

**EIA – EMP With Risk Assessment & DMP Report For Proposed Expansion In Existing Unit Of
M/s. Cheminova India Limited (Technical Division)** for manufacturing of Agrochemicals & their Intermediates
At Plot No. 241, 242/2, 241/P, Notified GIDC Industrial Estate, Panoli – 394 116, Dist. Bharuch, State - Gujarat, India

Chapter 7. Risk Assessment and Disaster Management Plan

7 RISK ASSESSMENT & DISASTER MANAGEMENT PLAN

7.1 BACKGROUND

Risk Assessment is a management tool for determining the hazards and risk associated with the various activities of a project and compute the damage potential of these hazards to life and property. Risk Assessment provides basis for determining the safety measures required to eliminate, minimize and control the risks as detailed in Disaster Management Plan (DMP) to handle onsite and offsite emergencies.

In Chemical Industry, Risk Assessment is carried out for the various hazards involved in storage and handling of hazardous raw materials, intermediates and finished products as well as for the manufacturing processes used by the unit.

7.2 OBJECTIVES

The given study was focused to fulfill the following objectives:

- Identification of safety areas
- Identification of process and storage hazards
- Visualization of maximum credible accident (MCA) scenarios
- Consequence analysis of scenarios
- Determination of quantities released, impact zones
- Estimation of damage distances for the accidental release scenarios with recourse to Maximum Credible Accident (MCA) analysis
- Preventive and control measures required for reducing the risk factors
- Delineation of Disaster Management Plan

7.3 SCOPE OF WORK

Based on the objectives as defined above, the scope of work for the given study has been framed as under:

- Hazard Identification
 - ✓ General description of project
 - ✓ Study of manufacturing activities
 - ✓ Study of plant facilities and layout
 - ✓ Hazardous inventory
 - ✓ Associated process and storage hazards
 - ✓ Safety measures as proposed by the proponent
- Hazard Assessment
- Identification of MCA and worst case scenarios using standard techniques
- Consequence analysis of selected scenarios using EFFECT model on ALOHA software
- Determination of risk reduction measures
- Preparation of DMP
- Recommendations

7.4 METHODOLOGY

The guidelines given by SEAC as well as Technical Guidance Manual of MoEF&CC have also been followed.

- Collecting Input data about Process, Inventories and Site conditions
- Hazard Identification
- Defining the Potential Accident Scenarios
- Evaluation of Consequences and Estimation of Accident Frequencies
- Estimate the Impacts
- Estimate the Risk
- Identify and Prioritize the Risk Reduction measures.

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7.5 HAZARD IDENTIFICATION

This is important and critical step in risk assessment. It is critical because Hazard omitted is hazard not analyzed. The tools used for identification are experience, detailed process knowledge, engineering codes, checklist, HAZOPs etc.

The unit shall handle hazardous materials and shall have a defined and organized hazard control and prevention system in place. The following statutory compliances shall be applicable to the unit:

- Manufacture, Storage and Import of Hazardous Chemicals (Amended) Rules, 2000
- The Factories Act 1948 & Rules therein
- The Insecticides Act 1968 and Rules 1971
- Petroleum Act 1934
- Petroleum Rules, 2002
- The Gas Cylinder Rules, 2004 and its amendment thereafter
- Chemical Accidents (Emergency planning, Preparedness and Response) Rules, 1996
- The Static and Mobile Pressure Vessels (Unfired) Rules, 1981

The hazards of the materials are identified from the MSDS. The major hazards are toxic, fire and explosion. Flammable material will form pool on leakage and this pool can sustain a pool fire. In case of toxic material the vapors evaporated from pool disperse in downstream direction and may cause problem for people in process units / buildings.

Proponent has classified hazardous incidents into three classes in onsite emergency plan :

L-1 – Major Incident – Fire & Toxic Release which affects all Plants

L-2 – Medium Incident – Leakage of chemicals from Storage Tanks and affect one plant

L-3 – Minor Incident – Leakage of chemical in plant and affect section of Plant

7.6 STORAGE HAZARDS AND CONTROL MEASURES

For proposed expansion, unit shall store and use hazardous chemicals of toxic, flammable and explosive nature in the form of organic and inorganic chemicals as liquids, solids as well as compressed gases. The major hazardous materials, their inventories and their hazardous properties are tabulated in Annexure-26. It should be noted that not all inventory shall be made at a time at site. These materials shall be procured and stored at the site according to requirement of production schedule.

Chemicals covered under Petroleum Act, 1934 and rules therein

CILT has license and approvals from CCOE (PESO) for bulk storage of Petroleum Class chemicals – Toluene, Methanol and Acetone, HSD for class B and Furnace Oil for class C that come under the purview of Petroleum Act 1934 and rules therein. Copy of license is annexed as Annexure-14. Ethanol and Heptane shall be required to be stored in tanks for new products for which proponent shall obtain necessary amendment in CCOE (PESO) license.

Chemicals covered under Gas Cylinder Rules, 2004 and its amendment thereafter and rules therein

Presently there is no storage of gas cylinders at the site. For proposed expansion, there shall be storage of Hydrogen gas, HCl gas cylinders, HCFC 22 cylinders and chlorine gas tonners whenever required as per production schedule, for which proponent shall obtain necessary licence under Gas Cylinder Rules, 2004 and its amendment thereafter. Presently the unit is not an MAH installation in accordance to the schedule 3 of MSIHC rules, 2000 and after proposed inventory; it shall not become an MAH installation.

List of Hazardous chemicals to be handled after expansion and their inventory and storage details are given in chapter 2 of this report.

7.7 PROCESS HAZARDS AND THEIR CONTROL MEASURES

Table 7-1 Process Hazards and their Control Measures

Hazardous processes and operations involved in manufacturing of proposed products	Preventive and control measures
Transfer of liquid and solid organic chemicals into day tanks, day vessels and reactors from storage tanks, drums and bags as applicable	LI, PT/LS/DCS Indications are provided in vessels
Heating of reaction mass in reactors upto required temperature	T/P/L-indications/controls/alarms-interlocks detectors/alarms are provided wherever necessary

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Hazardous processes and operations involved in manufacturing of proposed products	Preventive and control measures
Exothermic reactions where temperature control is critical	T/P/L High alarms, RD, Cooling arrangements, FWHS /FE's /DCS/PLC Controls/Trip system-provided (HT/ HP /HL) RD
Emission of hazardous gases during reactions as secondary product or unreacted gas	T/P/L High alarms, RD, Cooling arrangements, FWHS /FE's /DCS/PLC Controls/Trip system-provided (HT/ HP /HL) RD /Detector
Distillation of solvents from reaction mass through distillation system installed on reactors	LI, PI, TI, SV DCS/Local indications/controls for P,T,L SV's/RD's
Transfer of flammable or toxic chemicals from equipment or vessels to other equipment or tanks or drum or bag filling	LI, Pump Indication on DCS, Detector, alarms
Solid-Liquid or Liquid-Liquid separations such as filtration, layer separation having flammable and /or toxic chemicals	RD (Drager)/PLC Controls.
Chemical Spill, Toxic Release, Fire from Leakage from line / valve due to Failure of valve or joints or gaskets	All lines / valves periodically checked. Preventive maintenance of all safety devices Operators trained to arrest leakages. PPE's provided Flameproof fixtures provided wherever applicable
Chemical Spill, Toxic Release, Fire from Overpressure and failure of safety device due to Failure of part of vessel or jacket	DCS/PLC controlled operations Auto temp control cooling in limpet coil, Auto flow control, N2 blanketing –wherever required Operators trained for the process and SOPs in place. Preventive maintenance of all safety devices PPE provided to Workers. Flameproof fittings are provided wherever applicable
Chemical Spill, Toxic Release, Fire from Spillage from drums / bags due to Manual error, rupture	Operators trained to handle Drums and Bags. PPE's provided to Operators

7.8 OTHER HAZARDS & CONTROL

Sr. No	Name of possible Hazards /emergency	Its sources & reasons	Its effects on persons, property and environment	Place of Effect	Control measures provided
1	Mechanical Hazards	Rotating Equipments viz. Agitator drives, pumps – accidental entanglement of clothes or body touch, electrical shock Hand Tools and portable power tools – hit or fall on body part due to mis-operation or sudden startup or manual error, electrical shock	Damage to person	Production area, warehouse, utility	Guards are provided on all rotating equipment. The hand tools shall be kept at specified location so that they are easily available when required. Proper earthing is provided to all electrical equipment and checked regularly. Operators are skilled and experienced. Scaffolding and fall protection for working at height, Periodic inspection of lifting tools and tackles, inspection of pressure vessels, SOPs, Work permit system, HSE guidelines in place and regularly refreshed by HSE trainings
2	Steam & Electricity	Sparks, Electrical shocks	Damage to property and person	Production area as well as MCC Room	Flameproof fittings, proper earthing, covered cable trays, lightening arrestor provided, PPE utilized while working. Electrical shock proof gloves and shoes provided, Electrification as per zone classification, Electrical work permit

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Sr. No	Name of possible Hazards /emergency	Its sources & reasons	Its effects on persons, property and environment	Place of Effect	Control measures provided
					system in place
3	Structural failure	Corrosion, excessive vibration, landsliding	Damage to property and person	Any Part of the plant	Building design / Structural design as per relevant codes and standards. Building stability certificate available.
4	Road / Transportation Hazard	Hit of the vehicle or trolley	Loss of property and person	Adjacent roads and adjacent areas	Restricted vehicular movement, designated parking areas, Operator training on safe transportation Material transporter are educated for materials to be transported.
5	Lightening Hazard	Natural	Loss of property and person	Whole factory	Lightening Arrestor installed
6	Cyclone, Flood, Earthquake	Natural	Loss of property and person	Whole factory	Disaster Management Panoli GIDC estate falls in the Seismic Zone III. Since the estate is located at sufficient height from sea, there are no instances of Tsunami in the recorded past. The project area is sufficiently away from major river - Narmada river, since the site is at an elevation of ~ 26 m from the MSL. Storm water drainage network is in place and also the floods or abnormally high precipitation may obstruct block the internal roads and NH-48 only for a short period owing to the good drainage.
7	Toxic Release or fire or explosion effects from outside	Fire, Explosion or toxic release from Surrounding industries	Loss of property and person	Whole factory	taken care by GIDC fire station, mutual aid and District authorities. Emergency control services from DPMC are also available in Panoli GIDC

7.8.1 Sensitive locations around the project

The salient features given in chapter 2 of this report were studied to select the sensitive receptors w.r.t risk for fire, explosion and toxic release.

Table 7-2 Sensitive locations around the project

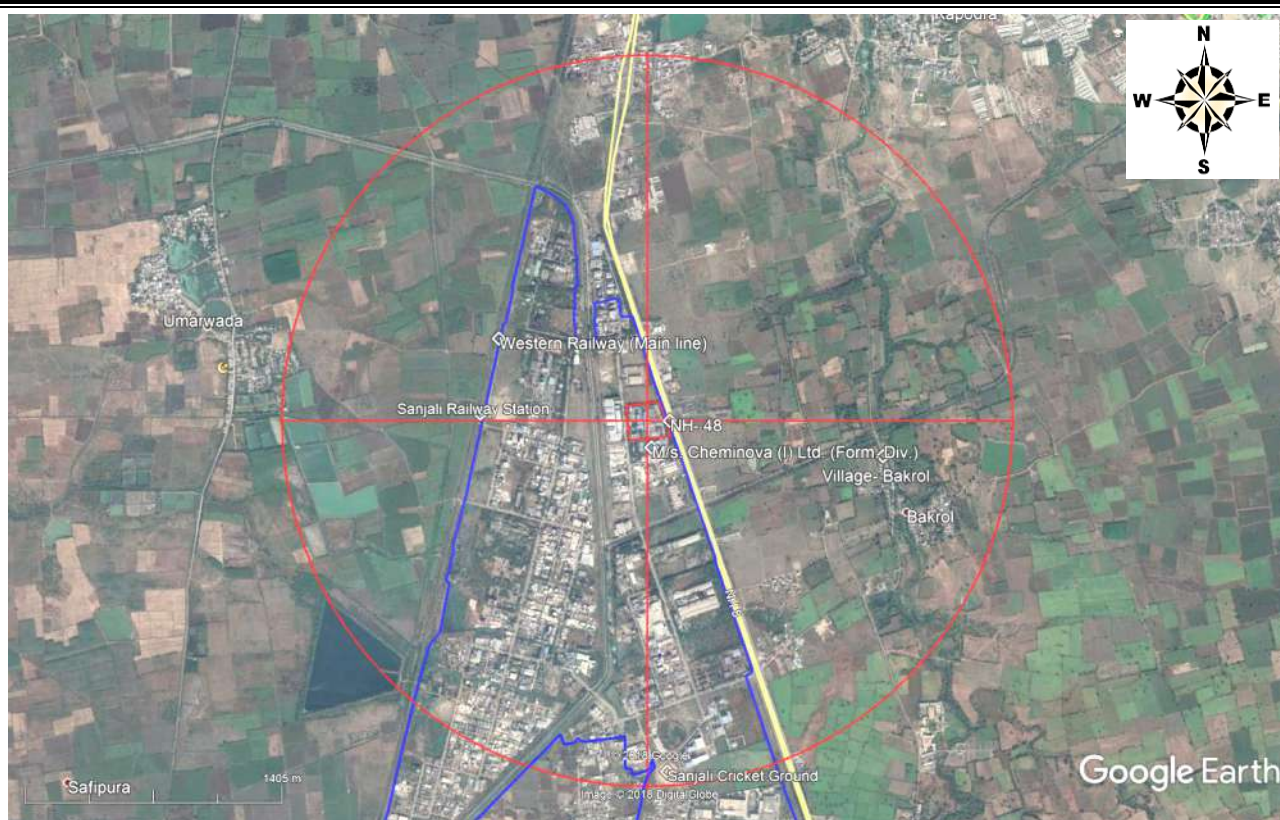
Sr. No.	Name of the village	Approx. Aerial Dist. From centre of project#, km	Direction w.r.t centre of project	Type of Area	Upwind or downwind w.r.t predominant wind direction (SW-NE)
1.	Bakrol Village	1.29	98.71° E	Residential	Crosswind
2.	Sanjali(CT)	1.7	183.88° S	Residential-Industrial	Upwind
3.	Western railway line in SW quarter	0.87	285.70° NWW	Railway line	Crosswind
4.	Residential Area near GIDC North	1.09	355.51° N	Residential-Industrial	Crosswind

#Co-ordinates of Centre of Project Site: Latitude: 21°34'30.39"N, Longitude: 72°59'50.39"E

Google Imagery of site and surrounding features upto 2 km radial distance from site

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Date of imagery : 26/11/2017



7.9 PROPOSED RISK REDUCTION MEASURES FOR THE PROJECT

Proponent is committed to provide inbuilt safety measures with modern & adequate facilities to all new plant sections as already provided to existing plant to reduce the risks involved and control hazards effectively.

The Safety department regularly carries out HAZOP studies, third-party safety audits, internal safety reviews to enhance the level of safety.

7.9.1 Inbuilt Safety at design, construction & commissioning stages

Plant Layout – design, engineering and construction

Existing plant is built as per engineering codes & standards such as ASME, applicable Indian standards (IS) and in compliance with the requirements of Factories Act, 1948. Proponent is committed to build the new plant sections with full compliance w.r.t safety of plant and personnel.

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- All equipment and vessels shall be designed for their desired operating parameters with proper selection of Material of construction, sealing arrangements, properly designed piping and pipe fittings.
- PSVs and TSVs on reactors, gas detectors at required locations.
- Piping layout, electrical layout, utility layout etc. shall be prepared as per standard guidelines to ensure intrinsic safety and ergonomics.
- Dyking, curbing, drains, containments and such other aspects of plant layout shall be incorporated in the expansion project.
- Civil foundations and structural work shall take into account protective measures for earthquakes, cyclones, landslides, flooding etc.
- A well-planned and well-maintained electrical grounding system with sufficient earthing pits provided covering all areas handling flammable chemicals including storages, production areas, loading, unloading areas, warehouses etc.
- Lightning arrester installed at critical locations
- Jumpers provided on flanges to prevent static charge wherever required

Area Segregation: -

- There is area segregation for segregated Flame proof and Non Flame proof area as per Zone classification. Same shall be applied for new manufacturing and storage areas also. Flame proof fittings/Equipment will be provided in designated flame proof areas.
- Storage tanks and areas designed and constructed in compliance to the various applicable rules under Manufacture, storage & Import of Hazardous Chemicals Rules, Factories act and Gujarat Factories Rules.
- The bulk chemicals storage area kept away from the main production areas.
- Flame arrestors, water sprinklers, breather valves provided to Storage tanks as per requirement and applicable rules.

For new storages

Proposed Additional tanks for Ethanol and Heptane in the same Explosive tank farm and PESO licence shall be amended accordingly.

New tanks shall be installed in existing non-explosive tankfarm.

Chlorine Storage Area:

- Chlorine tonners shall be stored separately and isolated area in compliance with requirement of Gas Cylinder Rules, 2004 and its amendment thereafter. Intermediate division of Cheminova India Ltd. has adequate experience of handling chlorine in compliance with applicable rules and same shall be followed in technical division also.
- Chlorine kit, FRP hood, SBA set, etc. shall be provided
- Personnel Protective Equipment shall be issued to workers & operatives.
- Displayment of notice for filled and empty Tonners.
- Water shower with eye-washer shall be provided.
- Chlorine shall be supplied through header and connector.

For Hydrogen and HCL gas cylinders, separate area has been assigned and marked in siteplan, which shall be constructed in accordance with applicable rules.

For Hydrogen cylinder storage, necessary licence from PESO shall be obtained if applicable.

PLC / DCS Control System and Emergency Shutdown System

- The new plant sections shall be automated to be best possible extent and controlled through DCS system. Where DCS is not feasible, PLC controls shall be employed as per requirement of process.
- Necessary instrumentation shall be provided on vessels and tanks for indication and control.
- Indicators, high and low alarms, NRVs, controllers shall be provided for pressure, temperature, level wherever required.
- The operators shall be provided with definite instructions in the form of Do's and Don'ts and Standard Operating procedures (SOPs) for the action to be taken on equipment or process malfunction.
 - Interlocks shall also be provided if found necessary

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7.9.2 Operational Safety

Systems and procedures

- Safe operating procedures are developed for handling of hazardous chemicals and for critical process operations such as loading and unloading tankers, drum charging, drum movement, vessel opening or drum opening, work permit systems. Safety measures to be taken by Transport agency including Emergency action and TREM card are also developed. Tanker drivers are trained in DPMC.
- Preventive maintenance schedule for all critical equipment and vessels planned and followed. Do's and don'ts for maintenance of critical equipment and machinery prepared and instructed to operators.
- Work Permit system implemented for hot work in Plant / Storage area, Vessel Entry Permit, Working at Height, Opening of the Process lines.
- All the equipment and pipelines marked for identification
- All the safety devices and instruments like safety valves, tested, inspected and recalibrated as per safety norms.
- Fire hydrant system, Fire extinguishers, fire alarms, detectors examined periodically and preventive maintenance to be undertaken.
- Hydraulic testing of pressure vessels and tanks done through Government approved Competent Person. (As per rule).
- Match boxes, Cigarettes, Mobile, any petroleum product prohibited. Visitors required depositing such items at security gate.
- The organization has developed an on-site emergency plan to handle emergencies and accidents and upgrades it periodically.
- Head count of all employees inside the Plant premises maintained by the Duty Security Head in a register on the Gate. Similarly, head count of all contract workers maintained.
- Accident records maintained and top management at headquarters appraised
- Periodical medical checkup of employees done & health records kept

Employee awareness and training

- Appropriate PPE provided to workers w.r.t type of operation and material handled.
- Training programs are conducted for employees for SOPs and safety as per yearly plan.
- All employees covered under Group Insurance Policy along with personal accident cover
- To check preparedness of workers for emergency control, mock drills on regular basis and disaster drills as per factory inspectorate guidelines to be conducted.
- Fire fighting team with adequate firefighters in each team and having proper training
- Trained first aid team

Fire Fighting Arrangements :

(Source : Onsite plan of Cheminova India Ltd. Technical Division – EHSQMSM/ESH/ER/01, ISSUE NO.01 Rev 04, Effective Date: 1ST March 2017)

Fire Water Network:

The fire hydrant system covers plants buildings, finished product tanks, utility room and storage tank area under occupation. Fire hydrant system shall be augmented to cover new plant section. Necessary network components shall be provided.

1.	a.	Water reserved for fire hydrant system	: 354 m3
	b.	Provisions are given for using raw water in Fire Hydrant System	: 518 m3
2.	Fire Hydrant Pumps:		
	a.	Diesel Pump 1	: 1 No
	b.	Jockey pump	: 1 No
	c.	Main pump 2 (125HP)	: 1 No
2.	Fire hydrant pump capacity:		
	a.	Diesel Pump	: 273 m 3 /Hr
	b.	Jockey pump	: 10.8 m 3 /Hr
	c.	Main pump 2 (125HP)	: 273 m3 /Hr

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- | | | |
|----------------------------|--------------------------|-----------|
| 3. Fire hydrant points: | a. Single hydrant points | : 16 Nos. |
| | b. Double hydrant points | : 04 Nos. |
| | c. Riser hydrant points | : 25 Nos. |
| | d. Monitors | : 07 nos. |
| 4. Fire hydrant hose boxes | | : 37 Nos. |

Fire Extinguishers:

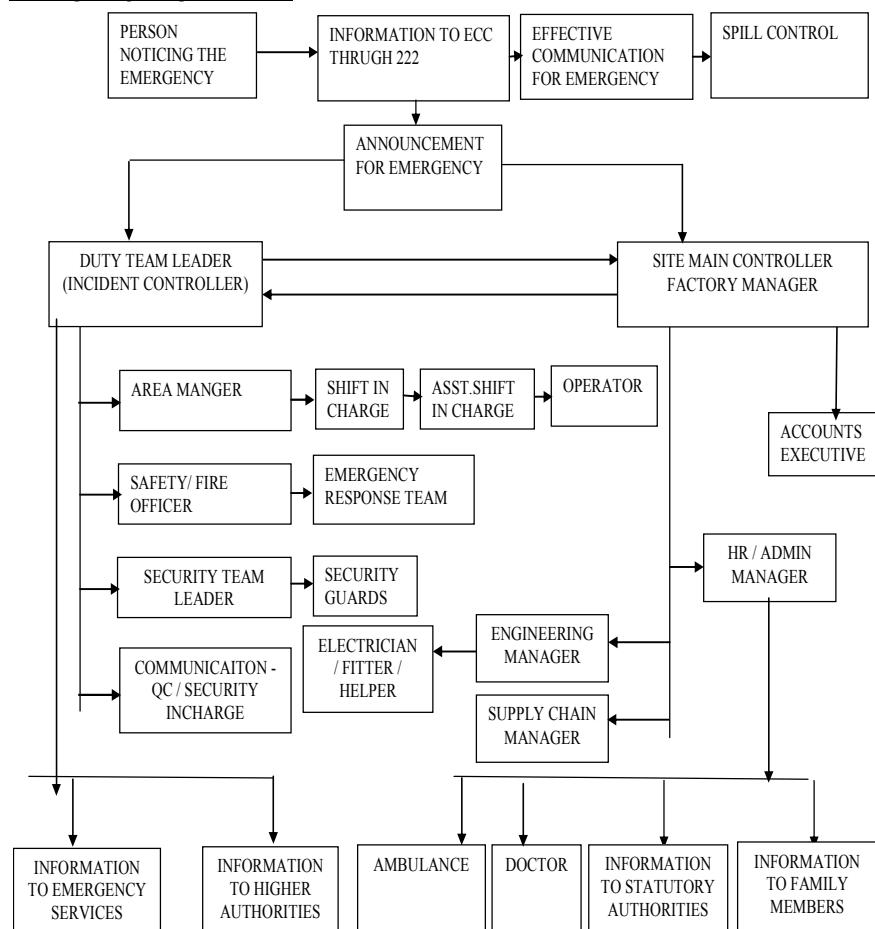
ABC type		DCP Type		Clean agent Type		CO ₂ Type		Mechanical Foam type	
Cap.	Total No.	Cap.	Total No.	Cap.	Total No.	Cap.	Total No.	Cap.	Total No.
2 kg	5	4 kg	44	2 kg	3	2 kg	3	9 lit	1
		5 kg	27					45 lit	3
		6 kg	39			4.5 kgs.	103	50 lit	1
		9 kg	10			9 kg	6		
		25 kg	1						
		75 kg	1					Foam trolley 100 LTR	2

After proposed expansion, new areas where fire hazards are present shall be provided with fire extinguishers of suitable type and size at all required locations and floors.

No. of water sprinklers or monitors (Connected to FWHS and also to Overhead tank)

1. On Class A Solvent sprinkler
2. On NH3 storagetanks- 2 sets
3. On unloading Tanker (1set)

Emergency Organization



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Emergency Communication system :

Intercoms : All the plants/departments are provided with internal phones and external phones are provided at the security gate and the administration building.

All plant offices, electrical substations (MCCs), Maintenance Dept, Instrumentation Dept., Civil and all emergency service departments (like Electrical Dept., Utility Dept.) are connected with internal telephone network which act as an easy and immediate means of communication.

Runners : Plant helpers, operator, contract helpers etc. while working in and around plants can easily notice any abnormal event that might occur. He shall immediately communicate about the same to the security officer at security gate. Security officer will blow siren.

External lines and messages : Emergency communication with local bodies and other organizations are made by phones or by sending messengers.

Hot line is provided to Intermediate Division (Cheminova).

All senior managers have been provided with external telephone connection in their office as well as at their residence.

S.NO	Type Of Communication	Person Responsible	Remarks
01	Internal Communication	QC officer	List of all intercom Phone Nos. Available with Security, DCS Ope. & Q.C. Chemist
02.	Neighboring factories and public in vicinity	QC officer	List of all Related Phone Nos. Available with Security
03.	Key personnel	QC officer	List of all Related Phone Nos. Available at Security office
04.	Outside emergency services or authorities	QC officer only after authorization from DTL (site main controller)	List of all Related Phone Nos. Available at Security office

Siren

There is one siren installed above the security building which can be operated from the switch located in the security building.

Declaring emergency using siren :-

- *Wailing to declare emergency (at the interval of 10 seconds on and 5 seconds off for 1 minute)*

Declaring all clear using siren :-

- *Continuous (one minute)*

Testing of siren : every day at 09.00 am.

Manual call points : Suitable manual call points for fire alarm system are also installed.

List Of Manual Call Point And Alarm	
Tag No	Location
MCP-1	PCC
MCP-2	Utility Operator
MCP-3	ETP
MCP-4	Q.C/R&D
Sounder-1	PCC
Sounder-2	Utility Operator
Sounder-3	ETP
Sounder-4	Q.C/R&D

Additional manual call points for fire alarm system shall be installed at new areas.

Public Address System : A public address system controlled security office is provided to warn of abnormal situations throughout the plant for taking quick and corrective action. For the proposed expansion, additional audio alarms with trip system shall be provided for alerting the plant personnel in case of any leakage.

The operators and supervisor are continuously taking rounds of the plant and monitoring the process parameters through local monitoring instruments provided in the field.

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Plant security personnel are present on all gates of premises and strategic location for the security of the plant. Any person or employee or contractor personnel are not allowed without proper purpose / gate pass.
CCTV cameras shall be installed in future for monitoring the site 24x7.

Detectors & alarms

Detectors shall be placed for Chlorine and Hydrogen at their respective storage and handling areas.

Smoke detectors are installed at following locations, additional detectors shall be placed wherever required.

Sr. No.	Detector No	Location	Zone	Detectors TYPE
1	SD-1	Over COP-3	Zone-3	Smoke detector
2	SD-2	Over CPP Outgoing panel	Zone-3	Smoke detector
3	SD-3	Over COP-1	Zone-3	Smoke detector
4	SD-4	over APFC panel	Zone-3	Smoke detector
5	SD-5	Over GEB Evacuation panel	Zone-3	Smoke detector
6	SD-6	Over PCC-1 GEB breaker	Zone-3	Smoke detector
7	SD-7	Over PCC-1 CPP Breaker	Zone-3	Smoke detector
8	SD-8	Over PCC-2	Zone-3	Smoke detector
9	SD-9	Over CPP Aux panel	Zone-3	Smoke detector
10	SD-10	Over MCC-9	Zone-3	Smoke detector
11	SD-11	Over MCC-2 & 7	Zone-2	Smoke detector
12	SD-12	Over Fire Room	Zone-2	Smoke detector
13	SD-13	Over MCC 8 left side	Zone-2	Smoke detector
14	SD-14	Over MCC 8 Right side	Zone-2	Smoke detector
15	SD-15	Over MCC 1	Zone-2	Smoke detector
16	SD-16	Over MCC 12/13	Zone-2	Smoke detector
17	SD-17	Over MCC 11	Zone-2	Smoke detector
18	SD-18	Over MCC 10	Zone-2	Smoke detector
19	SD-19	Over MCC 5	Zone-2	Smoke detector
20	SD-20	Over MCC-6	Zone-2	Smoke detector
21	SD-21	Q.C sample room	Zone-1	Smoke detector
22	SD-22	MCC-12A (Q.C/R&D)	Zone-1	Smoke detector
23	SD-23	IT room	Zone-1	Smoke detector
24	SD-24	In R/M Store	Zone-1	U/V Detector
25	SD-25	In R/M Store	Zone-1	U/V Detector
26	SD-26	In R/M Store	Zone-1	U/V Detector
27	SD-27	In R/M Store	Zone-1	U/V Detector
28	SD-28	In R/M Store	Zone-1	U/V Detector
29	SD-29	In R/M Store	Zone-1	U/V Detector
30	SD-30	Over MCC-3	Zone-1	Smoke detector
31	SD-31	Over MCC-3A	Zone-1	Smoke detector
32	SD-32	Over MCC-4	Zone-1	Smoke detector

A smoke detector is a sensing device, which senses the products of combustion (smoke).

U/V detectors work by detecting the UV radiation emitted at the instant of ignition. While capable of detecting fires and explosions within 3–4 milliseconds.

Wind direction indicators (Wind flags) : installed at :-

- Top of Azoxy Plant
- Top of Acephate Plant
- ETP Plant
- R&D Building
- Elec. Work shop building

Lightning arrestors are installed at :

- Boiler chimney
- Power plant chimney
- Azoxy/DMA plant overhead tank
- Incenerator chimney

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Emergency Control Centre (ECC)

Location of the Center : Security Office at Main gate

ECC is equipped with following items :-

Adequate number of external telephones with latest telephone directly.

Adequate number of internal telephones.

List of telephone numbers of DTL (Site Main Controller) and key personnel.

Plans of the factory to show :

Location of hazardous areas and plants.

Stock of fire extinguishing materials.

The fire hydrant system and sources of water.

Site entrances and road approach system.

Assembly points, lunch room and canteen.

First aid treatment center and location of the availability of the emergency vehicles.

Parking area and visitors room.

Location of the factory in relation of the surrounding area.

Copies of this Onsite and Offsite emergency plan.

Tri cycle with loaded emergency handling equipment

Respiratory and non-respiratory PPE Including SCBA, full suit

Spare inventory is kept for above.

Non respiratory Personal Protective equipments

Sr. No.	Items	Sub - Items
1	Hand Cloves	Unsupported (Rubber Hand Cloves)
		PVC supported Hand Gloves
		Nitrile Hand Gloves
		Electrical Hand Gloves
2	Helmet	Yellow Helmet
		Red Helmet
		White Helmet
		Green Helmet
3	Goggles	Close Poly Carbonate Goggles (MSA GIV-2000)
		"Punk" Type Goggles
		Rubber Air Tight Goggles
		Eye Wash Bottle
		Face Shield
4	Mask	Cotton Nose Mask / Dust Mask
		Air Bubble Hood
		Venus – Half Face Mask
5	Ear Protection	Ear Muff
		Ear Plug
6	Suit/Apron	PVC Suit with Coat & Paint
		PVC Apron
		Fire Suit for Phosphorous handling
7	Gum Boot	Gum Boot No. 7
		Safety Belt
		Monkey Ladder
		Wind Indicator Shocks
8	Accessories	Eye Wash Fountain / Nozzle
		Receptor Bowl
		Shower Head

Safe Assembly Points :-

S.N	Location of Assembly point	Accommodation capacity
1	Near Main Gate	@250
2	Near ETP	@250

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First Aid Boxes

First aid boxes have been provided at Security gate, Engg. Dept. plantwise office, Boiler house, ETP and QC lab which are regularly inspected and maintained by the OHC Officers.

First-aid boxes shall be provided at new plant sections also.

Selected employees from each department are trained for first-aid course to be available in all shifts and additional employees of new plant sections shall also be given training. All firstaiders are given refresher training once in a year.

List of trained first aiders is kept in ECC, OHC and onsite emergency plan.

External aid arrangements

Agency	Distance from site	Mutual aid for -
GIDC Fire station -Panoli	5 km	Water tender, foam tender
GIDC Fire station -Ankleshwar	~10 km	Water tender, foam tender
Disaster Prevention and Management Centre - Ankleshwar	~10 km	Foam tender, Water tender, PPE, Neutralizing agent – Soda Ash and Lime
Hikal Limited, Panoli	~1 km	Fire extinguisher, Foam compound, Ambulance, Water tender, PPE, Neutralizing agent – Soda Ash and Lime
IASGRO asia Pvt Ltd, Panoli	~1 km	Fire extinguisher, Foam compound, Amulance, Water tender, PPE, Neutralizing agent – Soda Ash and Lime
PI Industries Ltd, Panoli	~1 km	Fire extinguisher, Foam compound, Amulance, Water tender, PPE, Neutralizing agent – Soda Ash and Lime

External hospitals and medical officers engaged for medical checkup and emergency treatment

Proponent has made arrangement with Smt Jayaben Modi Hospital located in GIDC estate Ankleshwar approx. 4.5 km from the factory and Welcare hospital, Kharod approx. 3 km from the factory for medical treatment. Hospitals are well within the reach of factory.

Unit has own ambulance for emergency transport manned with driver at all times at site for Emergency transport. Ambulance facilities are available from 108 as well as from nearby LSI units.

Site is member of DPMC for emergency aid and also has mutual aid agreement with neighbouring industries. Copy of mutual aid is annexed as Annexure-30 and DPMC membership is attached as Annexure-31.

Trained Emergency Response Personnel : available in all shifts + general shift (~30 nos. presently)

Trained for :- Fire Fighting / Rescue / SCBA/ First Aid/ Toxic spill control – external as well as internal. Refresher training is a continuous process. Training shall be given to selected workers for using the chlorine emergency kit, SCBA and scrubber hood. Adequate fire fighting personnel shall be made available at new plant sections also.

Trained First-aiders : It is generally organized that any one first aider is available in any shift. Approx. 20 firstaiders are presently trained. Refresher training is a continuous process. Adequate First-aiders shall be made available at new plant sections also.

Training and Rehearsal for Emergency Management

The company is organizing mockdrills in quarterly basis to keep the system in readiness. Mockdrills after proposed expansion shall include chlorine and hydrogen handling.

Further suggestions from EIA consultant

- Emergency power for all critical drives / instruments
- Intelligent / Fuse less MCC for entire site
- Civil foundations and structural work shall take into account protective measures for earthquakes, cyclones, landslides, flooding etc.
- Seamless pipelines to be used wherever necessary.

Occupational Health Centre

An Occupational Health Centre (OHC) in compliance with statutory requirement is developed by the factory management adjacent to Main gate, easily approachable from all directions and having direct access to GIDC road.

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Male Nurse is available in each shift. It includes consulting room with necessary accessories for Factory Medical Officer, nursing station, two bedded observation cum treatment room cum record room with oxygenation and other resuscitation facilities, medicines & antidotes, dressing & dispensing cum record room, toilet block, computer – printer, O₂ -Portable analyzer system, pulse – oxymeter, ophthalmic charts, eye washer, First-Aid boxes– stretchers. OHC has intercom with zero dial facility. The contact number of all nearby hospitals and medical facilities shall be kept and put up on a board in the center. There is adequate space available for testing

Antidotes for major chemicals handled by the unit are identified and list is attached as Annexure-20. They are provided at the centre.

Visiting CIH doctor is appointed as Factory Medical Officer (FMO) who visits the unit daily (half day) - to attend routine work related / non related complaints. FMO is responsible for carrying out pre as well as periodical medical examination. The doctor is also accessible for speedy contact and consultation

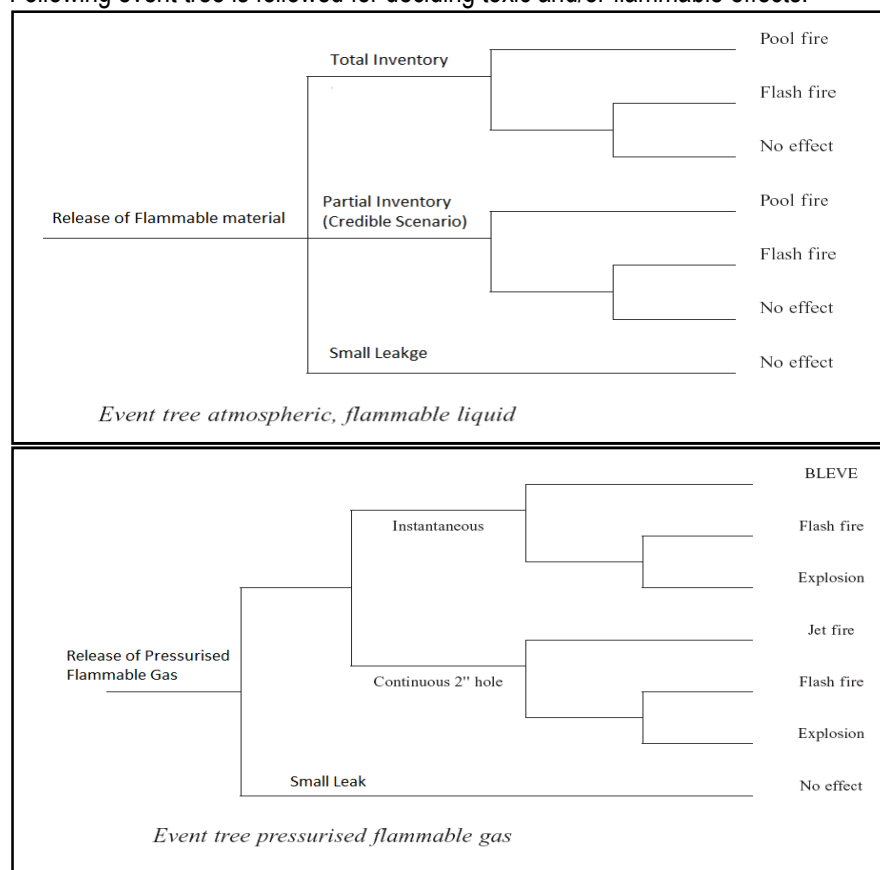
7.10 VISUALIZATION OF ACCIDENT SCENARIOS

- One scenario considered for all is 'Catastrophic Failure', which is the worst case (WC) and frequency of which is very rare in the lifetime of the plant.
- Major hazards posed by hazardous chemical storages can be assessed using MCA (Maximum Credible Accident) analysis. Hence most credible accident scenarios (MCA) are also considered primarily leaks from tanks, vessels or pipelines, drum damage in drum storage area.
Leak in the vessel or leak from the flange joints of these connections is possible. The leak through flange failure is considered from 50% of flange perimeter and accordingly equivalent area is calculated. This area is approximated to hole of 10mm or 10% of pipe diameter. The small bore pipes less than 2" is considered full bore leak.

For our analysis we consider leak from pipeline which are at pump discharge, hence it shall be pressurized and feeding to reactor or storage.

7.10.1 Selection of Initiating Events and Scenarios

Following event tree is followed for deciding toxic and/or flammable effects:



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Based on the inventory of hazardous chemicals and their hazardous properties, following accident scenarios have been visualized for the given project.

Table 7-3 Worst Case (WCS) and Most Credible Accident (MCS) Scenarios selected for the study

Sr. No.	Hazardous Chemical Name	Storage Parameters		Equipment Considered	Scenario Selected	Type Of Scenario	Flammable/ Toxic
		Temp (°C)	Pressure (kg/cm ²)				
1	Hydrogen	Amb	150	Cylinder	MCS	Leak through 10 mm hole in tubing	Flammable
2	Chlorine	Amb	Atm	Tonner	MCS	Tonner damage	Toxic
3	Phenyl Hydrazine	Amb	Atm	Drum	MCS	Drum Failure	Toxic
4	55% Hydrazine	Amb	Atm	Drum	MCS	Drum Failure	Toxic
5	Triethyl amine	Amb	Atm	Drum	MCS	Drum Failure	Toxic
6	HCl 30%	Amb	Atm	Tank	MCS	Leak in pipeline after pump discharge during transfer	Toxic
7	Acetic Acid	Amb	Atm	Tank	MCS	Leak in pipeline after pump discharge during transfer	Flammable
8	Furnace Oil	Amb	Atm	Tank	WCS	Catastrophic Failure	Flammable
9	Toluene	Amb	Atm	Tank	WCS	Catastrophic Failure	Flammable
10	HSD	Amb	Atm	Tank	WCS	Catastrophic Failure	Flammable
11	Acetone	Amb	Atm	Tank	WCS	Catastrophic Failure	Flammable
12	HCl gas	Amb	Atm	Cylinder	WCS	Catastrophic Failure	Toxic
13	Heptane	Amb	Atm	tank	WCS	Catastrophic Failure	Flammable

WCS : Worst Case Scenario

MCS : Most Credible Scenario

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7.11 CONSEQUENCE ANALYSIS

Hazardous substance on release can cause damage on a large scale in the environment. The extent of damage is dependent upon the nature of the release and the physical state of the material. It is necessary to visualize the consequences and the damages caused by such releases. The quantification of the damage can be done by means of various models, which can further be related in terms of injuries and damage to exposed population and buildings.

Software used for consequence analysis for proposed expansion project: ALOHA (AREAL LOCATIONS OF HAZARDOUS ATMOSPHERES)

Is part of the CAMEO suite developed by US Environmental Protection Agency (EPA), ALOHA® is an atmospheric dispersion model used for evaluating releases of hazardous chemical vapors, including toxic gas clouds, fires, and explosions. Using input about the release ALOHA generates a threat zone estimate. A threat zone is the area where a hazard (such as toxicity, flammability, thermal radiation, or damaging overpressure) is predicted to exceed a user-specified level of concern. Threat zones can also be plotted on maps with MARPLOT to display the location of facilities storing hazardous materials and vulnerable locations (such as hospitals and schools). Specific information about these locations can be extracted from CAMEO information modules to help make decisions about the degree of hazard posed.

In order to assess the damage, the damage criteria have to be first defined.

There are three principle types of exposures to hazardous effects

Heat radiation from a jet, pool fire, a flash fire or a BLEVE

Explosion,

Toxic effects, from toxic materials or toxic combustion products

A basis for the weather conditions (Temperature, wind speed etc.) is chosen for input in these models.

7.11.1 Frequencies Estimation:

No	Item	Mode Of Failure	Failure Frequency
1	Atmospheric Storage Tanks	Catastrophic Failure	10E-9 /yr
		Significant Leak	10E-5 /yr
2	Process Pipelines		
	<=50mm Dia	Full Bore rupture	8.8 x 10E-7 /yr
		Significant Leak	8.8 x 10E-6 /yr
	>50mm<=150mm Dia	Full Bore rupture	2.6 x 10E-7 /yr
		Significant Leak	5.3 x 10E-6 /yr
	<150mm Dia	Full Bore rupture	8.8 x 10E-7 /yr
		Significant Leak	2.6 x 10E-6 /yr
3	Hoses	Rupture	3.5 x 10E-2 /yr
4	Pressure Vessel	Catastrophic Failure	3 x 10E-6 /yr
		Significant Leak(6" nozzle)	7 x 10E-6 /yr
5	Liquid Line	Pipeline Leak	3 x 10E-7 /yr
		Fittings Leak	5 x 10E-6 /yr
6	vapor line	Leak	3 x 10E-6 /yr
7	6" Pipe	Leak (1 kg/s)	6x 10E-6 /yr
8	3" Pipe	Leak (1 kg/s)	6 x 10E-5 /yr
9	Flange	Leak (1 kg/s)	3 x 10E-4 /yr
10	Pump Seal	Leak (1 kg/s)	5 x 10E-3 /yr

For warehouse where the drums of chemicals are stored and handled the frequencies are as follows,

No	Item	Mode Of Failure	Failure Frequency
1	storage of substances in warehouses with protection levels 1 and 2	Liquid Spill	1 x 10E-5 Per handling
		Fire	8.8 x 10E-4 / yr
2	storage of substances in warehouses with protection level 3	Liquid Spill	1 x 10E-5 Per handling
		Fire	1.8 x 10E-4 / yr

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Table 7-4 Failure History data

SN	Item	International Data	Indian Data
1	Process Controller	2.4 x 10 ⁻⁵ hr ⁻¹	3.0 x 10 ⁻⁵ hr ⁻¹
2	Process Controller Valve	2 x 10 ⁻⁶ hr ⁻¹	2.4 x 10 ⁻⁵ hr ⁻¹
3	Alarm	2.3 x 10 ⁻⁵ hr ⁻¹	4.6 x 10 ⁻⁵ hr ⁻¹
4	Leakage at biggest storage tank	5 x 10 ⁻⁵ yr ⁻¹	3.0 x 10 ⁻⁵ yr ⁻¹
5	Leakage pipe line	1 x 10 ⁻⁷ m-1yr ⁻¹	3.0 x 10 ⁻⁸ m-1yr ⁻¹
6	Human failure	1 x 10 ⁻⁴ (demand)-1	1.8 x 10 ⁻³ (demand)-1

Table 7-5 Assumed failure rate for the study

SN	Item	Rupture (yr-1)	Leakage (yr-1)
1	Pipe lines <3" 3"-15" >15"	10-6 10-7 --	10-5 10-6 10-8
2	Vessel - pressurized - Atmospheric	5 x 10 ⁻⁶ 1 x 10 ⁻⁵	5 x 10 ⁻⁵ 1 x 10 ⁻⁴
3	vapor line	--	3 x 10 ⁻⁶ /yr
	storage of substances in warehouse - Liquid spill	1 x 10 ⁻⁵ per handling	1 x 10 ⁻⁵ per handling

Table 7-6 Damage Due To Incident Radiation Intensity

Incident Radiation Intensity (kJ/m ² s)	Type of Damage
62.0	Spontaneous ignition of wood
37.5	Sufficient to cause damage to process equipment
25	Minimum energy required for ignite wood at infinitely long exposure (non piloted)
12.5	Minimum energy required of piloted ignition of wood, melting plastic tubing etc.
4.5	Sufficient to cause pain to personnel is unable to reach cover within 20 sec.; however blistering of skin (1st degree burns) is likely
1.6	Will cause no discomfort on long exposure

Table 7-7 Physiological Effects Of Threshold Thermal Doses

Dose Threshold (kJ/m ²)	Physiological Effect
375	Third Degree Burns
250	Second Degree Burns
125	First Degree Burns
65	Threshold of pain, no reddening or blistering of skin caused
1st Degree Burns	Involve only epidermis, blister may occur
2nd Degree Burns	Involve whole of the epidermis over the area of burns plus some portion of dermis
3rd Degree Burns	Involve whole of epidermis and dermis. Subcutaneous tissues may also be damaged

Table 7-8 Heat Radiation & Escape Time

Radiation Intensity BTU/hr/ft ²	Time to Pain Threshold (Seconds)
440 (1.39 kW/m ²)	60
550 (1.6 kW/m ²)	40
740 (2.33 kW/m ²)	30
920 (2.9 kW/m ²)	16
1500 (4.7 kW/m ²)	9
2200 (6.93 kW/m ²)	6
3000 (9.5 kW/m ²)	5
3700 (11.66 kW/m ²)	4
6300 (19.9 kW/m ²)	2

Table 7-9 Tolerable Over Pressure Limits For Various Objects

Incident Over Pressure (Bar)	Incident Over Pressure (psi)	Object
0.02	0.29	Schools
0.04	0.59	Domestic Housing

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Incident Over Pressure (Bar)	Incident Over Pressure (psi)	Object
0.05	0.74	Public Roads
0.07	1.03	Ordinary Plant Buildings
0.10	1.47	Buildings with shatter-resistant windows fixed roof tanks containing highly flammable or toxic materials
0.20	2.94	Floating roof tanks, other fixed roof tanks, cooling towers, utility areas site roads
0.40	5.88	Other hazardous plants
0.70	10.29	Non-hazardous (if occupied) plants. Control room designed for blast resistance.

7.11.2 Assumptions Common for all Scenarios

		Maximum	Minimum
Temperature	Deg.C	45	11
Wind speed	m/s	5.55	1
Average Wind speed	m/s	2-5	
Wind Direction	From	South West	
Humidity	%	70	
Ground Roughness		Urban or Forest	
Cloud Cover	%	50	

- Atmospheric stability class D and F are considered for analysis. The stability classes are selected based on the temperature & wind velocity. The software prompts most suitable stability class based on temperature & wind velocity. For project atmospheric temperature & wind velocities the software prompted stability classes D & F are selected for analysis.
- Stability class D & wind velocity 5.55 m/s represents most turbulent atmosphere at site which is ideal to analyse effects within or nearby plant area. Stability class F and wind velocity 1 m/s represents most stable atmosphere at the site which is ideal to analyse effects at far distances.
- For any particular case if other stability class is chosen, it is included in its detail analysis.
- At respective class atmospheric temperatures, if flash point is higher and chemical may not ignite. But to assess the radiation effect at such situations, the radiation effect is calculated assuming burning is started due to other ignition source.
- For chemicals having flash point more than 45 degC, the effect is analysed only for class D.
- For all toxic material release LC50 are taken as the toxic end points. If LC50 is not available then LD50 values are considered
- For thermal radiation the distances for radiation level 37.5 kw/m², 4kw/m² and 1.6kw/m² are calculated.
- For vapor cloud explosion the distance for overpressure of 0.5 psi is calculated.
- For gas services the flow through leak is calculated in ALOHA by modelling leak through pipe with closed off (i.e. isolated portion). But this will give the rate which will be present only after isolation. The decreasing pressure inside pipe will affect the discharge rate. The rate of discharge before isolation will be at constant pressure and hence will be more than the rate calculated by ALOHA.
- Specific assumptions are mentioned in the detailed description of each scenario in following sections. The threat zones are superimposed on google earth imagery of the site plan for each scenario and presented herewith and ALOHA text summary output is annexed as Annexure 12.

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7.11.3 Summarized Table for effects of Consequences**Table 7-10 Toxic End points of Consequence Analysis**

No	Hazardous Material	Equipment Considered	Scenario Selected	Material spilled or leaked	End Point	Stability Class	Endpoint Concentration	Maximum Distance m	Maximum Distance to IDLH m
1	Triethyl Amine	Drum	Drum Failure	250lit	LC50	D	7.1mg/l	<10 (Onsite)	23 (Onsite)
						F	7.1mg/l	<10 (Onsite)	19 (Onsite)
2	55% Aqueous Hydrazine	Drum	Drum Failure	250lit	LC50	D	0.75 mg/L	<10 (Onsite)	25 (Onsite)
						F	0.75 mg/L	<10 (Onsite)	12 (Onsite)
3	Phenyl Hydrazine	Drum	Drum Failure	250lit	LC50	D	2610 mg/m3	<10 (Onsite)	<10 (Onsite)
						F	Material is solid at this temperature		
4	Chlorine	Tonner	Leakage through 10 mm hole	218/129 kg	LC50 (0.5 hr)	D	500	49 (Onsite)	413 (10 ppm)
						F	500	50 (Onsite)	610 (10 ppm)
5	HCl gas	Cylinder	Leak through 10 mm hole	32 kg	LC50 (4hrs)	D	1562 ppm	61 (Onsite)	383
						F	1562 ppm	54 (Onsite)	347
6	HCl 30%	Tank	Leak through 10 mm hole in pump discharge line	1140 kg	LC50 (4hrs)	D	1562 ppm	<10 (Onsite)	56
						F	1562 ppm	<10 (Onsite)	36
7	Acetic Acid	Tank	Leak through 10 mm hole in pump discharge line	1068 kg	LC50	D	11.4 mg/L	<10 (Onsite)	38 (Onsite)
						F	Material is solid at this temperature		

Table 7-11 Flammable End points of Consequence Analysis

No	Hazardous Material	Equipment Considered	Scenario Selected	Material spilled or leaked	Stability Class	Flash Fire Envelope Diameter LOC (60% of LEL)	Explosion Overpressure Distance for 0.5psi(0.05bar)	pool/ Jet Fire	Burn Duration	Heat Irradiation m	Maximum distances,		
				kg		m	m		mins	37.5Kw/m2	4Kw/m2	1.6Kw/m2	
1	Heptane	Fixed roof vertical Tank	Catastrophic Failure	20KL	D	<10	--	Pool Fire	36	15	41	57	
					F	<10	--	Pool Fire	44	<10	35	55	
2	Furnace Oil	Fixed roof vertical Tank	Catastrophic Failure	50KL	D	<10	--	Pool Fire	<60	11	26	37	
					F	<10	--	Pool Fire	<60	<10	23	37	
3	Toluene	Fixed roof vertical Tank	Catastrophic Failure	15KL	D	<10	--	Pool Fire	<60	11	30	41	
					F	<10	--	Pool Fire	<60	<10	25	41	
4	Acetone	Fixed roof vertical Tank	Catastrophic Failure	50KL	D	<10	--	Pool Fire	<60	<10	25	34	
					F	<10	<10	Pool Fire	<60	<10	20	33	
5	HSD	Fixed roof vertical Tank	Catastrophic Failure	50KL	D	<10	--	Pool Fire	<60	14	36	50	
					F	<10	--	Pool Fire	<60	<10	32	51	

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No	Hazardous Material	Equipment Considered	Scenario Selected	Material spilled or leaked	Stability Class	Flash Fire Envelope Diameter LOC (60% of LEL)	Explosion Overpressure Distance for pool/ Jet Fire	Burn Duration	Heat Irradiation m	Maximum distances,		
				kg		m	m	mins	37.5Kw/m2	4Kw/m2	1.6Kw/m2	
6	Hydrogen	Cylinder bank	Leakage from Tubing of Cylinder (10mm Leak)	25 kg	D	--	--	Jet Fire	4	<10	<10	14
					F	--	--	Jet Fire	5	<10	<10	15
7	Acetic Acid	Fixed roof vertical Tank	Leak through 10 mm hole in pump discharge line	1068 kg	D	<10	--	Pool Fire	29	<10	<10	11
					F	Material is solid(Fr.pt) at this temperature						
8	Triethyl Amine	Drum	Drum Failure	250lit	D	<10	--	Jet Fire	3	<10	17	23
					F	<10	--	Pool Fire	4	<10	13	21

Note : 'Material Released' is the total material spilled or released from container. In case of Liquid Pool, from this released material some of the material will be evaporated and dispersed in direction of wind. This evaporated quantity will be less than total quantity depends on the properties of material spilled and atmospheric conditions.

Detailed output of aloha is attached as Annexure – 12.

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7.11.4 Inference of Consequence analysis

Explosive Storage Tank Area (HSD, Toluene, Furnace Oil, Acetone & Heptane):

- The major consequence is pool fire from failure of tanks storing flammable material. In case of catastrophic failure of tank the released liquid will be contained inside the dyke and pool is formed.
- The 37.5 kw/m² radiation distance which can cause damage to process equipment is 15m max. for Heptane and shall remain within tankfarm area.
- The 4 kw/m² radiation distance which can cause pain and blistering of skin is upto 41 m max. for Heptane which shall be around the tankfarm area.

Non-flammable toxic material storage tank (30% HCl, Acetic acid)

- For 30% HCl leak scenario, the LC50 distances will remain at less than 10m. whereas IDLH values remain within 56 m in 5D class and will only cross the tankfarm area and remain within plant.
- For Acetic acid, leak scenario is analyzed. LC50 concentration will not be experienced beyond 10 m for atmospheric class D. IDLH value shall remain within site.
- Hence, control actions have to be started speedily to contain the spilled liquid and prevent from spreading.
- As Acetic Acid is Solid at 11°C, hence scenario is not analyzed for stability class F.
- Also spilled material should be covered immediately, material required for covering should be kept handy while pumping is on.
- Eye shower and full showers should be placed near the location.

Drum Storage Area: (Triethyl Amine, 55% Aqueous Hydrazine, Phenyl Hydrazine, Heptane)

The most of the raw materials are stored and handled in 250 lits drums. The drum failure during handling is analysed as most credible scenario.

- For Toxic effect, drum failure of Triethyl Amine, 55% Aqueous Hydrazine, Phenyl Hydrazine are analysed. For all scenarios, LC50 concentration are less than 10 m and within the warehouse area
- IDLH distance shall extend to max. 25 for 55% Aq. hydrazine but will go beyond warehouse but within the site
- For flammable effect, drum failure of heptane and Triethyl Amine is analysed. The radiation of 37.5 kw/m² will be experienced at less than 10 m due to this fire. The radiation of 1.6 kw/m² will be experienced up to 25 m around the warehouse.

Cylinder storage area (Hydrogen cylinders, HCl gas cylinders & Chlorine tonners)

- Hydrogen cylinder leak shall give thermal effects due to explosion while chlorine and HCl gas cylinder leak will give toxic gas effects.
- For Hydrogen, jet fire shall result in thermal radiation effects. The radiation of 37.5 Kw/m² & 4.0 Kw/m² will be experienced up to <10m from jet source. The flame length is 1m at start. This is due to high pressure inside of the cylinder. The thermal radiation from jet fire shall not go beyond cylinder storage area.
- The Chlorine and HCl gas, LC50 values shall remain within the site whereas IDLH distances may go off site hence should be included in off-site emergency planning. However, there are no residential villages covered in these distances, the manpower within the GIDC estate might be affected

7.11.5 Risk to Individuals from a Major Release

Basis of estimation

- The risk to health to an individual at a specific point in the direction of the plume or heat radiation is dependent on a number of factors, the most important being:
 - the direction of the wind when the release takes place; and
 - mitigating factors, such as whether the individual might be indoors or out of doors.
- In the case of the wind direction, the plume width may be represented by the sector of a circle having an included angle of 15°. In such a case, on the basis that wind direction arise, it is possible to approximate that an individual present in a single location for one year may be exposed for only 15/360ths of that year, or 4 x 10⁻²
- In reality, it is unlikely that a person would be present at any one location in the open air for 100% of the year. Allowing for periods at work or indoors, a risk reduction factor of 3 is reasonably conservative. (three shift operation is considered)

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- Also the fatality % due to radiation is assumed at 50%. This assumption is based on the response time and the duration of fire in our case.
- The overall consequence of the mitigation due to wind direction and indoor/outdoor location would be the product of these three factors, namely 1.33×10^{-2} .
- The overall chance of an individual being affected at a specific location by exposure to the toxic gases would be as indicated in following table. From the table it is clear that for catastrophic failure the distance for 50% fatality is more than MCS scenarios.

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Flammable effect

No	Hazardous Chemical	Incident/Different Cases	Consequence Effect	Frequency of Occurance	No of Vessels/Reactors	Frequency of Occurance	Consequence Mitigation factor	Frequency of Occurance	Cummulative Individual Risk
			Overpressure(psig)/	per yr	(No of Probable Sources)	per yr		per yr	(Areawise)
			Radiation(kw/m2)					(Representing Individual Risk)	
1	HSD	Catastrophic Failure	Radiation (Pool Fire)	1.00E-05	1	1.00E-05	1.33E-02	1.33E-07	1.33E-07
2	Toluene	Catastrophic Failure	Radiation (Pool Fire)	1.00E-05	1	1.00E-05	1.33E-02	1.33E-07	2.66E-07
3	Furnace Oil	Catastrophic Failure	Radiation (Pool Fire)	1.00E-05	2	2.00E-05	1.33E-02	2.66E-07	5.32E-07
4	Heptane	Catastrophic Failure	Radiation (Pool Fire)	1.00E-05	1	1.00E-05	1.33E-02	1.33E-07	6.65E-07
5	Acetone	Catastrophic Failure	Radiation (Pool Fire)	1.00E-05	1	1.00E-05	1.33E-02	1.33E-07	7.98E-07
6	Hydrogen	Leakage from Tubing of Hydrogen Cylinder (10mm Leak)	Jet fire Overpressure	3.00E-06	5	1.50E-05	1.33E-02	2.00E-07	9.98E-07
7	Acetic Acid	Leak through 10 mm hole in pipeline	Radiation (Pool Fire)	1.00E-06	1	1.00E-06	1.33E-02	1.33E-08	1.01E-06

Toxic effect

No	Hazardous Chemical	Incident/Different Cases	Frequency of Occurance	No of Joints/Flanges/ Valves / Containers	Frequency of Occurance	Consequence Mitigation factor	Frequency of Occurance per yr	Cummulative Individual Risk
			per yr	(No of Probable leaks)	per yr		(Representing Individual Risk)	(Areawise)
1	Triethyl Amine	Drum Failure	1.00E-05	38	3.80E-04	1.33E-02	5.05E-06	5.05E-06
2	55% Hydrazine	Drum Failure	1.00E-05	34	3.40E-04	1.33E-02	4.52E-06	9.58E-06
3	Phenyl Hydrazine	Drum Failure	1.00E-05	26	2.60E-04	1.33E-02	3.46E-06	1.30E-05
4	Chlorine	Catastrophic Failure	5.00E-06	9	4.50E-05	1.33E-02	5.99E-07	1.36E-05
5	HCl gas	Leakage from Tubing of Hydrogen Cylinder (10mm Leak)	3.00E-06	32	9.60E-05	1.33E-02	1.28E-06	1.49E-05
6	30% HCl	Leak through 10 mm hole in pipeline	1.00E-06	1	1.00E-06	1.33E-02	1.33E-08	1.49E-05

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7.12 RECOMMENDATIONS

Flammable Tank Storage Area:

- As the tankfarm is constructed as per PESO guidelines, it has sufficient fire water network providing hydrants and monitors around Tank, reactor building/ process area.
- Suitable foam fire extinguishing system should be used for pool fire fighting. This can be semi fixed system with connections to all tanks and dykes and portable foam cans can be used along with fire water monitors around tank farm.
- Fire ring should be surrounding the tankfarm from all sides.
- The fire fighting distance should be from at distance of minimum 15m from tank dyke with fire resistant clothing.
- Fireproofing requirement of structure and equipment supports needs to be analysed and fireproofing to be provided accordingly.
- No pumps to be installed inside the dyke.
- The tanks shall be provided with breather valve with flame arrester and emergency vent.
- All transfer pumps should have double mechanical seals.
- The tanks shall be provided with breather valve with flame arrester and emergency vent.
- Emergency vehicle shall be able to move around Flammable Tanks.
- All pipeline flanges handling flammable liquids should be connected with metallic jumpers to avoid accumulation of static charge.

Non Flammable and Toxic Tank:

- Fire water network providing hydrants and monitors should be around Tank.
- No pumps to be installed inside the dyke.
- Safety shower & eye washer to be placed near Tank.
- Breather valve and emergency vent shall be provided.

Drums, Tonners and carboys Storage

- In drum storage area in warehouse, toxic and flammable materials shall be stored separately.
- The area shall be provided with small bund wall (100mm) to contain any spill.
- The warehouse shall be well ventilated.
- Fire water network providing hydrants and monitors should be around warehouse.
- Safety shower & eye washer to be placed near warehouse.
- Smoke detector and/or automatic actuated DCP extinguishers should be installed to get early warning and control of any fire incident



The list of chemicals or names of chemicals and actions in case of spill should be displayed in store area. The required neutralizers and spill kit (Soaker- adsorbers/PPEs/disposal bags) should be kept in storage area.

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- The fittings in flammable storage area should be classified fittings.
- Safety shower & eye washer to be placed near warehouse.

Chlorine Tonner Storage Area

- Chlorine gas monitors should be installed in the facility. The early detection of any leak will help to prevent any potential big incident. It also gives enough time for evacuation of the people. Chlorine gas is heavier than air so gas monitors should be mounted approximately two feet from the floor for quick and accurate detection.
- Chlorine Gas detectors to be maintained and inspected regularly for effectiveness and set alarm level.
- FRP hood, chlorine kit and neutralizing agent should be placed in ready-to-use condition
- Only trained personnel to attend leaking tonners
- Regular training and mock drills for using FRP hood and chlorine kit and emergency action for tonner leak should be conducted
- If fire is present or imminent, chlorine containers and equipment should be moved to a safe location, if possible.
- Non-leaking containers or equipment that cannot be moved should be kept cool by the application of water. This should continue until well after the fire has been extinguished and the containers are cooled.

Hydrogen & HCl Cylinder Area

- Gas detectors to be placed near cylinder bank area and reactor area.
- Hydrogen cylinder bank should be placed at distance (min 15m) from reactor area. The bank area should be covered with FW monitor and hydrants.
- Only trained personnel to attend leak

Instrumentation & Control:

- DCS connectivity should be provided to the maximum extent possible to reduce manual errors.
- Indicators, alarms should be installed at plant levels and loading and unloading areas to alert workers around.
- Interlocks for pumps, remote switches for sprinklers should be considered.
- The alarm should be provided on either temperature or pressure based on the nature of process (exothermic or high pressure reaction)

Applicable Regulation:

Chlorine Tonners will require to follow The Gas Cylinder Rules, 2016.

Tank and Drum storages shall follow Manufacture Storage and Import of hazardous chemicals Rules, 1989, amended 2000

General

- The plant handles flammable materials. The handling of these materials requires control of spark, ignition source, and open flame. This is ensured by selecting equipments as per Hazardous area classification analysis. Ensure that all electrical installations and instruments are as per hazardous area classification(ref IS 5571 & 5572)

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- Spiral wound gaskets are recommended for hydrocarbon lines. Screwed fittings should not be used except for stainless steel instrumentation.
- Shut off and isolation valves shall be easily approachable in emergencies
- Fireproofing requirement of structure and equipment supports needs to be analysed and fireproofing to be provided accordingly.
- The process area should be classified area for selection of electrical equipments and instruments.
- The construction and fabrication should be as per standard codes and practices (ASME /ANSI / IS etc) as the failure frequencies will be valid for such construction. If there is some deviation then the frequencies may increase.
- Provide training for employees in the procedures established for their operating and maintenance functions. Also a refresher training program at specific intervals is to be prepared to keep operators updated.
- The fire fighters crew who is responding to emergency involving such chemicals should be aware of toxic effects of stored chemicals and should use the advised PPEs for those chemicals.
- wind direction pointers shall be well maintained for visibility and operation so that in an emergency the wind direction can be directly seen and downwind population cautioned
- Ignition exclusion Zones of the Plant shall be clearly marked with 'No Sparks Zone'.
- Use of portable electrical instruments such as transistor radio or cellular phone handsets should not be allowed to be carried in the Plant premises.
- Work likely to involve flame or sparks, such as, welding or burning, shall be performed only after the area is checked for no presence of flammable material and other safety arrangement as required.
- A proper training shall be given to the staff to handle any emergency situation and use of PPE during the work and emergency.
- Proper drains around production and storage areas, connected to ETP to contain contaminated water during fire emergency
- Eye washers / showers to be provided at all required locations
- Personal protective equipments to be provided to all the employees related to the type of work and hazard associated
- Mutual aid from neighboring industries to be made for cylinder and tonner leakage scenarios
- All the safety devices and instruments like safety valves, shall be tested, inspected and recalibrated as per safety norms
- Fire extinguishers, fire alarms, detectors shall be serviced and examined periodically and preventive maintenance to be undertaken.
- Hydraulic testing of pressure vessels, and tanks shall be done through Government approved Competent Person. (As per rule).

All Fire fighting arrangements as described above shall be augmented for the new manufacturing sections.

7.13 DISASTER MANAGEMENT PLAN

The proponent M/s. Cheminova India Limited is an established international group and as regards the proposed expansion, existing manufacturing sections are operating successfully and safely at the Panoli site. The proposed new plants shall be more of a replica of the existing w.r.t production, manufacturing processes, utilities, chemical inventory, process control, safety aspects etc. and with better plant technology.

There shall be inbuilt safety in the plant through DCS and PLC operations and safety interlocks wherever required. Also the technology adopted is the most proven technology already implemented in similar units of the group. The plant design and layout aspects also comply with the applicable regulations and requirements of industrial ergonomics. Thus, the risks associated with the project are having low probability and severity.

CILT management has prepared and implemented an on-site emergency plan in compliance to the requirements of Schedule 8A under rule 68J(12)(1) of Gujarat Factories Rule 1963 (2004) and schedule 11 under Rule 13 (1) of The Manufacture Storage and Import of hazardous chemicals Rules, 1989, amended 2000. The DMP includes emergency preparedness plan, emergency response team, emergency communication, emergency responsibilities, emergency facilities, and emergency actions. The content page of onsite plan is annexed as Annexure -9.

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The plan also includes an OFF site emergency plan for the concerned government authority giving details about steps to be taken to inform related Government agencies, Medical Centers, Rescue teams and other local agencies, in an event where the emergency poses danger to surrounding area requiring evacuation.

Unit is member of Disaster Prevention and Management Centre (DPMC), Ankleshwar for immediate assistance in fire and toxic release emergencies.

EIA Consultant has reviewed the latest plan (*Onsite plan of Cheminova India Ltd. Technical Division – EHSQMSM/ESH/ERP/01, ISSUE NO.01 Rev 04, Effective Date: 1ST March 2017*) assessing suitability and adequacy w.r.t proposed expansion. The review points are mentioned herewith.

Objectives of DMP

As per latest plan -	Any additions or modifications required for expansion -
<p>To define and assess the emergencies, including risk and environment impact assessment.</p> <p>To contain the incident and bring it under control by mobilizing the internal resources and with the help of mutual aid schemes.</p> <p>To safeguard the lives.</p> <p>To minimize the damage to property and / or neighboring environment.</p> <p>To inform the employee, the public and the authority about the hazards / risk assessed, safeguards provided and the role to be played by them in case of emergency.</p> <p>Initiating and organizing evacuation of affected persons.</p> <p>Medical preparedness for the probable casualties.</p> <p>Integration of resources under OFF-SITE EMERGENCY ACTION PLAN of DISTRICT CONTINGENCY PLAN for Bharuch.</p> <p>To secure the safe rehabilitation of affected areas and to restore normalcy.</p> <p>To work out a plan with all provisions to handle emergencies and to provide for emergency preparedness and the periodical rehearsal of the plan.</p>	<ul style="list-style-type: none"> To preserve records, equipment etc., and to organize investigation into the course of the onsite emergency and preventive measure to stop its recurrence.

Components of DMP

As per latest plan -	Any additions or modifications required for expansion -
<ul style="list-style-type: none"> Emergency Organization - structure, duties and responsibilities of authorities response team, their coordinators Communication Major accident response procedures Action plan for specific emergency Action plan for road transport emergency Off-site Emergency plan Mock drill / Rehearsal / Exercise Annexures 1 to 33 Related Appendices 	<ul style="list-style-type: none"> Updation in Annexures in prescribed formats

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Emergency Response

As per latest plan -	Any additions or modifications required for expansion -
<ul style="list-style-type: none"> Written procedures for controlling different types of emergencies Training of workforce for procedures and individual roles and responsibilities Availability of emergency response equipment with location and quantity and incharge 	<ul style="list-style-type: none"> Additions of emergency response procedures for new chemicals to be handled for expansion <p>Following points shall be kept in mind while preparing the procedures :</p> <ul style="list-style-type: none"> The exposure of workers to be limited as much as possible during the operation Contaminated areas should be cleaned and, if necessary disinfected Limited impact on the environment at the extent possible.

Levels of Emergency

L-1 – Major Incident – Fire & Toxic Release which affects all Plants

L-2 – Medium Incident – Leakage of chemicals from Storage Tanks and affect one plant

L-3 – Minor Incident – Leakage of chemical in plant and affect section of Plant

No changes in levels of emergency are required.

Onsite plan shall be revised to identify and include emergencies from new plants.

The communication system beginning with raising the alarm, declaring the major emergency and procedure to make it known to others include the following :		No changes required
<ul style="list-style-type: none">Declaring the major emergency		
<ul style="list-style-type: none">Emergency Siren Code		
<ul style="list-style-type: none">Information And Warning		
<ul style="list-style-type: none">Safe Assembly Points		
<ul style="list-style-type: none">Declaration Of Emergency		
Assembly points :		No changes required, proper instruction boards shall be installed at new plant sections to inform new employees and workers about the assembly points. Training on the same shall be given
Location	Accommodation	
Near ETP	All	
Nr.main gate	All	
Emergency Control Centre (ECC) – Security Office equipped with necessary items as delineated in the onsite plan ECC in charge as identified for individual ECC will maintain it		Updated documents to be placed at ECCs

Emergency Communication (Available system at CILT)

As per latest plan -	Any additions or modifications required for expansion -
Levels of Emergency and Siren Codes are mentioned in the plan.	Addition of alarms, PA system and sirens in new plant section.
1) Landline telephones 2) Emergency mobile phones 3) Emergency phone at Emergency Control Room 4) Mobile phone with Senior Engineer	

Any additions or modifications required for expansion

There shall be additional manpower employed in the plant during construction phase as well as operational phase of the expansion including contract labour. This additional manpower, particularly construction labour shall be given proper training on the levels of emergency and their role during emergency. Regular inspection and examination of their awareness about possible incidences and their emergency response shall be undertaken by EHS personnel. Mock drill for construction labour is also suggested.

Emergency Management Team & Emergency organogram - additional personnel from new plant sections to be added

The following emergency management executive/personnel are required to play stellar role in combating the emergency.

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- Site Main Controller
- Incident Controller (Manager (Oprns.) /manager (Maintenance))
- Deputy Incident Controllers (Deputy Manager / Asst. Manager)
- Essential Workers
- Key Personnel
- Plant Supervisor/Operator
- Communication Controller/Telephone Operator
- Personnel Officer
- Security Officer
- Safety Officer

The plan designates all positions and also defines the roles and responsibilities of Site Controller, Incident Controller and other key personnel for emergency control. Personnel from new plant sections shall be added in the list of all positions of emergency management team.

The existing DMP includes the following :

- Onsite action and emergency control procedures based on consequence analysis results
- Evacuation & Transportation
- Safe Close-Down
- Use Of Mutual Aid
- Use Of External Authorities
- Medical Treatment
- Accounting for personnel

Additions required :

- Mitigation of Environmental Impact during emergency for -
 - Fire, Explosion
 - Chemical Spillage
 - Mitigation of Environmental Impact during emergency for -Fire, Explosion and Chemical Spillage
- Access to Records
- Rehabilitation
- Consequence analysis shall be included together with their emergency control procedures if different from existing.
- Specific medical treatment as per MSDS shall be noted by FMO and added in OHC manual and given training to first-aiders.

Annexures of onsite emergency plan to be revised accordingly.

Offsite Emergency Preparedness – already addressed in existing plan