitation, transport and provide essential and support services. For this purposes, Security In-charge, Personnel department, essential services personnel should be engaged. All these personnel would be designated as key personnel.

In each shift, electrical supervisor, electrical fitters, pump house in-charge, and other maintenance staff would be drafted for emergency operations. In the event of power or communication system failure, some of staff members in the office/plant offices would be drafted and their services would be utilized as messengers for quick passing of communications. All these personnel would be declared as essential personnel.

5.4.1 Emergency Communication

Whoever notices an emergency situation such as fire, growth of fire, leakage etc. should inform his immediate superior and emergency control center. A place nearer to the gate house complex shall be identified as emergency control center. The person on-duty in the emergency control center should appraise the site controller. Site controller verifies the situation from the incident controller of that area or the shift In-charge and takes a decision about an impending on site emergency. This would be communicated to all the incident controllers, emergency co-ordinators. simultaneously, the emergency warning system would be activated on the instructions of the site controller.

- **Alarms for Various Emergencies:**

The emergency alarm will be sounded by the shift in-charge of CISF from the Control Room located at the Main Gate. The emergency alarm/siren is located on the top of the Main Plant building. For operation of siren switch, switch will be under SHIFT-IN-CHARGE OF CISF CONTROL ROOM and is manned round the clock.

The emergency alarm shall consist of repeated long and short blast for 2 minutes. The purpose is to advise all persons on the outburst of major emergency occurred in the Plant. A separate siren audible to a distance of 5 Kms range is available for this purpose. The alarm is sounded such that the nature of emergency can be distinguished as a major fire or explosion.

In-case of major outbreak of fire, Gas leakage, the state of emergency has to be declared by the concerned by sounding Emergency Siren.

EMERGENCY SIREN

Type	Duration	Freq
In case of fire/Explosion	One minute ON, 30 seconds OFF	10 times
Hazardous gas leakage	20 seconds ON, 10 seconds OFF	30 times
All Clear signal	Continuous siren for 3 minutes	

5.5 Emergency Responsibilities

The responsibilities of the key personnel are appended below:

5.5.1 Site Controller

On receiving information about emergency would rush to Emergency Control Center (ECC) and take charge of ECC and the situation. His responsibilities would be as indicated below:

- Assesses the magnitude of the situation on the advice of incident controller and decides;
  - ➢ Whether the effected area needs to be evacuated;
  - ➢ Whether personnel who are at assembly points need to be evacuated;

- Declares emergency and orders for operation of emergency siren;
- Organizes announcement by public address system about location of emergency;
- Assesses which areas are likely to be affected, or need to be evacuated or are to be alerted;
- Maintains a continuous review of possible development and assesses the situation in consultation with incident controller and other Key personnel as to whether shutting down the plant or any section of the plant is required and if evacuation of persons is required;
- Directs personnel for rescue, rehabilitation, transport, fire, brigade, medical and other designated mutual support systems locally available, for meeting emergencies;
- Controls evacuation of affected areas, if the situation is likely to go out of control or effects are likely to go beyond the premises of the factory, informs the District Emergency Authority, Police, Hospital and seeks their intervention and help;
- Informs inspector of factories, deputy chief inspector of factories, UPPCB and other statutory authorities;
- Gives a public statement, if necessary;
- Keeps record of chronological events and prepares an investigation report and preserves evidence; and
- On completion of onsite emergency and restoration of normalcy, declares all clear and orders for all clear warning.

5.5.2 Incident Controller

- Assembles the incident control team;

- Directs operations within the affected areas with the priorities for safety to personnel minimize damage to the plant, property and environment and minimize the loss of materials;
- Directs the shutting down and evacuation of plant and areas likely to be adversely affected by the emergency;
- Ensures that key personnel help is sought;
- Provides advice and information to the fire and security officer and the local fire services as and when they arrive;
- Ensures that all non-essential workers/staff of the affected areas are evacuated to the appropriate assembly points, and the areas are searched for casualties;
- Has regard to the need for preservation of evidence so as to facilitate any inquiry into the causes and circumstances, which caused or escalated the emergency;
- Co-ordinates with emergency services at the site;
- Provides tools and safety equipment to the team members;
- Keeps in touch with the team and advices them regarding the method of control to be used; and
- Keeps the site controller of emergency informed of the progress being made.

5.5.3 Emergency Coordinator - Rescue, Fire Fighting

- On knowing about emergency, rushes to ECC;
- Helps the incident controller in containment of the emergency;
- Ensure fire pumps are in operating condition and instructs pump house operator to ready for any emergency with standby arrangement;
- Guides the fire fighting crew i.e. firemen, trained plant personnel and security staff;
- Organizes shifting the fire fighting facilities to the emergency site, if required;
- Takes guidance of the incident controller for fire fighting as well as assesses the requirements of outside help;
- Arranges to control the traffic at the gate and the incident area;
- Directs the security staff to the incident site to take part in the emergency operations under his guidance and supervision;
- Evacuates the people in the plant or in the nearby areas as advised by Site Controller;
- Searches for casualties and arranges proper aid for them;
- Assembles search and evacuation team;
- Arranges for safety equipment for the members of this team;
- Decides which paths the evacuated workers should follow; and
- Maintains law and order in the area, and if necessary seeks the help of police.

5.5.4 Emergency Coordinator-Medical, Mutual Aid, Rehabilitation, Transport and Communication

- In the event of failure of electric supply and thereby internal telephone, sets up communication point and establishes contact with the ECC;
- Organizes medical treatment to the injured and if necessary will shift the injured to near by hospitals;
- Mobilizes extra medical help from outside, if necessary;
- Keeps a list of qualified first aid providers for the plant and seeks their assistance;
- Maintains first aid and medical emergency requirements;
- Makes sure that all safety equipment is made available to the emergency team;
- Assists site controller with necessary data to coordinate the emergency activities;
- Assists site controller in updating emergency plan, organizing mock drills, verification of inventory of emergency facilities and furnishing report to Site Controller;
- Maintains liaison with civil administration;
- Ensures availability of canteen facilities and maintenance of rehabilitation center.

- Liaises with site controller/incident controller;
- Ensures transportation facility;
- Ensures availability of necessary cash for rescue/rehabilitation and emergency expenditure;
- Controls rehabilitation of affected areas on discontinuation of emergency; and
- Makes available diesel/petrol for transport vehicles engaged in emergency operation.

5.5.5 Emergency Coordinator - Essential Services

- Assists site controller and incident controller;
- Maintains essential services like diesel generator, water, fire water, compressed air/instrument air, power supply for lighting;
- Plans alternate facilities in the event of power failure, to maintain essential services such as lighting, etc;
- Organizes separate electrical connections for all utilities and emergency services so that in the event of emergency or fires, essential services and utilities are not affected;
- Gives necessary instructions regarding emergency electrical supply, isolation of certain sections etc. to shift in-charge and electricians; and
- Ensures availability of adequate quantities of protective equipment and other emergency materials, spares etc.

5.5.6 General Responsibilities of Employees during an Emergency

During an emergency, which becomes more enhanced and pronounced when an emergency warning is raised, the workers who are in-charge of process equipment should adopt safe and emergency shut down and attend to any prescribed duty as essential employee. If no such responsibility is assigned, he should adopt a safe course to assembly point and await instructions. He should not resort to spreading panic. On the other hand, he must assist emergency personnel towards meeting the objectives of DMP.

7.5.6 <u>Emergency Facilities</u>

5.6.1 Emergency Control Center (ECC)

The following information and equipment are to be provided at the Emergency Control Center (ECC).

- Intercom, telephone;
- P and T telephone;
- Self contained breathing apparatus;
- Fire suit/gas tight goggles/gloves/helmets;
- Hand tools, wind direction/velocities indications;
- Public address megaphone, hand bell, telephone directories (internal, P and T)
- Plant layout, site plan;
- Emergency lamp/torch light/batteries;
- Plan indicating locations of hazard inventories, plant control room, sources of safety equipment, work road plan, assembly points, rescue location vulnerable zones, escape routes;
- Hazard chart;
- Emergency shut-down procedures;
- Nominal roll of employees;
- List of key personnel, list of essential employees, list of emergency coordinators;
- Duties of key personnel;
- Address with telephone numbers and key personnel, emergency coordinator, essential employees; and

- Important address and telephone numbers including Government agencies, neighboring industries and sources of help, outside experts, fuel fact sheets and population details around the factory.

5.6.2 Assembly Point

Number of assembly points, depending upon the plant location, would be identified wherein employees who are not directly connected with the disaster management would be assembled for safety and rescue. Emergency breathing apparatus, minimum facilities like water etc would be organized. In view of the size of plant, different locations would be ear marked as assembly points. Depending upon the location of hazard, the assembly points are to be used.

5.6.3 Fire Fighting Facilities

First aid and firefighting equipment suitable for emergency should be maintained in each section in the plant. This would be as per statutory requirements. However, fire hydrant line covering major areas would be laid. It would be maintained as 6- kg/cm^2 pressure. Fire alarms should be located in the bulk storage areas. Fire officer will be the commanding officer of fire fighting services. Fire tender would also be provided for fire fighting.

5.6.4 Location of Wind Sock

Wind socks shall be installed at appropriate places in the plant to indicate direction of wind for emergency escape.

5.6.5 Emergency Medical Facilities

Stretchers, gas masks and general first-aid materials for dealing with chemical burns, fire burns etc would be maintained in the medical center as well as in the emergency control room. Medical superintendent of the medical center will be the head of the casualty services ward. Private medical practitioners help would also be sought. Government hospital would be approached for emergency help.

Apart from plant first aid facilities, external facilities would be augmented. Names of medical personnel, medical facilities in the area would be prepared and updated. Necessary specific medicines for emergency treatment of patient’s burns would be maintained.

Breathing apparatus and other emergency medical equipment would be provided and maintained. Also, the help of nearby industries would be taken on mutual support basis.

5.6.6 Ambulance

Availability of an ambulance with driver in all the shifts would be ensured to transport injured or affected persons. Number of persons would be trained in first aid so that, in every shift first aid personnel would be available.

5.7 Emergency Actions

5.7.1 Emergency Warning

The emergency would be communicated both to the personnel inside the plant and the people outside. An emergency warning system shall be established for this purpose.

5.7.2 Emergency Shutdown

There are number of facilities, which can be provided to help deal with hazardous conditions, when a tank is on fire. The suggested arrangements are:

1. Stop feed;
2. Dilute contents;
3. Remove heat;
4. Deluge with water; and
5. Transfer contents.

5.7.3 Evacuation of Personnel

There could be a number of persons in the storage area and other areas in the vicinity. The area would have adequate number of exits, staircases. In the event of an emergency, unconnected personnel have to escape to assembly point. Operators have to take emergency shutdown procedure and escape. Time Office shall maintain a copy of deployment of employees in each shift at ECC. If necessary, persons can be evacuated by rescue teams.

5.7.4 All Clear Signal

Also, at the end of an emergency, after discussing with incident controllers and emergency co-ordinators, the site controller orders an all clear signal. When it becomes essential, the site controller communicates to the district emergency authority, police, fire service personnel regarding help required or development of the situation into an off-site emergency. The on-site emergency organization chart for various emergencies is shown in **Figure-14.**

5.8 General

5.8.1 Employee Information

During an emergency, employees would be warned by raising siren in specific pattern. Employees would be given training of escape routes and taking shelter. Employees would be provided with information related to fire hazards, antidotes and first aid measures. Those who would be designated as key personnel and essential employees should be given training for emergency response. Contractual workers will also be given necessary training by respective contractors for fire hazards, antidotes and first aid measures. A list of contractor's worker information will be maintained at CISF Post at main gate.

5.8.2 Public Information and Warning

The industrial disaster effects related to this plant may mostly be confined to the plant area. The detailed risk analysis has indicated that the pool fire effects would not be felt outside. However, as an abundant precaution, the information related to fuels in use would be furnished to district emergency authority for necessary dissemination to general public and for any use during an off site emergency. Plants of this size and nature have been in existence in our country for a long time.

5.8.3 Co-ordination with Local Authorities

Keeping in view of the nature of emergency, two levels of coordination are proposed. In the case of an on-site emergency, resources within the organization would be mobilized and in the event extreme emergency local authorities help would be sought.

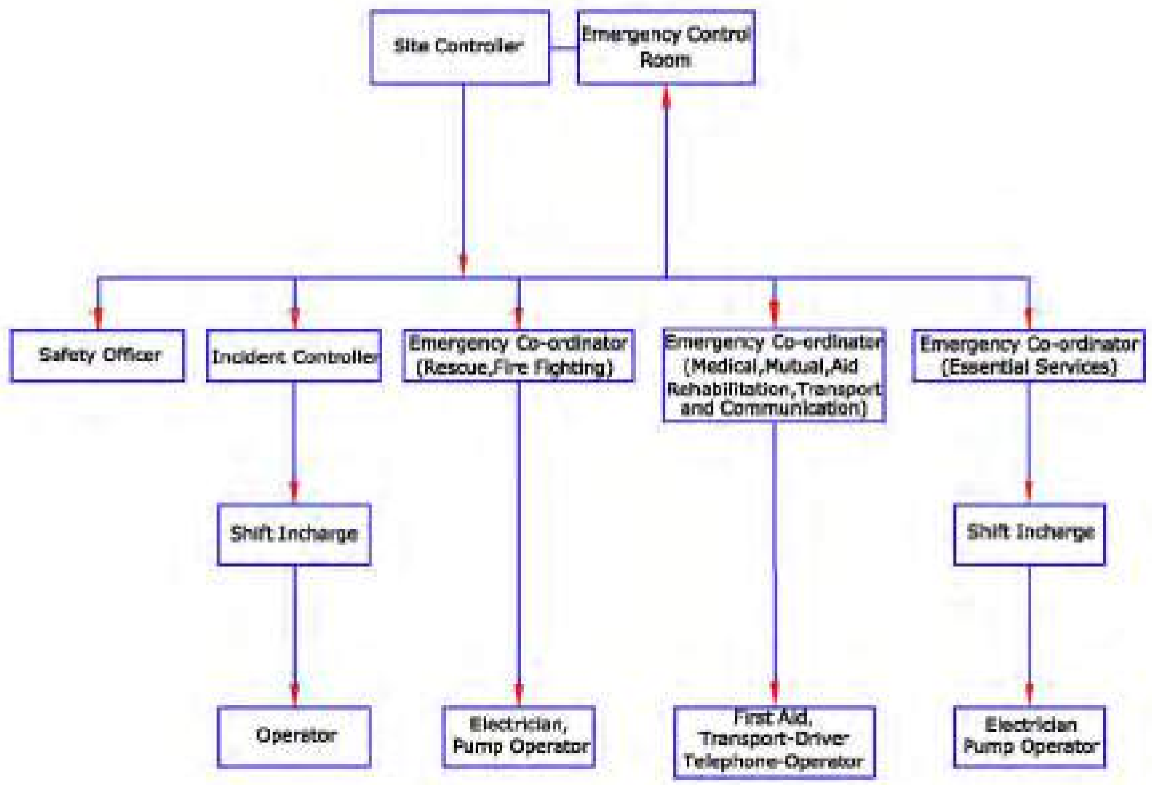

FIGURE-7.14
ON-SITE EMERGENCY ORGANIZATION CHART

In the event of an emergency developing into an off-site emergency, local authority and district emergency authority (normally the collector) would be appraised and under his supervision, the off-site disaster management plan would be exercised. For this purpose, the facilities that are available locally, i.e. medical, transport, personnel, rescue accommodation, voluntary organizations etc would be mustered. Necessary rehearsals and training in the form of mock drills would be organized.

5.8.4 Mutual Aid

Mutual aid in the form of technical personnel, runners, helpers, special protective equipment, transport vehicles, communication facility, medical facilities and Fire stations etc. would be sought from the neighboring industries i.e. NTPC Vindhyachal, NTPC Rihand and other neighboring industries. Existing plant has already a full-fledged Sanjeevani Hospital and other facilities for handling Emergency situations.

5.8.5 Mock Drills

Emergency preparedness is an important part of planning in industrial disaster management. Personnel would be trained suitably and prepared mentally and physically in emergency response through carefully planned, simulated procedures. Similarly, the key personnel and essential personnel would be trained in the operations.

5.8.6 Important Information

Once the plant goes on stream, important information such names and addresses of key personnel, essential employees, medical personnel outside the plant, transporters address, address of those connected with off-site emergency such as police, local authorities, fire services, district emergency authority would be prepared and maintained.

6 Off-site Emergency Preparedness Plan

The task of preparing the off-site emergency plan lies with the district collector; however, the off-site plan will be prepared with the help of the local district authorities. The proposed plan will be based on the following guidelines.

6.1 Introduction

Off-site emergency plan would follow the on-site emergency plan. When the consequences of an emergency situation go beyond the plant boundaries, it becomes an off-site emergency. Off-site emergency is essentially the responsibility of the public administration. However, the plant management will provide the public administration with the technical information relating to the nature, quantum and probable consequences on the neighboring population.

The off-site plan in detail will be based on those events, which are most likely to occur, but other less likely events, which have severe consequence, will also be considered. Incidents which have very severe consequences yet have a small probability of occurrence would also be considered during the preparation of the plan. However, the key feature of a good off-site emergency plan is flexibility in its application to emergencies other than those specifically included in the formation of the plan.

The roles of the various parties who will be involved in the implementation of an off-site plan are described below. Depending on local arrangements, the responsibility for the off-site plan would either rest with the plant management or with the local authority. Either way, the plan would identify an emergency coordinating officer, who would take the overall command of the off-site activities. As with the on-site plan, an emergency control center would be setup within which the emergency coordinating officer can operate.

An early decision will be required in many cases on the advice to be given to people living "within range" of the accident - in particular whether they should be evacuated or told to go indoors. In the latter case, the decision can regularly be reviewed in the event of an escalation of the incident. Consideration of evacuation may include the following factors:

- In the case of a major fire but without explosion risk (e.g. an oil storage tank), only houses close to the fire are likely to need evacuation, although a severe smoke hazard may require this to be reviewed periodically; and

- If a fire is escalating and in turn threatening a store of hazardous material, it might be necessary to evacuate people nearby, but only if there is time; if insufficient time exists, people should be advised to stay indoors and shield themselves from the fire. This later case particularly applies if the installation at risk could produce a fireball with very severe thermal radiation effects.

Although the plan will have sufficient flexibility built in to cover the consequences of the range of accidents identified for the on-site plan, it will cover in some detail the handling of the emergency to a particular distance from each major hazard works.

6.2 Aspects Proposed to be considered in the Off-Site Emergency Plan

The main aspects, which should be included in the emergency plan are:

- ***Organization***

Detail of command structure, warning systems, implementation procedures, emergency control centers.

Names and appointments of incident controller, site main controller, their deputies and other key personnel.

- ***Communications***

Identification of personnel involved, communication center, call signs, network, list of telephone numbers.

- ***Specialized Knowledge***

Details of specialist bodies, firms and people, it may be necessary to call upon them during emergency e.g. those with specialized knowledge, laboratories etc.

- ***Voluntary Organizations***

Details of organizers, telephone numbers, resources etc

- ***Information on Fuel and Hazardous Material Storages***

Details of the hazardous substances stored and a summary of the risk associated with them.

- ***Meteorological Information***

Arrangements for obtaining details of weather forecasts and weather conditions prevailing at that time

- ***Humanitarian Arrangements***

Transport, evacuation centers, emergency feeding, treatment of injured, first aid, ambulances and temporary mortuaries.

- ***Public Information***

Arrangements for (a) dealing with the media press office; (b) informing relatives, etc

- ***Assessment of Emergency Plan***

Arrangements for:

(a) Collecting information on the causes of the emergency; and
(b) Reviewing the efficiency and effectiveness of all aspects of the emergency plan.

6.3 <u>Role of the Emergency Co-coordinating Officer</u>

The various emergency services would be coordinated by an Emergency Coordinating Officer (ECO), who will be designated by the district collector. The ECO would liaison closely with the site main controller. Again depending on local arrangements, for very severe incidents with major or prolonged off-site consequences, the external control would be passed to a senior local authority administrator or even an administrator appointed by the central or state government. The ECO will be equipped with address and phone numbers of important agencies.

6.4 Role of the Local Authority

The duty to prepare the off-site plan lies with the local authorities. The emergency planning officer (EPO) appointed should carry out his duty in preparing for a whole range of different emergencies within the local authority area. The EPO should liaison with the plant, to obtain the information to provide the basis for the plan. This liaison should ensure that the plan is continually kept upto date.

It will be the responsibility of the EPO to ensure that all those organizations which will be involved off site in handling the emergency, know of their role and are able to accept it by having for example, sufficient staff and appropriate equipment to cover their particular responsibilities. Rehearsals for off-site plans should be organized by the EPO.

6.5 Role of Police

Formal duties of the police during an emergency include protecting life and property and controlling traffic movements.

Their functions should include controlling bystanders, evacuating the public, identifying the dead and dealing with casualties, and informing relatives of death or injury.

6.6 Role of Fire Authorities

The control of a fire should be normally the responsibility of the senior fire brigade officer who would take over the handling of the fire from the site incident controller on arrival at the site. The senior fire brigade officer should also have a similar responsibility for other events, such as explosions. Fire authorities in the region should be apprised about the location of all stores of flammable materials, water and foam supply points, and fire-fighting equipment. They should be involved in on-site emergency rehearsals both as participants and, on occasion, as observers of exercises involving only site personnel.

6.7 Role of Health Authorities

Health authorities, including doctors, surgeons, hospitals, ambulances and so on, should have a vital part to play following a major accident, and they should form an integral part of the emergency plan.

For major fires, injuries should be the result of the effects of thermal radiation to a varying degree, and the knowledge and experience to handle this in all but extreme cases may be generally available in most hospitals.

Major off-site incidents are likely to require medical equipment and facilities additional to those available locally, and a medical "mutual aid" scheme should exist to enable the assistance of neighboring authorities to be obtained in the event of an emergency.

6.8 Role of Government Safety Authority

This will be the factory inspectorate available in the region. Inspectors are likely to satisfy themselves that the organization responsible for producing the off-site plan has made adequate arrangements for handling emergencies of all types including major emergencies. They may wish to see well-documented procedures and evidence of exercise undertaken to test the plan.

In the event of an accident, local arrangements regarding the role of the factory inspector will apply. These may vary from keeping a watching brief to a close involvement in advising on operations.

The action plan suggested for control of the off-site emergencies is given in **Table-19**.

TABLE-19
OFF-SITE ACTION PLAN

Sr. No.	Action Required to be taken to Mitigate Disaster by Aid giving agency	Responsible Agencies for taking action	Equipments/Material facilities required at site to mitigate Emergency
A 1	Arrangements for evacuation/ rescue of persons from zone of influence to predetermined camps	Police Department	Self Breathing apparatus with spare cylinder Chemical gas mask with spare canister Vehicle with PA system Transportation for evacuation of people
2	Caution to public by announcement		
3	Traffic and Mob control by cordoning of the area		
4	Law & order		
5	Request to railway authority for keeping the nearest by railway gate open & to stop the up & down trains at the nearest railway station		
B	Control of fire	District Fire Brigade	Self breathing apparatus with spare cylinders Foam/water fire tenders Gas mask with spare canisters Lime water Neck to toe complete asbestos suit, PVC hand gloves, gumboots, safety goggles Mobile scrubbing system along with suction arrangement.
1	Scrubbing of the flashed off gas cloud with water curtain		
2	To rescue trapped persons		
3	If fire is big, keep surrounding area cool by spraying water		
4	Communication to State Electricity Board to continue or cut off electric supply		
5	Communication to water supply department for supplying water		
C	Medical facilities for affected persons (first aid and treatment)	Hospital and public health	Ambulance with onboard resuscitation unit, first aid, stretchers
D	Identification of concentration of gas in zone of influence	Pollution Control Board	Gas detector
E	Removal of debris and damaged structures	Municipal corporation	Provide bulldozers Provide cranes
F 1	Monitor the incoming and out going transports	Transport department	Provide traffic police at site Provide emergency shifting vehicles at site Provide stock of fuel for vehicles
2	Arrange emergency shifting of affected persons and non affected person to specified area		
3	Arrange diesel/petrol for needed vehicles		
G 1	Give all information related to meteorological aspects for safe handling of affected area for living beings	Meteorological Department	Provide wind direction and velocity instruments with temperature measurements Mobile van for meteorological parameter measurements
2	Forecast important weather changes, if any		
H1	Representatives of all departments are in the local crisis group; therefore they are expected to render services available with them. Since it is a group of experts with authority, the mitigating measures can be implemented speedily. The representatives from locals are also there so that communication with local people is easy and quick.	Local Crises Group	Must have all resources at hand, specially disaster management plan and its implementation method. All relevant information related to hazardous industry shall available with crisis group Newspaper editor shall be a part of the group so that right
2	The district emergency or disaster control officer / collector shall be the		

Sr. No.	Action Required to be taken to Mitigate Disaster by Aid giving agency	Responsible Agencies for taking action	Equipments / Material facilities required at site to mitigate Emergency
	president and he shall do mock drill etc so that action can be taken in right direction in time		and timely media release can be done
I 1	Collector shall be the President of District Crisis Group therefore all district infrastructure facilities are diverted to affected zone	District Crisis Group	All necessary facilities available at district can be made available at affected zone Control of law and order situation
2	All other functions as mentioned for local crisis group		