QRA/DMP FOR PROPOSED ACTIVE PHARMACEUTICAL INGREDIENTS (API) AND API INTERMEDIATES MANUFACTURING UNIT	QUANTINENTAL PHARMACHEM PVT. LTD.
	Plot # A-106/1, MIDC Paithan Industrial Area, Village: Mudhalwadi, Taluka: Paithan-431148, Aurangabad, Maharashtra

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ABBREVIATIONS

EHS	Environment, Health and Safety
EER	Evacuate, Escape and Rescue Plan
ERPG	Emergency Response Planning Guidelines
ECC	Emergency Control Center
IDLH	Immediately Dangerous to Life or Health
LEL	Lower Flammability Limits
LCLo	Lethal Concentration Low
MSIHC	Manufacture, Storage, Import & Hazardous Chemical Rules
MoEF	Ministry of Environment and Forests
MCLS	Maximum Credible Loss Scenarios
MSDS	Material Safety Data Sheet
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limits
PPEs	Personnel Protective Equipment
SMC	Site Main Controller
ToR	Terms of References
TLV	Threshold Limit Value
UFL	Upper Flammable Limits

1.1 PROJECT LOCATION

The MIDC Paithan has been established in the year 1974 by Government of Maharashtra wide notification No. IDC2174-24149 dtd. 6/9/1974. The agricultural barren land was acquired by MIDC for development of industries.

#	particulars	Details
1.	Project Name	M/s. Quantinental Pharmachem Pvt. Ltd.
2.	Site Description	Shape of Plot- Polygon Terrain – The site has flat terrain
3.	Site surrounding details	The site is located in notified industrial area MIDC Paithan
4.	Production	Active Pharmaceutical Ingredient's (API)and API intermediates of Pharma products
5.	Production details	Manufacturing of chemical synthetic organic chemicals
6.	Location	A-106/1, MIDC Paithan Industrial Area, Village: Mudhalwadi, Taluka: Paithan, Aurangabad, Maharashtra. Pin Code: 431148
7.	Geographical location	Latitude - $19^0$31' 56.2" N Longitude - $75^0$23' 02.2" E
8.	Wind Speed	Average 4-10 m/s
9.	Temperature	Min. 11.9 ^{0}C Max- 41.8 ^{0}C
10.	Annual rainfall	772 mm
11.	Nearest River	Godavari river
12.	Nearest Town, city or Headquarter	Paithan
13.	Nearest Highway	SH – 30 towards West
14.	Nearest Railway Station	Aurangabad Railway Station
15.	Nearest Airport	Aurangabad Airport
16.	List of surrounding Industries	1. Nagina Herbals, 2. Tooba Pharmaceuticals Pvt Ltd. 3. Kedar Scientific Ltd 4. Ajanta Pharma (Pharmaceutical) Paithan MIDC,

		Mudhalwadi, Maharashtra 5. FaingerLeser (Metal Fabric) D3, MIDC, Aurangabad, Maharashtra 6. Encore Healthcare Pvt. Ltd (Pharmaceutical) Paithan MIDC, Mudhalwadi, Maharashtra 7. Apex Medichem (Pharmaceutical) Paithan MIDC, Mudhalwadi, Maharashtra 8. PepsiCo Ltd Paithan MIDC, Mudhalwadi, Maharashtra 9. Hindustan Composite Ltd Paithan MIDC, Mudhalwadi, Maharashtra 10. Navonor Pharma Paithan MIDC, Mudhalwadi, Maharashtra 11. Sant EknathSahkari Sakhar Kharkhana Eknathnagar, Paithan 12. Shalini Chemicals Wahegaon, Maharashtra 13. Fouress Engineering Paithan MIDC, Mudhalwadi, Maharashtra 14. Aventis India Ltd. (Pharmaceutical) Paithan MIDC, Mudhalwadi, Maharashtra 15. Aurangabad Paper Mills Paithan MIDC, Mudhalwadi, Maharashtra

Location on Google image

1.2 SCOPE OF WORK

1. Identification of Hazard from activities like Manufacturing Storage and Handling of Hazardous chemicals (MSIHC Rules, 2000, amended till date)
2. Assessment of Risk
3. Mitigation measures
4. Preparation of Disaster management plan

1.2.1 Methodology

The methodology includes,

Hazard identification

- Based on Physico-chemical properties like flash point, Toxicity, quantity and state of chemicals (Raw materials, products and solvents) storage and handling activities at site.
- Transportation of Raw materials and Products

Physico-chemical properties of Chemicals handling at site are given in 1-1. Storage barrel details are given in Table 1-2.

Table 1-1a: List of Products with quantity per month production

S.No.	Name of Products	CAS	Qty TPM
1.	m- Bromoanisole	2398-37-0	0.800
2.	Etorocoxib	202409-33-4	0.200
3.	Ethyl Triphenylphosphonium Bromide	1530-32-1	10.0
4.	Fluconazole	86386-73-4	0.475

5.	Linezolid	165800-03-3	0.094
6.	Telmisartan	144701-48-4	0.400
7.	Tetrabutyl Ammonium Bromide	1643-19-2	0.130
8.	Glimepiride	93479-97-1	0.150
9.	Tri-Ortho Tolyl Phosphine	6163-58-2	02.00
10.	Cilnidipine	132203-70-4	0.150
11.	Triclabendazole	68786-66-3	0.082
12.	Voglibose	83480-29-9	0.005
13.	Darunavir	206361-99-1	0.100
14.	Montelucast Sodium	151767-02-1	0.750
15.	Losartan	114798-26-4	0.975
16.	Sparfloxacin	110871-86-8	0.05
17.	Salbutamol Sulphate	51022-70-9	02.00
18.	Pantoprazole Sodium	718635-09-7	0.450
19.	Fenofibrate	49562-28-9	0.500
20.	Clopidogrel Hydrogen Sulphate	120202-66-6	0.175
21.	Rosuvastatin Calcium	147098-20-2	0.500
22.	Domeperidone	57808-66-9	0.100
23.	Nebivolol Hydrochloride	152520-56-4	0.360
24.	R&D Products	NA	0.100

Table 1-2b. List of Raw Material with storage quantity

S.No.	Raw Material	CAS	Storage Qty (Tons)
1.	2- Chloromethyl-3-4-dimethoxy pyridine hydrochloride	72830-09-2	0.30
2.	2- Methoxyethyl 3-Oxybutanone	-	0.06
3.	2.3-Dichloro Phenol	120-83-2	0.05
4.	2-Methyl-2-Butanol	75-85-4	0.05
5.	3,4- Dichloro Aniline	95-76-1	0.06

6.	3-Chloro Phenyl benzo imidazole one	3574-96-7	0.06
7.	4- Methyl –Biphenyl -2 Craboxylate	-	0.40
8.	4-Amino-N-[2R,3S] [3-Amino-2-hydroxyphenyl butyl] isobutyl bezenesulphonamide	-	0.10
9.	4-Chloro 4- hydroxyl benzophenone	42019-78-3	7.50
10.	5-Difluoro methoxy-2-mercapto benzimidazole	97963-62-7	0.30
11.	6-Fluoro 3,4-dihydro methanone	97963-62-7	0.10
12.	Acetic acid	64-19-7	0.40
13.	Acetic anhydride	108-24-7	0.05
14.	Acetone	67-64-1	1.25
15.	Acetonitrile	75-05-8	0.70
16.	Activated Carbon	7440-44-0	0.30
17.	Ammonia/ Aq. Ammonia	7664-41-7	1.00
18.	Ammonium Carbonate	506-87-06	0.05
19.	Benzimidazole	51-17-2	0.5
20.	Benzophenone	119-61-9	0.01
21.	Benzyl Amine	100-46-9	0.02
22.	Benzyl Salbutamol	1173021-73-2	0.10
23.	Bromoisobutyrate	600-00-0	0.50
24.	Calcium Acetate	5743-26-0	0.10
25.	Carbon	7782-42-5	0.01
26.	Carbon di-sulphide	75-15-0	0.05
27.	Chloro compound	Mixture	0.15
28.	Chloro Phenyl Benzimidazole RMI	4857-06-1	0.10
29.	Chlorosulphonic acid	7790-94-5	0.25
30.	Cilnidipine	132203-70-4	0.15
31.	Cinnamyl -3-oxobutanoate	-	0.10
32.	Clopidogrel Base	120202-66-6	0.15
33.	Crude Fenofibrate	49562-28-9	5.50
34.	Crude Fluconazole	86386-73-4	0.60
35.	Cyclohexane	110-82-7	0.03
36.	Di Isoproyl Ether	108-20-3	0.06
37.	Dimethyl Formamide	68-12-2	0.10

38.	Dimethyl sulfoxide	67-68-5	0.75
39.	DImethylSulphate	77-78-1	0.05
40.	DIsucinimidyl Carbonate	74124-79-1	0.06
41.	Ethyl Acetate	141-78-6	0.02
42.	Ethyl Bromide	74-96-4	3.15
43.	Ethylene di chloride	107-06-2	0.60
44.	Ferro Sulphate	7782-63-0	0.02
45.	Hexahydro furan-3-ol	156928-09-5	0.03
46.	Hexane	110-54-3	0.12
47.	Hydrochloric acid 30%	7647-01-0	0.05
48.	Hydroxy propyl-phenyl-2-Propanol	-	0.05
49.	Hyflo	Silica, amorphous, diatomaceous earth-68855-54-9 Silica, cristobalite-14464-46-1 Quartz-14808-60-7	0.05
50.	Isopropyl Acetate	108-21-4	0.50
51.	Isopropyl Alcohol	67-63-0	11.00
52.	Isopropyl –alphabromoisobutyrate	67-63-0	4.20
53.	KetoSulphone	202409-33-4	0.12
54.	Linezolid Crude	165800-03-3	0.50
55.	Losartan Intermediate I	114798-26-4	1.00
56.	Magnesium	7439-95-4	0.80
57.	Meta Nitro Bromo Benzene	585-79-5	1.00
58.	Methanosulphonyl Chloride	124-63-0	0.25
59.	Methanol	67-56-1	10.6
60.	Methyl Isobutyl Ketone	108-10-1	0.20
61.	Methyl tertiary butyl ether	1634-04-4	0.30
62.	Methylene di-chloride	75-09-2	0.15
63.	N,N-Di isopropyl Ethyl amine	7087-68-5	0.005
64.	N-BromoSuccinamide	128-08-5	0.35
65.	N-Butyl amine	109-73-9	0.10
66.	N-Butyl Bromide	109-65-9	0.10
67.	Nebivolol	152520-56-4	0.35
68.	n-Hexane	110-54-3	1.30
69.	Nitric Acid	7697-37-2	0.03

70.	N-Methyl Pyrrolidine	120-94-5	0.03
71.	O- Chloro Toluene	95-49-8	4.17
72.	Pantoprazole	718635-09-7	0.45
73.	Phenyl Isocynate	103-71-9	0.10
74.	Phosphorus Tri Chloride	7719-12-2	1.38
75.	Piperzine	110-85-0	0.015
76.	p-Nitro TolueenSulphonic acid	6192-52-5	0.10
77.	Potassium Carbonate	584-08-7	2.88
78.	Potassium Hydroxide	1310-58-3	1.10
79.	Potassium Tertiary Butoxide	865-47-4	0.04
80.	Pyrroline	109-96-6	0.07
81.	Raney Nickel with sterile water	Ni-7440-02-0 Al-7429-90-5	0.02
82.	Rosuvastatin	147098-20-2	0.50
83.	Sodium azide	26628-22-8	0.70
84.	Sodium Carbonate (Soda Ash)	497-19-8	0.15
85.	Sodium Chloride	7647-14-5	0.005
86.	Sodium Hydroxide	1310-73-2	1.60
87.	Sodium Hypochlorite	7681-52-9	2.30
88.	Sodium Nitrite	7632-00-0	0.30
89.	Sodium Sulphate	7757-82-6	0.004
90.	Sparfloxacin	110871-86-8	0.05
91.	Sulphonyl Methyl Cyclopropane Acetic Acid	-	0.32
92.	Sulphuric acid	7664-93-9	0.50
93.	Tera Hydro furan	109-99-9	0.05
94.	Tetra Butyl ammonium bromide	1643-19-2	0.36
95.	Tetra fluoro Quinoline	-	0.06
96.	Toluene	108-88-3	8.00
97.	Trans-4 Methyl Cyclohexylisocynate	32175-00-1	0.08
98.	Triclabendazole	68786-66-3	0.80
99.	Triethyl Amine	121-44-8	1.45
100.	Triphenyl Phosphine	603-35-0	7.45
101.	Voglibose Crude	83480-29-9	0.005
102.	Vitride	22722-98-1	0.55

Table 1-3: Chemicals Properties of Key Raw Materials

S. No	Raw Materials/ Products	Formula	CAS Number	State	Color	Odor	Mol. Wt (g/mole)	Flash Point (°C)	Melting Point (°C)	Boiling Point (°C)	IDLH (ppm)	Stability	Hazard	Specific Gravity (g/cc)	LEL %	UEL %	Odour threshold (ppm)	TLV ppm	LD50mg/kg LC50mg/m3	Vapour Density (air=1)
Raw material																				
1	Acetonitrile	C2H3N	75-05-8	Liquid	Colorless	odor	41.05	6	-46	82	NA	Unstable on exposure to moisture	Hazardous	-	4.4	16	42	NA	NA	NA
2	Ethyl Acetate	$C_4H_8O_2$	141-78-6	Liquid	Colorless	Fruity	88.11	-4.4	-83.6	77.22	2000	Stable	Flammable	0.902	2	11.5	3.9	NA	NA	NA
3	Acetic anhydride	(CH3CO)2	108-24-7	Liquid	Light	Strong	102.09	49	-73.1	139.9	200	Stable	Extremely hazardous	1.08	2.7	10.3	0.1	5	ORAL (LD50): Acute: 1780 mg/kg [Rat]. DERMAL (LD50): Acute: 4000 mg/kg [Rabbit]. VAPOR (LC50): Acute: 50100 mg/m 8 hours [Rat]. 44000 mg/m 4 hours [Mouse].	3.52
4	Ammonia	NH3	7664-41-7	Gas/Aqueous	Colorless	strong odor similar to “smelling salts”	17	NA	-77.7	-33.4	300	Stable	Hazardous	0.59	16	25	20			
5	Caustic Soda	NaOH	1310-73-2	Flakes	White	Odourless	40	NA	317.77	1390	10	Stable	Non-Flammable	2.13	NA	NA	NA	NA	NA	NA
6	Hydrochloric Acid	HCl	7647-01-0	Liquid	Colorless to light yellow	Pungent	NA	-	-46.2	83 C @ 760 mm Hg	-	Stable under normal condition	Corrosive	1.21	-	-	0.25 to 10	NA	NA	NA
7	Methanol	CH4O	67-56-1	Liquid	Colorless	Pungent	32.04	11.11	-97.77	64.61	6000	Stable	Flammable	0.792	6	36.5	100	NA	NA	NA
8	Potassium Hydroxide	KOH	1310-58-3	Solid	white	odorless	56.11	-	380	1384	-	Stable	Hazardous	2.044	-	-	-	NA	NA	NA
9	Sodium Carbonate	Na2Co3	497-19-8	Solid	White	Odorless	105.99	-	851	-	-	Stable	-	-	-	-	NA	NA	NA	NA
10	Sulfuric acid	H2SO4	7664-93-9	Liquid	Colorless	Odorless, but has a choking odor when hot	98.08	NA	10.36	290	15 mg/m 3	Stable	Extremely hazardous	1.84	NA	NA	NA	NA	NA	NA
11	Toluene	C_7H_8	108-88-3	Liquid	Colorless	Sweet, Aromatic	92.14	4.44	-95	110.61	500	Stable	Flammable, Toxic	0.867	1.27	7.1	1.6	NA	NA	NA
12	Isopropyl	C_3H_8O	67-63-0	Liquid	Colorless	Strong odor of Rubbing Alcohol	60.1	11.7	-89	83.5	2000	Stable	Flammable	0.7851	2.0	12.7	NA	400	Oral rat LD50: 5045 mg/kg; skin rabbit LD50: 12.8 gm/kg; inhalation rat LC50: 16,000 ppm/8-hour	2.1

Table 1-4: Chemicals Storage Barrel details

S. No.	Name of Chemical	Physical state	Number of storage barrel	Capacity of Storage Barrel (KL) each	MOC	Type of Storage Barrel *	Barrel Height (m)	Barrel Dia (m)	Storage condition		Dyke/Bund area (m^2)	Dyke/Bund Height (m)
									Pressure (bar)	Temperature (°C)		
1.	Acetonitrile	Liquid	4	0.2 KL each	MS	Atmospheric storage barrel	0.93	0.59	Atmospheric	Ambient	8	0.3
2.	Methanol	Liquid	50	0.2 KL each	HDPE	Atmospheric storage barrel	0.93	0.59	Atmospheric	Ambient	30	0.3
3.	Ethyl Acetate	Liquid	1	0.2 KL each	HDPE	Atmospheric storage barrel	0.93	0.59	Atmospheric	Ambient	1	0.3
4.	Toluene	Liquid	40	0.2 KL each	MS	Atmospheric storage barrel	0.93	0.59	Atmospheric	Ambient	25	0.3
5.	Isopropyl	Liquid	50	0.2 KL each	HDPE	Atmospheric storage barrel	0.93	0.59	Atmospheric	Ambient	30	0.3

Table 1-5: Scenarios for Simulation

#	Name of the Material	Hazard involved	No. of container & Size at Site	Storage Parameters		Scenario Considered	Consequence
				Pressure (bar)	Temp. (^{0}C)		
1.	Methanol	Flammable, Toxic	4 Nos.,0.2 KL Each	Atmospheric	Ambient	10mm leak	Jet fire, Pool fire, Explosion
						Catastrophic rupture	Pool fire, Explosion
2.	Acetonitrile	Flammable	50 Nos.,0.2 KL Each	Atmospheric	Ambient	10mm leak	Jet fire, Pool fire, Explosion
						Catastrophic rupture	Pool fire, Explosion
3.	Ethyl Acetate	Flammable	1 No.,0.2 KL Each	Atmospheric	Ambient	10mm leak	Jet fire, Pool fire, Explosion
						Catastrophic rupture	Fireball, Explosion
						Catastrophic rupture	Pool fire, Explosion

#	Name of the Material	Hazard involved	No. of container & Size at Site	Storage Parameters		Scenario Considered	Consequence
				Pressure (bar)	Temp. (^{0}C)		
4.	Toluene	Flammable, Toxic	40 Nos.,0.2 KL Each	Atmospheric	Ambient	10mm leak	Jet fire, Pool fire, Explosion
						Catastrophic rupture	Pool fire, Explosion
						Catastrophic rupture	Pool fire, Explosion
5.	Isopropyl	Flammable	50 Nos.,0.2 KL Each	Atmospheric	Ambient	10mm leak	Jet fire, Pool fire, Explosion
				Atmospheric	Ambient	Catastrophic rupture	Pool fire, Explosion

Considering above all details, Qualitative and Quantitative risk assessment study has been carried out and presented in next section.

2 RISK ASSESSMENT

Risk is an expression of chance, a function of the likelihood of an adverse impact and the magnitude of its consequences. Environmental Risk Assessment is the process of the evaluating the likelihood of adverse effect in, or transmitted by the natural environment from hazards that accompany human activities.

Qualitative and Quantitative Risk assessment is elaborated in this section.

2.1.1 Qualitative Risk Assessment

In Qualitative Risk Assessment, risk has been analyzed using methodology called HIRA-Hazards Identification & Risk Assessment. In HIRA, major manual activities carried out by plant personnel as well as contract labors have been considered.

Qualitative Risk Assessment has been carried out for the following areas:

- Storage and Handling of Solid Chemicals like Caustic soda, Manganese acetate, potassium hydroxide, sodium acetate and sodium carbonate

Risk involved in various processes / process equipment cannot be addressed completely by consequence analysis. As a conservative approach, these risks have been considered separately under this topic. The approach is to identify hazards associated in operation of equipment as well as in processes, assessing its impacts, ranking the risk posed by it and finally to propose remedial actions/mitigation measures such that the risk is minimized to tolerable level. The Risk Matrix presented in Table 2-1, is referred in evaluating the assessment. Risk acceptability criteria given in Table 2-2.

Table 2-1: Risk Matrix for Qualitative Risk Assessment

LIKEHOOD/ PROBABILITY		SEVERITY				
		Catastrophic (Death/System Loss)	Major/ Critical (Serious injury/Illness)	Moderate (Less Serious Injury/Illness)	Minor/Marginal (Minor Injury/Illness)	Insignificant/ Negligible (No injury/illness)
		5	4	3	2	1
Almost Certain	E	H	H	H	M	M
Likely	D	H	H	M	M	L
Possible	C	H	M	M	M	L
Unlikely	B	M	M	M	L	L
Impossible	A	M	M	L	L	L

Table 2-2: Risk Acceptability Criteria

Risk Range	Risk Acceptability Criteria	Remarks
H	Unacceptable/ High	Management's Decision/Action Plan Required. Potential off-site Impact.
M	Medium	Generally Minor Impact. Acceptable with Management's Review. Specific monitoring or SOP to be followed.
L	Low	Acceptable without Review. Manage through Routine Procedure.

Table 2-3: Storage and Handling of Solid Chemicals

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
1.	Handling Chemical bags	• Chemical Exposure	• Skin/Eye irritation.	2	C	M	• Operators/Workers to be trained for Safe Work Practices. • Chemical handling bags to be labeled properly • Availability of Eye wash and Safety shower station nearby • Chemicals shall be stored in an isolated storage rooms having provision for natural & forced ventilation. • Certified Dust respirator shall be used. • Use of suitable protective clothing like apron, Helmet and hand gloves	1	B	L
2.	Cleaning of Chemical Spillage.	• Fumes Inhalation. • Dust Exposure.	• Severe irritation to eyes, skin. • Inhalation.	2	C	M	• Spillage shall be cleaned or neutralized with suitable media. • Dust mask shall be used. • Suitable protective clothing, gloves, boots shall be used.	1	B	L

Table 2-4: Storage and Handling of Caustic soda

S.	Process Or	Associated	Health & Safety Impact	Initial Risk	Mitigation Measures	Residual Risk

No.	Activity	Hazards	(Risk)	Severity	Likelihood	Risk		Severity	Likelihood	Risk
1.	NaOH handling /Loading & Unloading	• Exposure due toleakage fromjoints, corroded lines failure etc.	• Skin burn. • Eye irritationand respiratorydisorder.	2	C	M	• SOPs to be prepared and followed the same. • Proper trainings to beprovided to theoperators/workers. • Provision of Dyke. • Availability of Eye wash and Safety shower station nearby. • Timely maintenance asper schedule. • Use of PPE, like face mask, gloves etc. by concernedperson.	1	B	L
2.	Working in Storage Area	• Splashover body	• Severe irritationto eyes, skin etc. • Body burns.	2	C	M		1	B	L

Table 2-5: Storage and Handling of corrosive chemicals

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
1.	Acids Loading & Unloading.	• Exposure to acid fumes (due to leakage in pipe/ container/ valves etc.). • Splashover body • Spillage.	• Skin/Eye irritation. • Toxic Vapor inhalation etc. • Acid burns	2	C	M	• Periodic Inspection of flanges/ferrule joints shall be carried out. • Availability of Eye wash and Safety shower station nearby. • Neutralization media shall be kept available in areas where acids are stored/handled/used.	1	B	L

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
							• PPEs like chemical safety goggles or full face shield, Rubber or neoprene gloves and additional protection including impervious boots, apron shall be used. • Respirators shall be used.			
2.	Working in Storage Area.	• Exposure to acid fumes.	• Severe irritation to eyes, skin. • Body burns.	3	C	M	• Acid proof floorings shall be constructed. • In case of spillage, neutralization shall be done immediately with soda ash/lime or spill shall be absorbed in sand or by suitable adsorbent. • PPEs like chemical safety goggles or full face shield, Rubber or neoprene gloves and additional protection including impervious boots, apron shall be used. • Respirators shall be used. • Eye wash stations & Safety Shower shall be installed in near vicinity. • Only trained personnel shall be allowed to work in this area.	2	B	L

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
							• Dyke wall shall be provided.			
3.	Barrel overflow/leakage from joints etc.	• Exposure to acid fumes.	• Severe irritation to eyes, skin.	3	B	M	• Level indicator shall be provided. • Provision of adequate Dyke wall. • PPEs like chemical safety goggles or full face shield, Rubber or neoprene gloves and additional protection including impervious boots, apron shall be used. • Respirators shall be used. • Eye wash stations & Safety Shower shall be installed in near vicinity.	2	B	L

Table 2-6: Storage and Handling of toxic chemicals

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
1	Chemical handling /Loading & Unloading	• Exposure to fumes (due to leakage from joints, corroded lines failure	• Skin burn. • Eye irritation and respiratory disorder.	3	C	M	• Dyke will be provide. • Shall be stored in well-ventilated area. • Eye wash station and Safety Shower shall be installed in	2	B	L

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
		etc.).					nearby location. • Maintenance shall be carried as per schedule. • Employee will be provided with impervious clothes, gloves, face shield (eight-inch minimum),dust and splash proof safety goggles, chemically resistant safety shoes, etc. • Proper trainings to be provided to the operators/workers. • SOPs to be prepared and followed the same. • Spill control procedure is available.			
2	Working in Storage Area	• Exposure to fumes due to spillage.	• Severe irritation to eyes, skin etc. • Internal body burns.	3	C	M	• Neutralization media shall be kept available for Caustic. • HCl torch shall be made available to be used for the detection of ammonia leakage. • PPEs like face mask, gloves, goggles, etc. shall be worn by concerned person.	2	B	L

S. No.	Process Or Activity	Associated Hazards	Health & Safety Impact (Risk)	Initial Risk			Mitigation Measures	Residual Risk		
				Severity	Likelihood	Risk		Severity	Likelihood	Risk
							• Eye wash station or Safety Shower shall be installed in storage area. • Provision of an automatic leak detection system • Display of Safety warning postures/signs inside the area.			
3	Barrel overflow	• Chemical Exposure	• Eyes and Skin irritation.	4	B	M	• Level indicator shall be installed and the same shall be checked for its proper operation. • Dyke wall shall be available to contain the spill. • Periodic inspection to be carried for all the related accessories of level indicator.	2	B	L

2.1.2 Quantitative Risk Assessment

Quantitative Risk Assessment (QRA) is a structured approach to identifying and understanding the hazards and risks associated with Storage and Handling of flammable/toxic chemicals. The assessment starts by taking into account an inventory of hazardous chemicals stored, likelihood of leakage/spillage associated with it and selecting the worst case scenario for consequence estimation. Finally, suggesting the measures to minimize or mitigate risks to meet appropriate acceptability criteria. The planning for emergency evacuation shall be borne in mind whilst interpreting the results.

Consequence analysis

In a plant handling hazardous chemicals, the main hazard arises due to storage and handling of hazardous chemicals as mentioned above. If these chemicals are released into the atmosphere, it may cause damage due to resulting fires or vapor clouds. Blast overpressures depend upon the reactivity class of material between two explosive limits.

Damage criteria

In consequence analysis studies, in principal three types of exposure to hazardous effects are distinguished:

1. Heat radiation, from jet, pool fire, a flash fire or a BLEVE
2. Explosion
3. Toxic effects, from toxic materials or toxic combustion products.

The chosen damage criteria are given and explained as per the Guidelines for QRA – PHAST Software, version 6.7 (DNV) & Purple Book for QRA released by Centre for Chemical Process Safety (CCPS).

2.1.3 Planning

Event Classification and Modes of Failure

Hazards that can lead to accidents in operations are discussed in this section. Important hazardous events are classified in Table 2-7.

Table 2-7: Event Classification

Type of Event	Explanation
BLEVE	Boiling Liquid Evaporating Vapor Explosion; may happen due to catastrophic failure of refrigerated or pressurized gases or liquids stored above their boiling points, followed by early ignition of the same, typically leading to a fire ball
Deflagration	Is the same as detonation but with reaction occurring at less than sonic velocity and initiation of the reaction at lower energy levels
Detonation	A propagating chemical reaction of a substance in which the reaction front advances in the un-reacted substance at or greater than sonic velocity in the un-reacted material
Explosion	A release of large amount of energy that form a blast wave
Fire	Fire
Fireball	The burning of a flammable gas cloud on being immediately ignited at the edge before forming a flammable/explosive mixture.
Flash Fire	A flammable gas release gets ignited at the farthest edge resulting in

Type of Event	Explanation
	flash-back fire
Jet Fire	A jet fire occurs when flammable gas releases from the pipeline (or hole) and the released gas ignites immediately. Damage distance depends on the operating pressure and the diameter of the hole or opening flow rate.
Pool Fire	Pool fire is a turbulent diffusion fire burning above a horizontal pool of vaporizing hydrocarbon fuel where the fuel has zero or low initial momentum
Spill Release	'Loss of containment'. Release of fluid or gas to the surroundings from unit's own equipment / barrel s causing (potential) pollution and / or risk of explosion and / or fire
Structural Damage	Breakage or fatigue failures (mostly failures caused by weather but not necessarily) of structural support and direct structural failures
Vapor Cloud Explosion	Explosion resulting from vapor clouds formed from flashing liquids or non-flashing liquids and gases

Hazard and Damage Assessment

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

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

Consequences of Fire/Heat Wave

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

Table 2-8 : Damage due to Radiation Intensity

Radiation (kW/m^2)	Damage to Equipment	Damage to People
1.2	Solar heat at noon	
1.6	-	Minimum level of pain threshold
2.0	PVC insulated cable damage	
4.0	-	Causes pain if duration is longer than 20 sec. But blistering is unlikely.
6.4	-	Pain threshold reached after 8 sec. Second degree burns after 20 sec.
12.5	Minimum energy to ignite wood with a flame; melts plastic tubing.	1% lethality in one minute. First degree burns in 10 sec.
16.0	-	Severe burns after 5 sec.
25.0	Minimum energy to ignite wood at identifying long exposure without a flame.	100% lethality in 1 min. Significant injury in 10 sec.
37.5	Severe damage to plant	100% lethality in 1 min. 50% lethality in 20 sec. 1% lethality in 10 sec.

Consequences of Overpressure

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

Table 2-9: Overpressure Damage

Overpressure (bar)	Damage
0.001 0.002 0.003	Annoying noise (137 dB if of low frequency 10-15 Hz) Loud noise (143 dB, sonic boom glass failure Occasional breaking of large glass windows already under strain
0.007	Breakage of small windows under strain
0.010 0.020	Typical pressure for glass breakage projectile limit; some damage to house ceilings; 10% window glass broken
0.027	Limited minor structural damage
0.034 0.034 to 0.068	Large and small windows usually shattered; occasional damage to window frames
0.048 0.068 0.068 to 0.136	Minor damage to house structures Partial demolition of houses, made uninhabitable Corrugated asbestos shattered; corrugated steel or aluminum panels, fastenings fail, followed by buckling, wood panels (standard housing) fastenings fail, panels blown in
0.088 0.136 0.136 to 0.204	Steel frame of clad building slightly distorted Partial collapse of walls and roofs of houses Concrete of cinder brick walls, not reinforced, shattered
0.157	Lower limit of serious structural damage
0.170 0.204 0.204 to 0.272	50% destruction of brickwork of houses Heavy machines (3,000 lb) in industrial building suffered little damage; steel frame building distorted and pulled away from foundations. Frameless, self -framing steel panel building demolished; rupture of oil storage barrel s
0.272 0.340	Cladding of light industrial buildings ruptured Wooden utility poles snapped; tall hydraulic press (40,000 lb) in building slightly damaged
0.340 to 0.476 0.476	Nearly complete destruction of houses Loaded train wagons overturned
0.476 to 0.544 0.612 0.680 20.414	Brick panels, 8-12 inches thick, not reinforced; heavy machine tools (7,000 lb) moved and badly Loaded trains boxcars completely demolished Probable total destruction of buildings; heavy machines tools (7,000 lb) moved and badly damaged, very heavy machines tools (12,000 lb) survived. Limit of crater lip

Source: CCPS Consequence analysis of chemical release

Consequences of Toxic Release

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

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

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

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

Following are some of the common terms used to express toxicity of materials.

- Threshold Limit Value (TLV): it is the permitted level of exposure for a given period on a weighted average basis (usually 8 hrs. for 5 days in a week)
- Short Time Exposure Limit (STEL): it is the permitted short term exposure limit usually for a 15 minutes exposure.
- Immediately Dangerous to life and health (IDLH): It represents the maximum concentration of a chemical from which, in the event of respiratory failure, one could escape within 30 minutes without a respirator and without experiencing any escape/impairing (eg. Severe irritation) or irreversible health effects.
- Lethal Concentration Low (LCLo): It is the lowest concentration of a material in air, other than LC50, which has been reported to cause a death in human or animals.
- Toxic Concentration Low (TCLo): It is the lowest concentration of a material in air, to which humans or animals have been exposed for any given period of time that has produced a toxic effects in humans or produced carcinogenic, neoplastigenic or teratogenic effect in humans or animals.
- Emergency Response Planning Guidelines 1 (EPRG1): The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour (without a respirator) without experiencing other than mild transient adverse health effects or without perceiving a clearly defined objectionable odor.
- Emergency Response Planning Guidelines 2 (ERPG2): The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
- Emergency Response Planning Guidelines 3 (ERPG3): The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

2.1.4 Meteorology

Atmospheric stability plays an important role in the dispersion of the chemicals. “Stability means, its ability to suppress existing turbulence or to resist vertical motion”.

Atmospheric stability plays an important role in the dispersion of chemicals. “Stability means, its ability to suppress existing turbulence or to resist vertical motion”.

Variations in thermal and mechanical turbulence and in wind speed are greatest in the atmospheric layer in contact with the surface. The air temperature has influenced these turbulences greatly and air temperature decreases with the height. The rate at which the temperature of air decreases with height is called Environment Lapse Rate (ELR). It will vary from time to time and from place to place. The atmosphere is said to be stable, neutral or unstable according to ELR less than, equal to or greater than Dry Adiabatic Lapse Rate (DALR), which is a constant value of 0.98 ºC per 100 meters.

Pasquill Stability Classes

Pasquill has defined Six (6) stability classes.

- A - Extremely unstable.
- B - Moderately unstable
- C - Slightly unstable.
- D - Neutral
- E - Slightly stable.
- F - Moderately stable.

Three prime factors that defines Stability

- Solar radiation
- Night-time sky over
- Surface wind

When the atmosphere is unstable and wind speeds are moderate or high or gusty, rapid dispersion of vapors will occur. Under these conditions, air concentrations will be moderate or low and the material will be dispersed rapidly. When the atmosphere is stable and wind speed is low, dispersion of material will be limited and air concentration will be high.

2.1.5 Weather Conditions

Following Weather conditions are selected for consequence analysis

Table 2-10: Weather Condition Selected

Time	Remarks	Weather Condition		
		Temperature in ^{o}C	Wind speed m/s	Stability Class
Day Time	Prevalent during the day, most times of the year	25.8	4	C
Night Time	Prevalent during the night, most times of the year	21.7	3	D
Monsoon Period	Prevalent during the monsoon months	24.0	5	D

2.1.6 Consequences Analysis

The consequences of the release of Hazardous substances by failures or catastrophes and the damage to the surrounding area can be determined by means of models. Models help to calculate the physical effects resulting from the release of hazardous substances and to translate the physical effects in terms of injuries and damage to exposed population and environment. To assess the damage level caused by the various accidental events, it is essential to firm up the damage criteria with respect to different types of accidents e.g. thermal radiation, toxicity, explosion overpressure etc.

Consequence analysis involves the application of mathematical, analytical and computer models for calculation of effects and damages subsequent to a hydrocarbon release accident. Consequence models are used to predict the physical behavior of the hazardous incidents. The techniques used to model the consequences of hydrocarbon and other hazardous material releases cover the following:

- Modeling of discharge rates when holes develop in process equipment/pipe work/pipeline.
- Modeling of the size and shape of flammable and toxic gas clouds from releases in the atmosphere
- Modeling of the flame and radiation field of the releases that are ignited and burn as jet fire, pool fire, flash fire and BLEVE/ Fire ball
- Modeling of the explosion fields of releases, which are ignited away from the point of release

The information normally required for consequence analysis includes meteorological conditions, failure data of equipment and components, ignition sources, population characteristics within and outside the plant, acceptable levels of risk etc.

About the software – PHAST, Version 6.7

The consequence analysis for the modeled scenarios has been done using DNV's software PHAST (Process Hazard Analysis Software Tool) which allows assessment of situations which present potential hazards to life, property and the environment, and to quantify their severity. PHAST examines the progress of a potential incident from the initial release to far-field dispersion including modeling of pool spreading and evaporation, and flammable and toxic effects. It is recommended for use by the Ministry of Environment & Forests per its EIA Guidelines, 2006.

PHAST Professionals sophisticated modeling calculates distances effect produced by hazardous events. With this information, you can evaluate the need for mitigating measures such as changes in design, operation or response. PHAST software can be used to model a proposed facility or operational change to ease the selection of the most effective solutions. With PHAST Professional, you can define special events, model the change in a leak over time, and investigate the details of behavior with special stand-alone models and much, much more.

PHAST is integrated into safety and meets regulatory requirements. It uses unified dispersion modeling to calculate the results of the release of material into atmosphere.

The salient features of this package:

1. It gives the consequence results in terms of – Flammable, Toxic and Explosion effects.
2. Flammable parameters covered under this package is-

- Defines the LEL and UEL zone
- Jet fire and pool fire scenario along with their respective effect zones (risk contour).
- Flash fire and fire ball envelope

3. Toxic parameters-

- Cloud concentration at user defined time as well as location
- Categorize the toxic results in terms of ERPG, IDLH and STEL values.
- Summarize results in terms of equivalent toxic dose along with effect zones.

4. Explosion parameters-

- Categorize the explosion effects in terms of overpressures levels along with distance covered.
- BLEVE (Boiling Liquid Expanding Vapor Explosion)

Assumption

For consequence analysis, assumptions regarding Meteorological, Pasquil Stability Classes, Wind velocity, Ambient Temperature, Relative Humidity, Inventory, Ground Roughness, Model used etc. are very important. In this report, the following assumptions have been considered.

1. Meteorological Paste other tables

- Atmospheric Conditions: No Inversion
- Ambient Temperature: 35°C has been considered as MCA approach.
- Relative Humidity: As the site is not in rainy zone RH of 50% has been considered.

2. Pasquil Stability Classes

- Pasquil Stability category C/D is considered as conservative approach.

3. Other assumptions:

- Ground Roughness: Ground Roughness has been considered as 0.3 M.
- Dispersion model of both Heavy Model and also Gaussian distribution have been used as applicable/appropriate.
- Inventory: Release of 100% of the inventory has been considered. For this, failure of the container has been considered from the bottom.
- Storage conditions: Storage conditions have been considered as they are practically stored at site.

Input data for software (modeling)

For consequence analysis, input data considered are as below:

1. Volume inventory (Quantity of material)
2. Scenario
   - Leak
   - Catastrophic Rupture
3. Leak size
   - 10 mm hole

4. Storage conditions
   - Pressure
   - Temperature
5. Bund details
   - Bund height
   - Bund area
6. Weather condition:
   - Wind speed
   - Pasquil stability
   - Atmospheric temperature
   - Relative humidity

MCAS Development Techniques

As a first step towards risk assessment is to identify the possible release scenarios based on available information about scenario development for Maximum Credible Accident Scenarios (MCAS).

2.2 SELECTION OF MAXIMUM CREDIBLE LOSS SCENARIOS (MCLS')

Following points are considered while selecting the release scenarios:

- Flash point for flammable chemicals
- IDLH of Toxic chemicals
- Operating/ Storage Temperature and Pressure of the material
- Total inventory of the material

2.2.1 Failure Rates

A leak or rupture of the barrel / pipe, releasing some or all of its contents, can be caused by brittle failure of the barrel/tank walls, welds or connected pipe work due to use of inadequate materials, combined with loading such as wind, earthquake or impact. The failure rates are the deciding factor for selecting the MCAS'. The failure rates for selected MCAS' are given in ***Table 2-11***.

Table 2-11: Failure Frequencies for Storage Barrel s

Categories	Catastrophic Rupture Frequency (per barrel per year)	Leak Frequency (per year)
Atmospheric Storage Barrel	3.0×10^{-6}	2.8×10^{-3}

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

2.2.2 Internationally recognized yardsticks for measuring risk

Risk assessment is considered using certain internationally recognized yardsticks for measuring risk. These first need to be explained, and this is done as ***Table 2-12***.

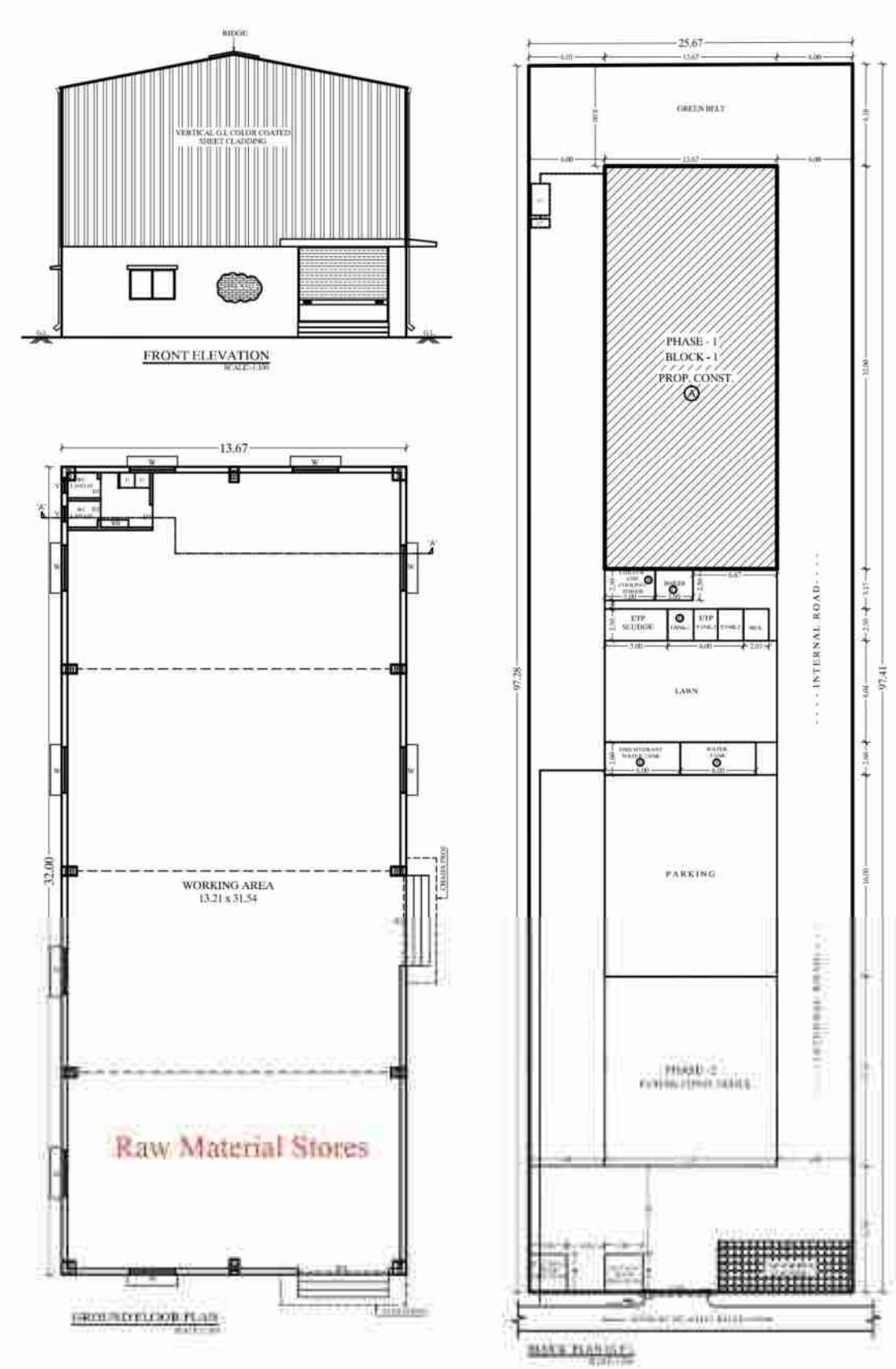
Table 2-12: Broadly Accepted Frequency

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

2.2.3 Simulation of Release and Development of Contours

As the MCLS' were developed for the selected set of chemicals, the next step is to carry out the consequence analysis. The consequence analysis results along with their contours are presented in the following sections. Contours are presented on plant layout map. Total length of plot is 97.41 m while total breadth is 25.67 m. The storage area is 31.54 m x 13.67 m = 431.15 m^2 while required storage area is 115 m^2 hence the storage area provided is adequate to store the stated quantity of raw material and finished products.

Map 2-1: Plot Plan



Methanol

Radiation level effect distance and overpressure effect distance due to the release of Methanol are presented below:

Table 2-13: Effect Distance due to Release of Methanol

Chemical (Storage Barrel)	Failure Scenario	Consequence	Met Data	Effective Distance in meter to Radiation Level			Overpressure Distances in Meters		
				4 kW/m2	12.5 kW/m2	37.5 kW/m2	0.02 bar	0.13 bar	0.2 bar
Methanol	10 mm Leak	Late pool fire	4.0/C	29	21	10	25	14	13
			3.0/D	30	21	10	40	25	24
			5.0/D	29	21	10	26	14	13
	Catastrophic Rupture	Late pool fire/ Late Ignition	4.0/C	49	30	21	164	180	136
			3.0/D	55	49	29	160	137	192
			5.0/D	60	46	31	163	176	132
		Fireball	4.0/C	31	16	NR	-	-	-
			3.0/D	66	35	NR	-	-	-
			5.0/D	31	14	NR	-	-	-

NR: Not Reached

The contours for effect distance generated for the release of methanol are presented below;

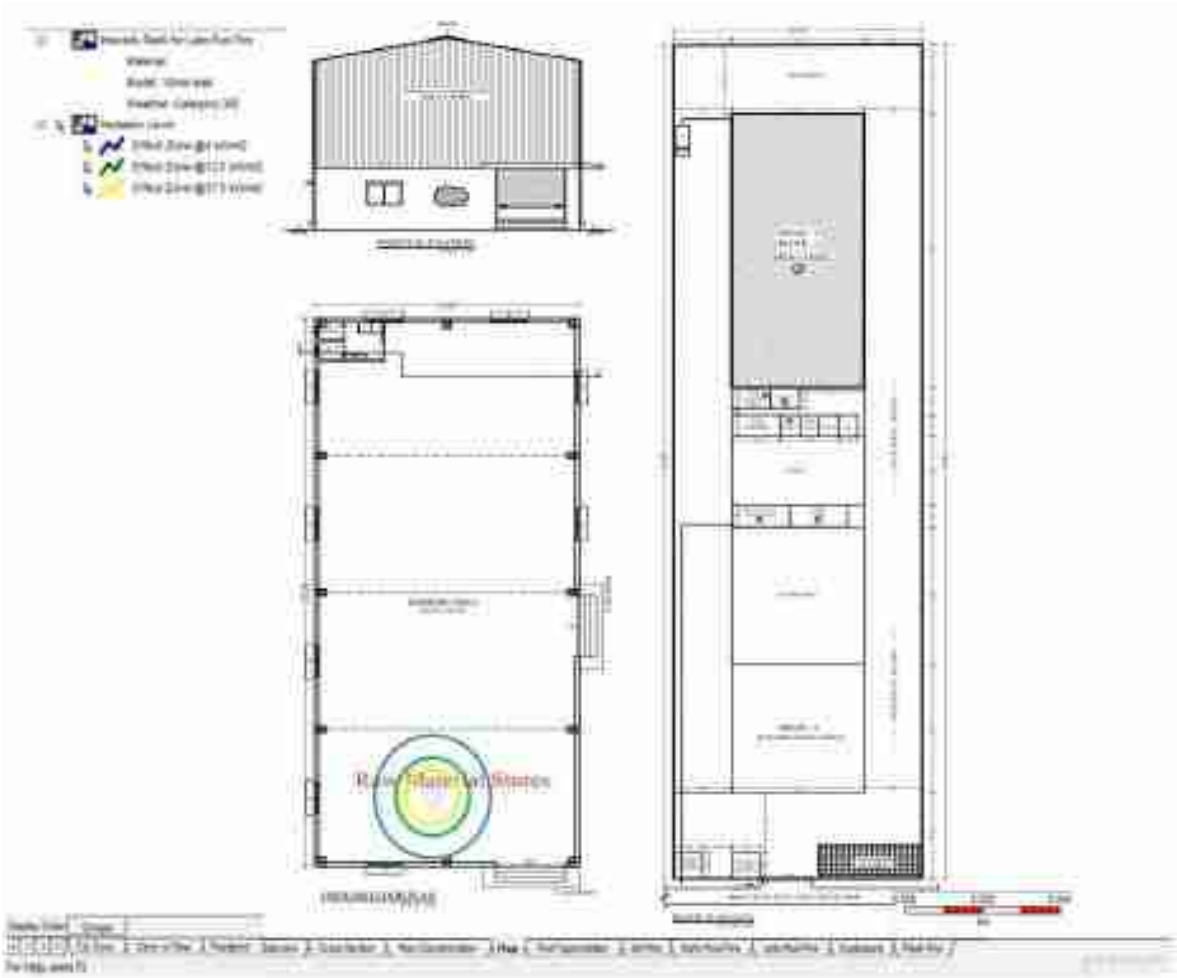


Figure 2-1: Late Pool Fire effect distance Contour due to 10 mm leak in storage barrel /Tank at weather condition 3/D.

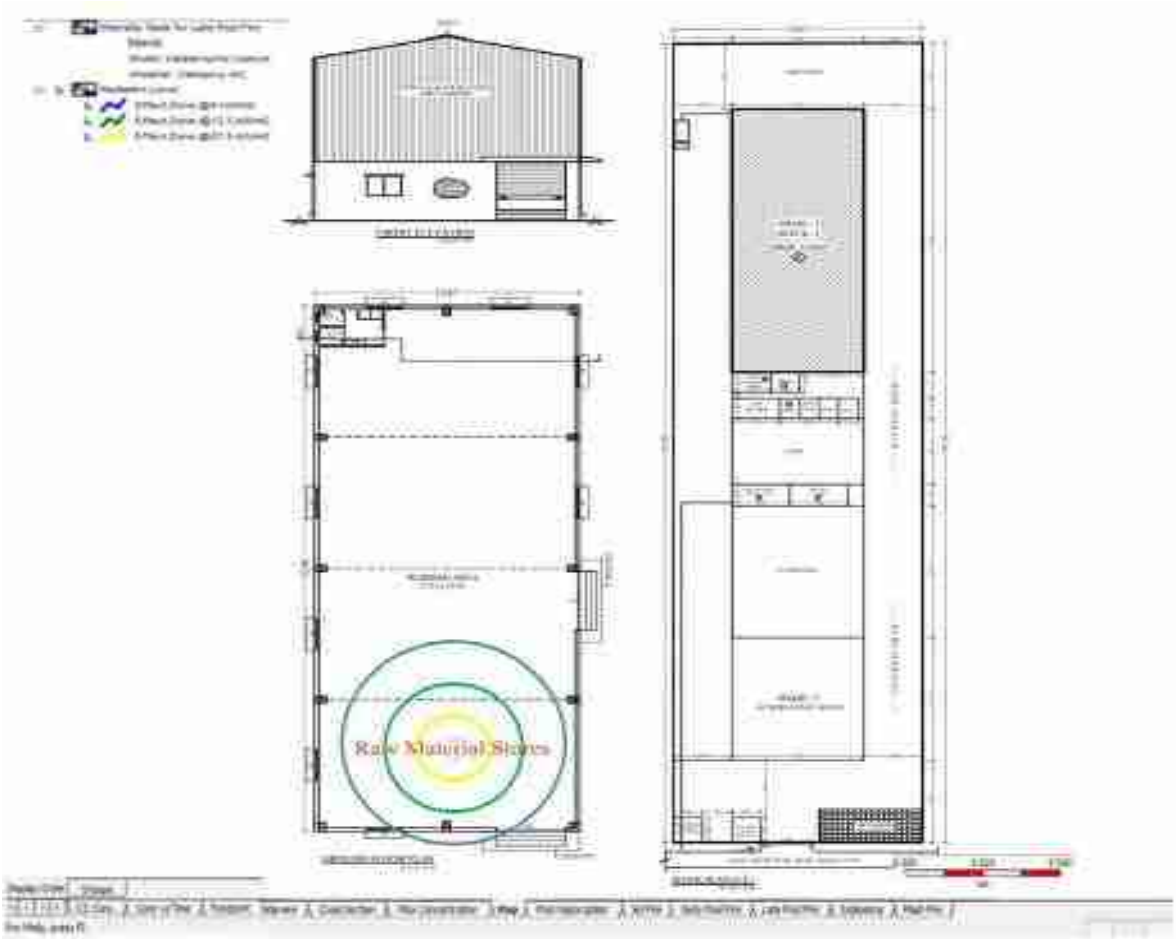


Figure 2-2: Late Pool Fire effect distance Contour due to Catastrophic rupture of storage barrel/Tank at weather condition 4/C

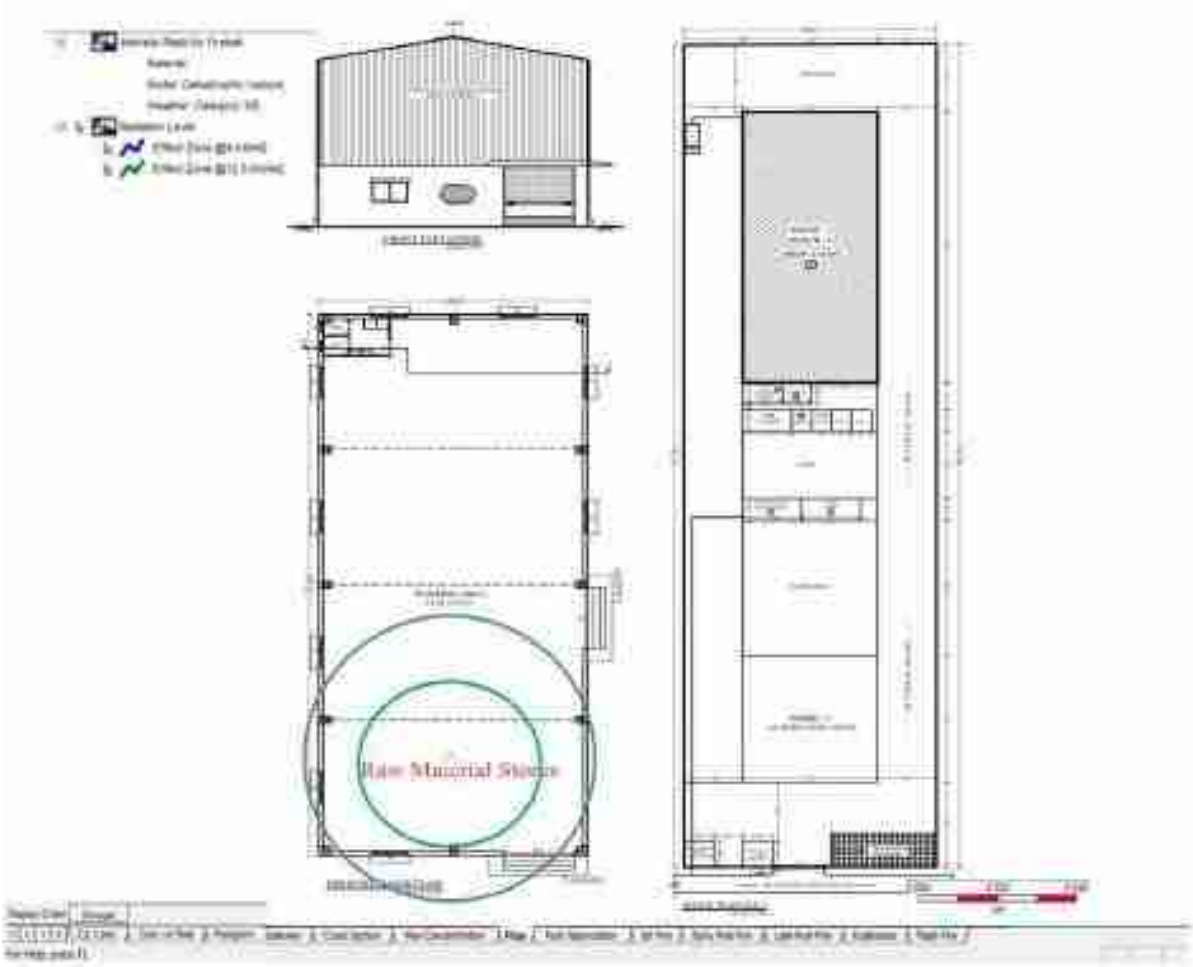


Figure 2-3: Fireball effect distance Contour due to Catastrophic rupture of storage barrel at weather condition 3/D

Acetonitrile

Radiation level effect distance and overpressure effect distance due to the release of acetonitrile are presented below

Table 2-14: Effect Distance due to Release of acetonitrile

Chemical (Storage Barrel)	Failure Scenario	Conse-quence	Met Data	Effective Distance in meter to Radiation Level			Overpressure Distances in Meters		
				4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	0.02 bar	0.13 bar	0.2 bar
Aceto-nitrile	10 mm Leak	Late pool fire	4.0/C	12	15	08	12	7	7
			3.0/D	34	26	14	13	7	7
			5.0/D	23	23	11	11	6	6
	Catastro phic Rupture	Late pool fire	4.0/C	70	47	22	61	24	23
			3.0/D	66	47	22	58	25	23
			5.0/D	70	48	24	60	26	24

The contours for effect distance generated for the release of acetonitrile are presented below:

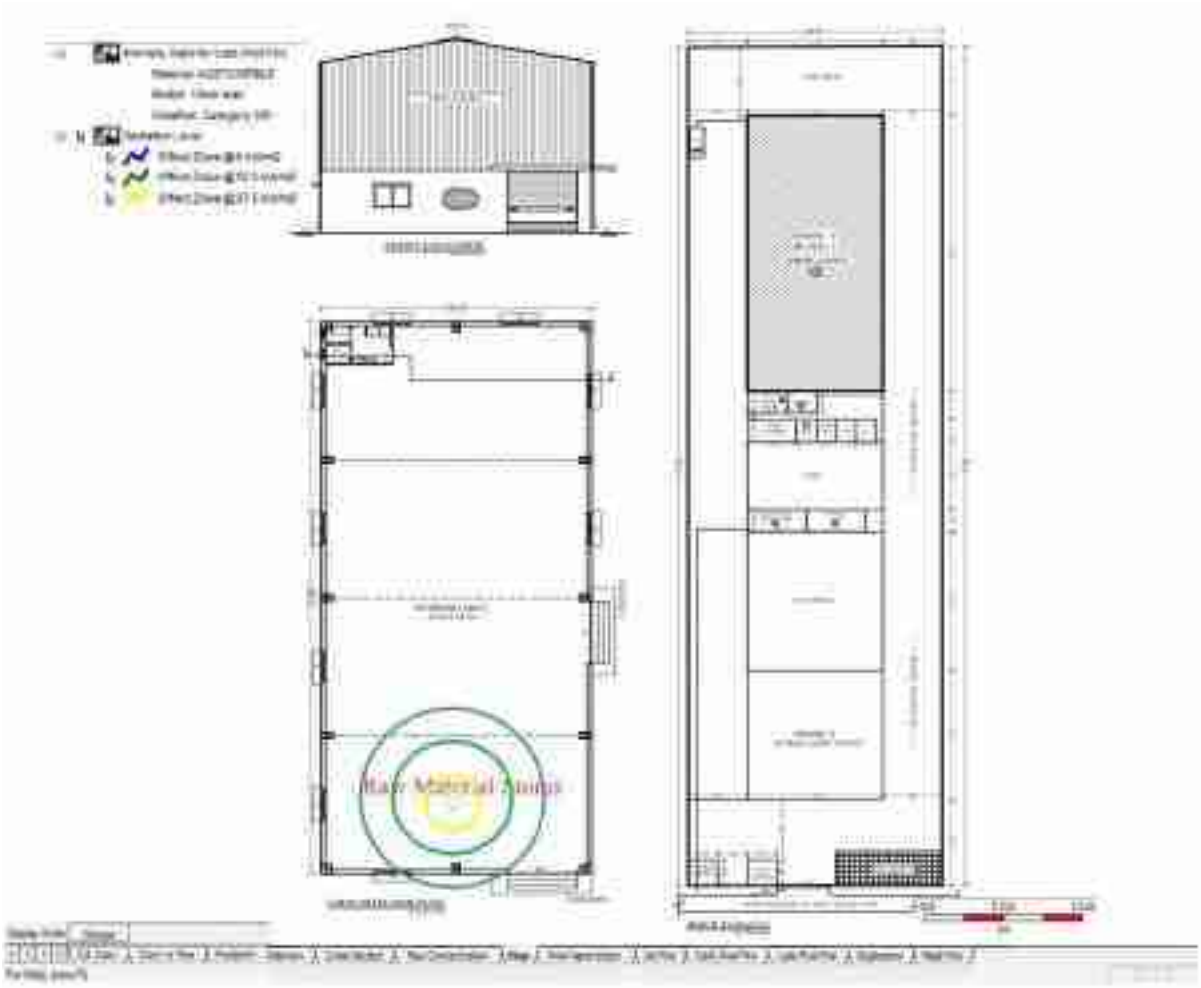


Figure 2-4: Late Pool Fire effect distance Contour due to 10 mm leak in storage barrel at weather condition 3/D.

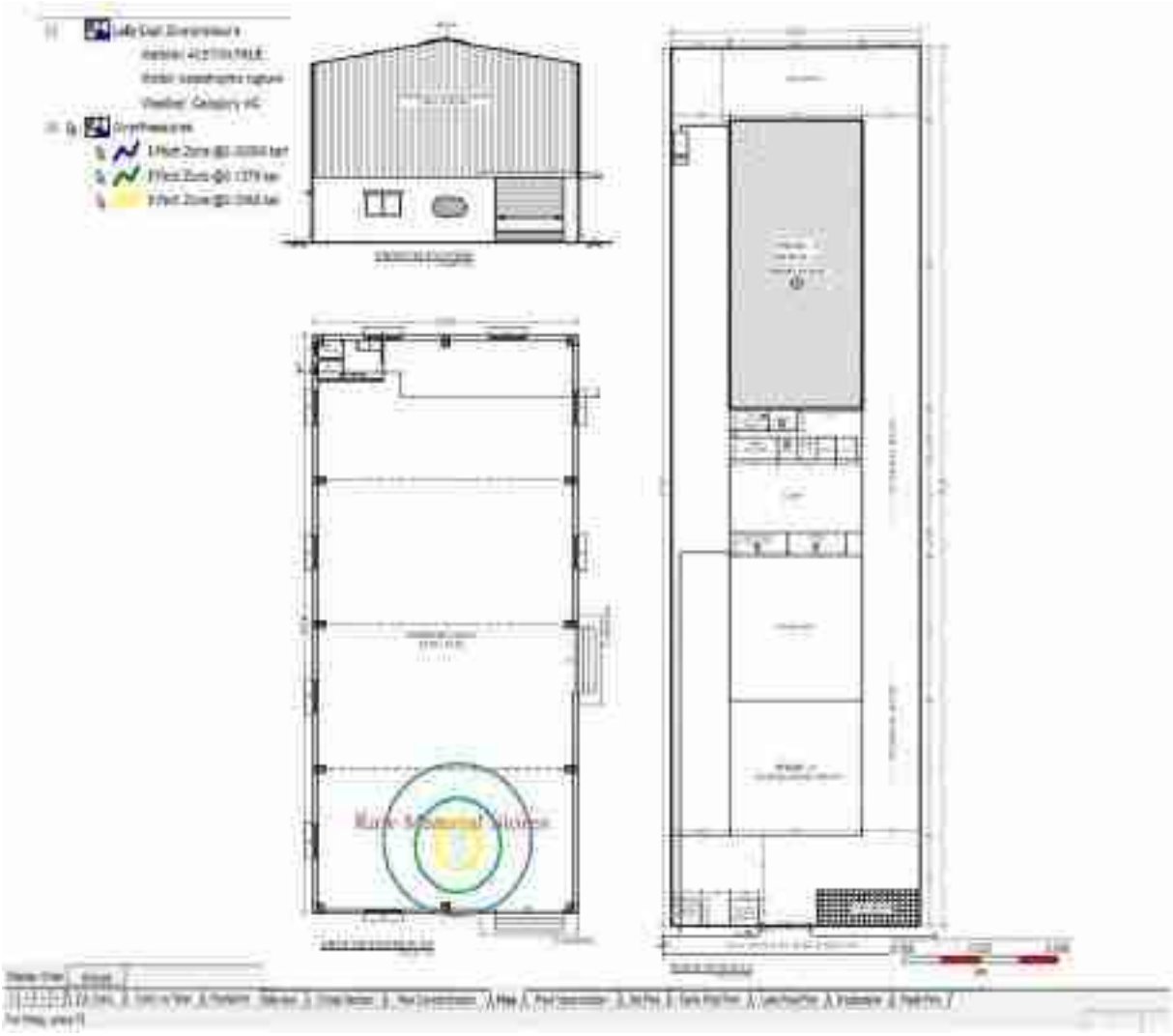


Figure 2-5: Late explosion overpressure effect distance Contour due to Catastrophic rupture of storage barrel/Tank at weather condition 4/C

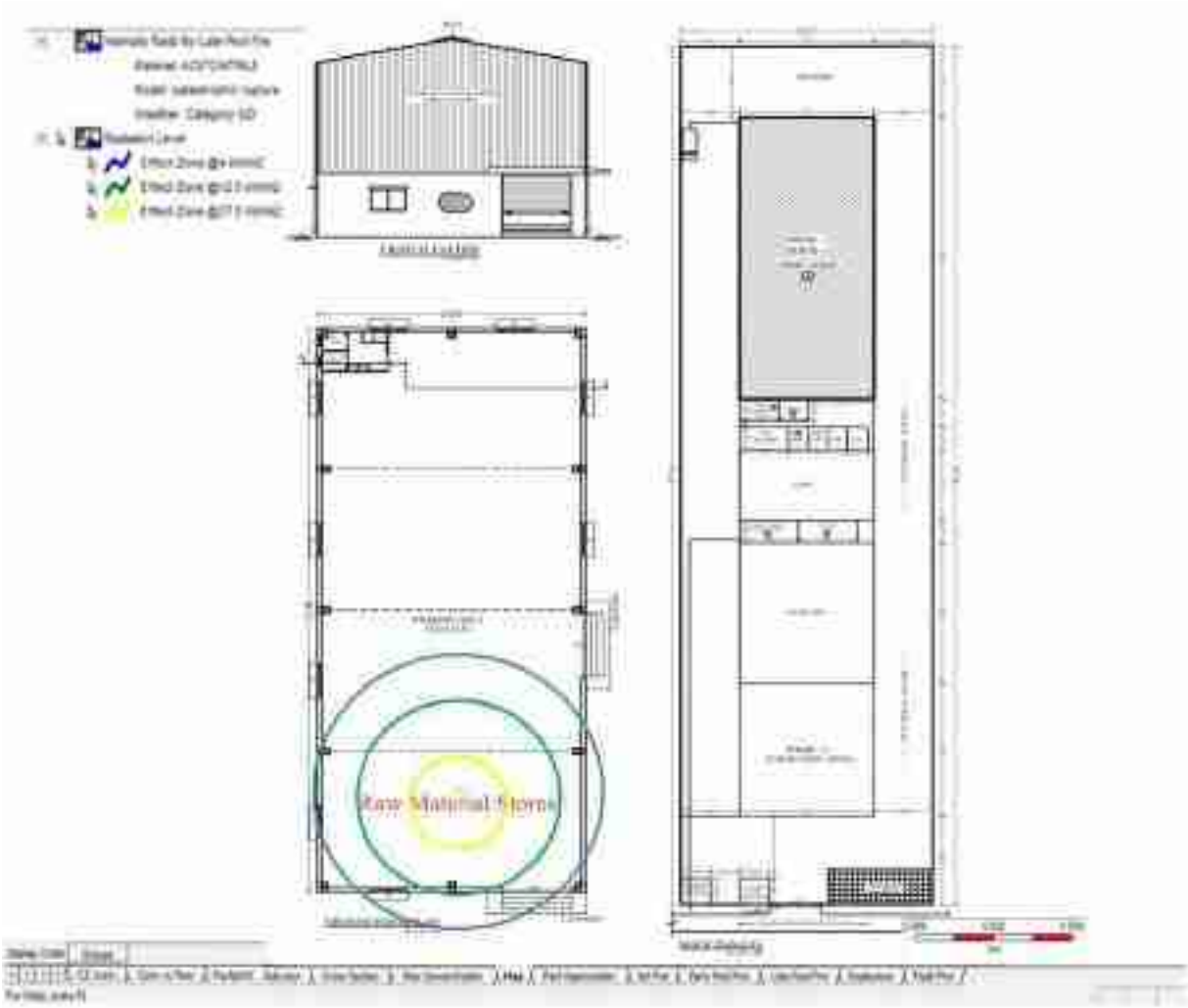


Figure 2-6: Late Pool Fire effect distance Contour due to catastrophic rupture of storage barrel/Tank at weather condition 5/D.

Ethyl Acetate

Radiation level effect distance and overpressure effect distance due to the release of Ethyl Acetate are presented below

Table 2-15: Effect Distance due to Release of Ethyl Acetate

Chemical (Storage Barrel)	Failure Scenario	Consequence	Met Data	Effective Distance in meter to Radiation Level			Overpressure Distances in Meters		
				4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	0.02 bar	0.13 bar	0.2 bar
Ethyl Acetate	10 mm Leak	Late pool fire	4.0/C	53	41	28	25	14	13
			3.0/D	67	43	28	23	13	13
			5.0/D	63	42	29	23	13	13
	Catastrophic Rupture	Late pool fire /Late Ignition	4.0/C	72	68	41	61	52	33
			3.0/D	72	67	39	67	67	48
			5.0/D	75	69	42	69	55	36

The contours for effect distance generated due to release of material are presented below:

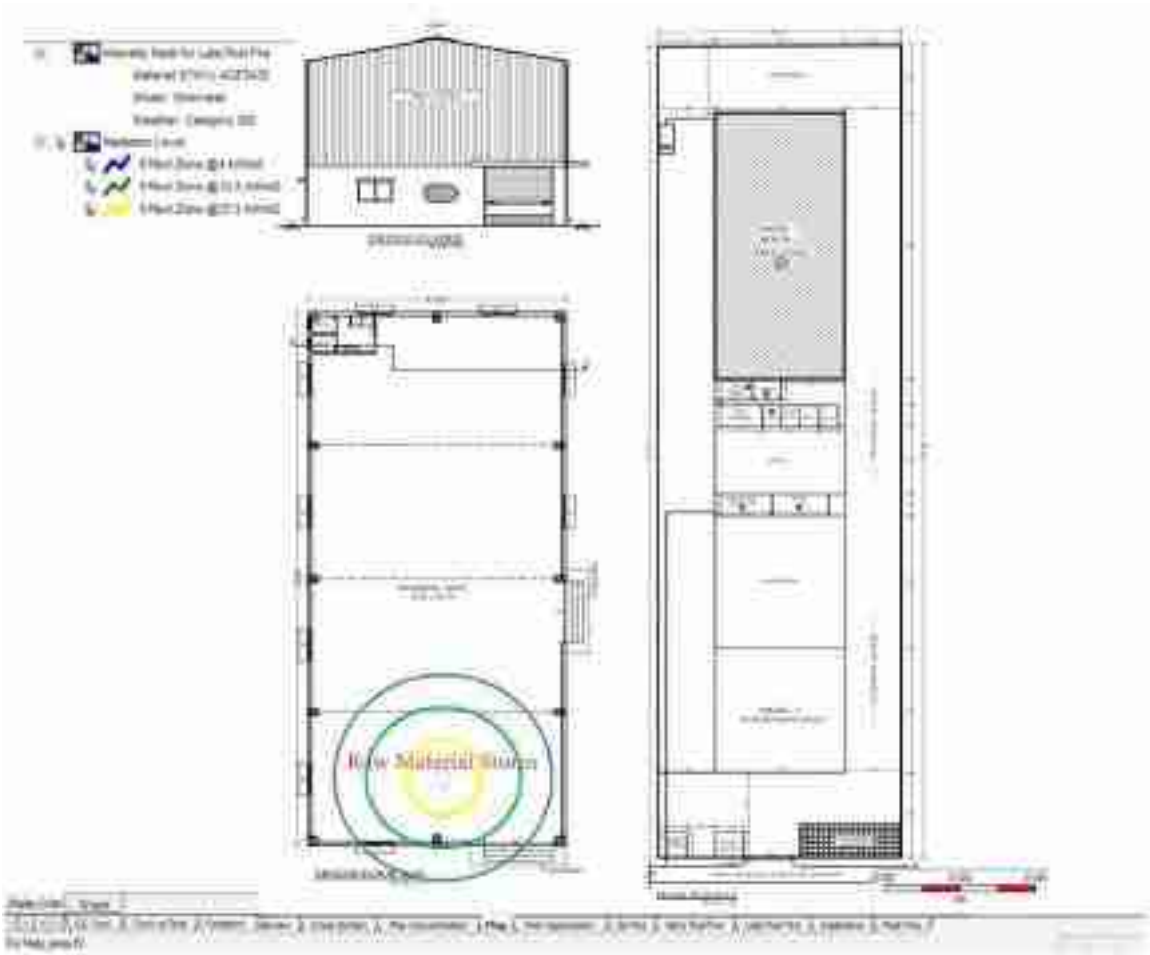


Figure 2-7: Late Pool Fire effect distance Contour due to 10 mm leak in storage barrel at weather condition 3/D.

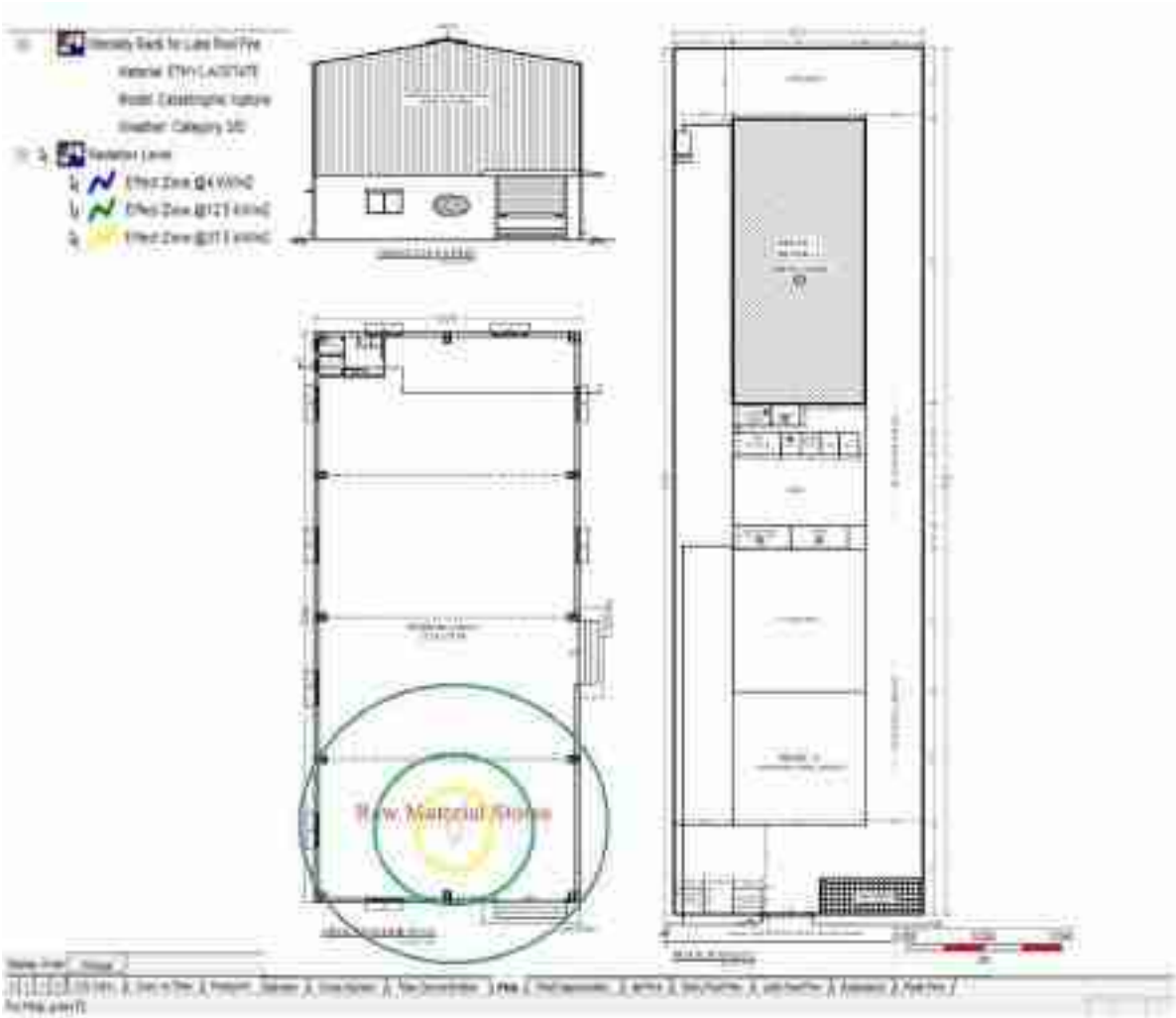


Figure 2-8: Late Pool Fire effect distance Contour due to Catastrophic rupture of storage barrel/Tank at weather condition 3/D

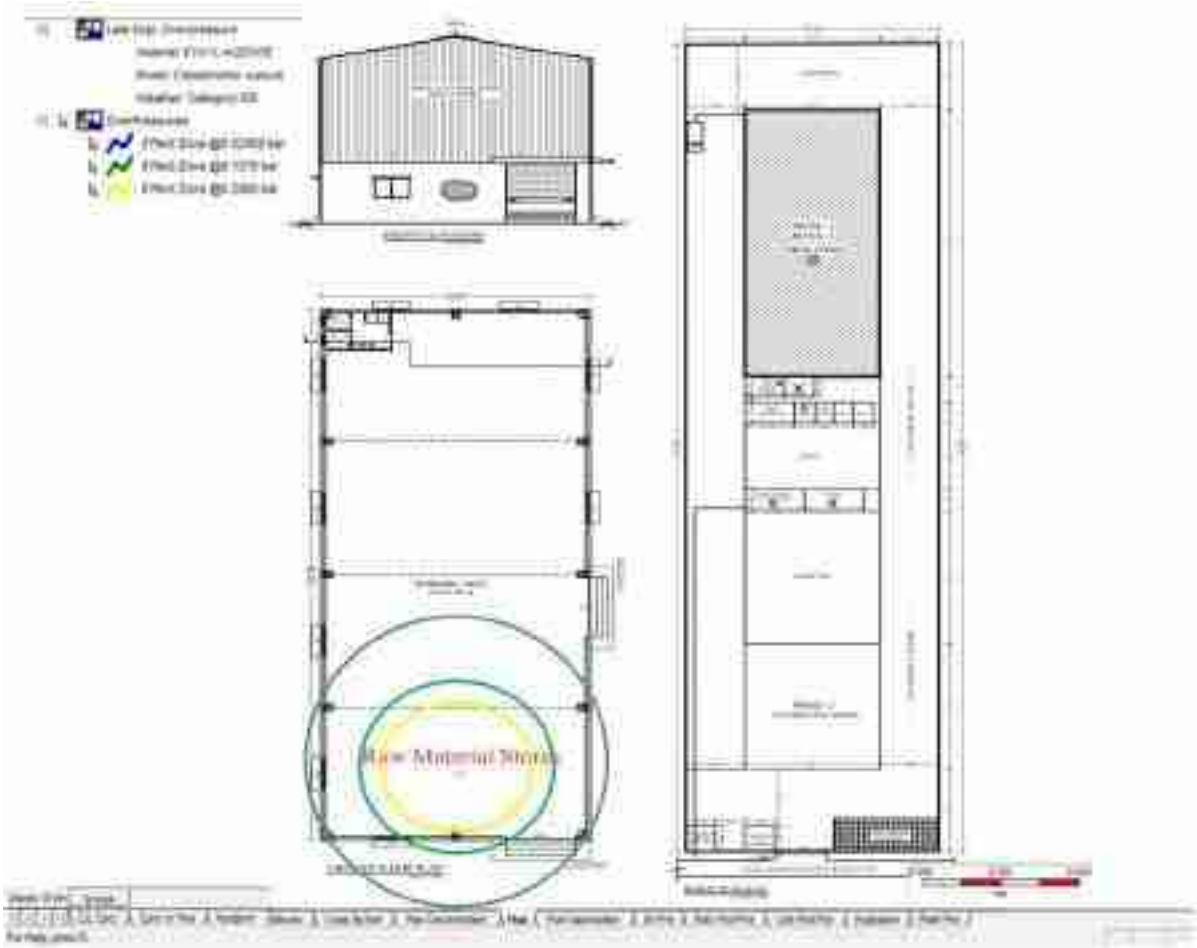


Figure 2-9: Late Explosion effect distance Contour due to Catastrophic rupture of storage barrel at weather condition 5/D

Toluene

Radiation level effect distance and overpressure effect distance due to the release of Toluene are presented below

Table 2-16: Effect Distance due to Release of Toluene

Chemical (Storage Barrel)	Failure Scenario	Consequence	Met Data	Effective Distance in meter to Radiation Level			Overpressure Distances in Meters			Effective Distance in meter to Toxic Level			
				4 kW/m^2	12.5 kW/m^2	37.5 kW/m^2	0.02 bar	0.13 bar	0.2 bar	EPRG 1 (50 ppm)	EPRG 2 (300 ppm)	EPRG 3 (1000 ppm)	IDLH (500 ppm)
Toluene	10 mm Leak	Late pool fire	4.0/C	15	11	6	14	12	7	73	30	17	33
			3.0/D	13	12	6	12	9	7	106	41	21	46
			5.0/D	16	13	6	15	13	7	90	34	16	38
	Catastrophic Rupture	Late pool fire / Late Ignition	4.0/C	37	27	NR	60	15	10	484	167	84	182
			3.0/D	37	27	NR	61	22	10	809	189	98	214
			5.0/D	39	29	NR	67	17	11	713	165	81	181

The contours for effect distance generated due to release of material are presented below:

Figure 2-10: Late Pool Fire effect distance Contour due to 10 mm leak in storage barrel at weather condition 5/D.

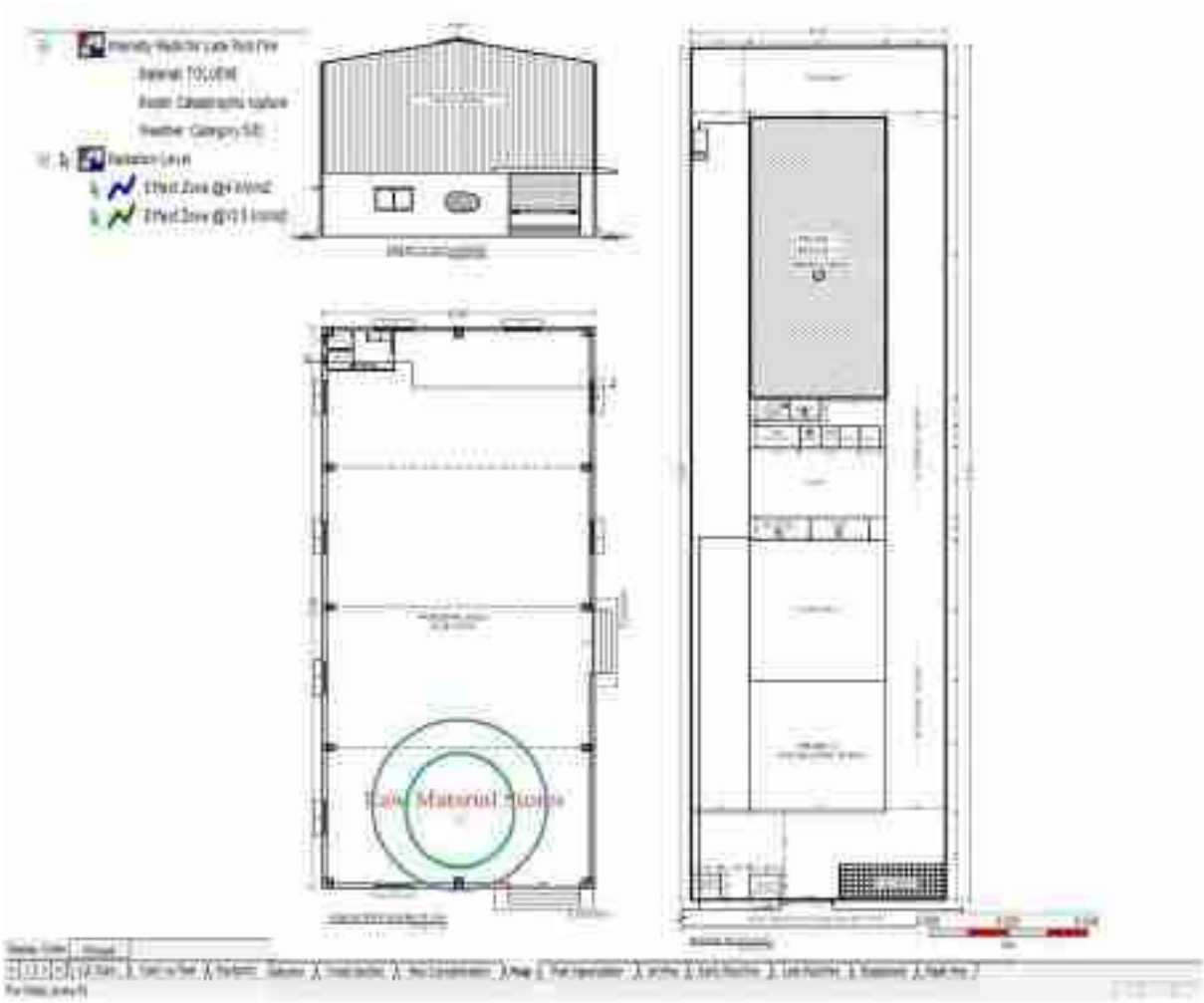


Figure 2-11: Late Pool Fire effect distance Contour due to Catastrophic rupture of storage barrel at weather condition 5/D.

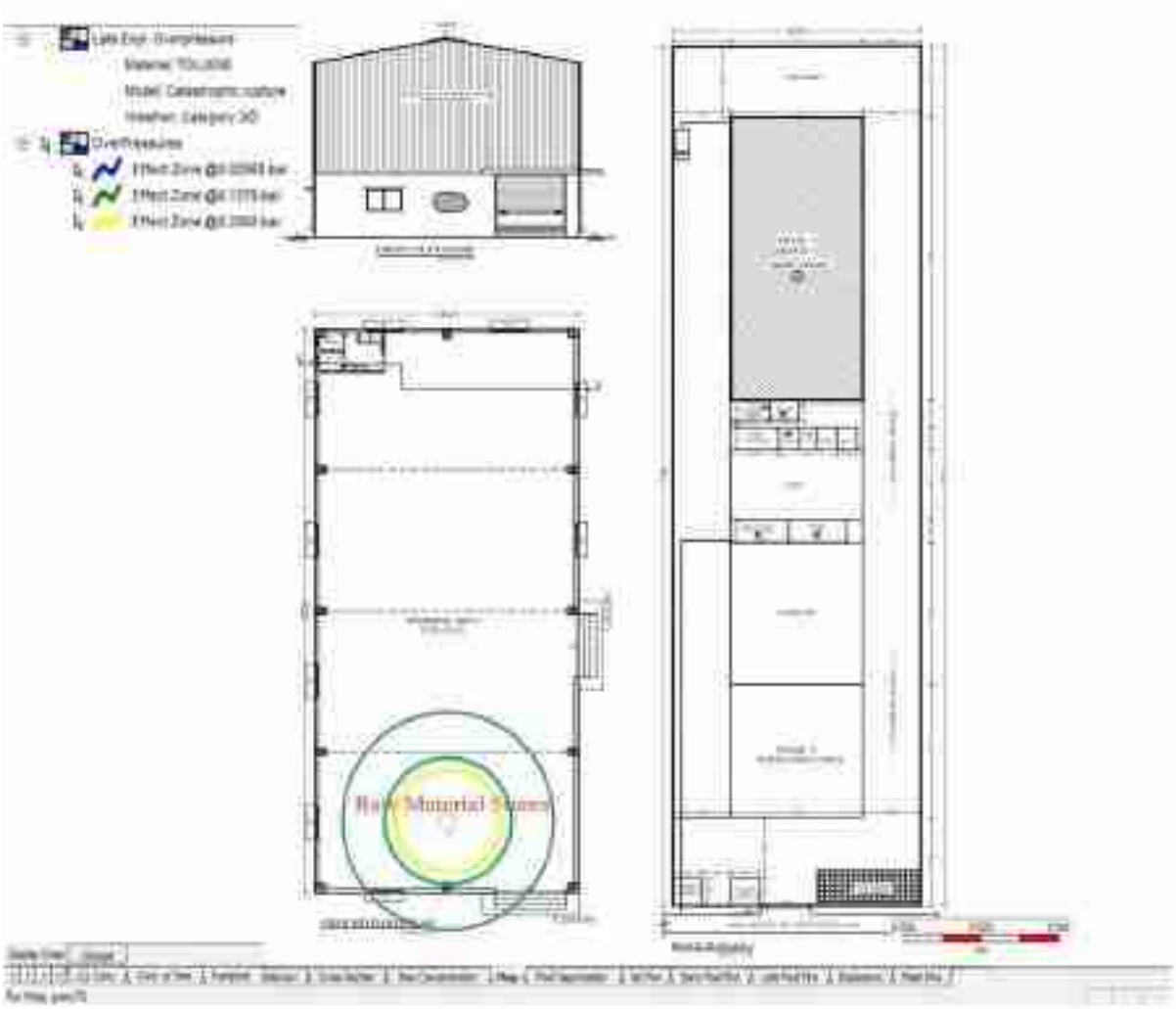


Figure 2-12: Late Explosion effect distance Contour due to Catastrophic rupture of storage barrel at weather condition 3/D

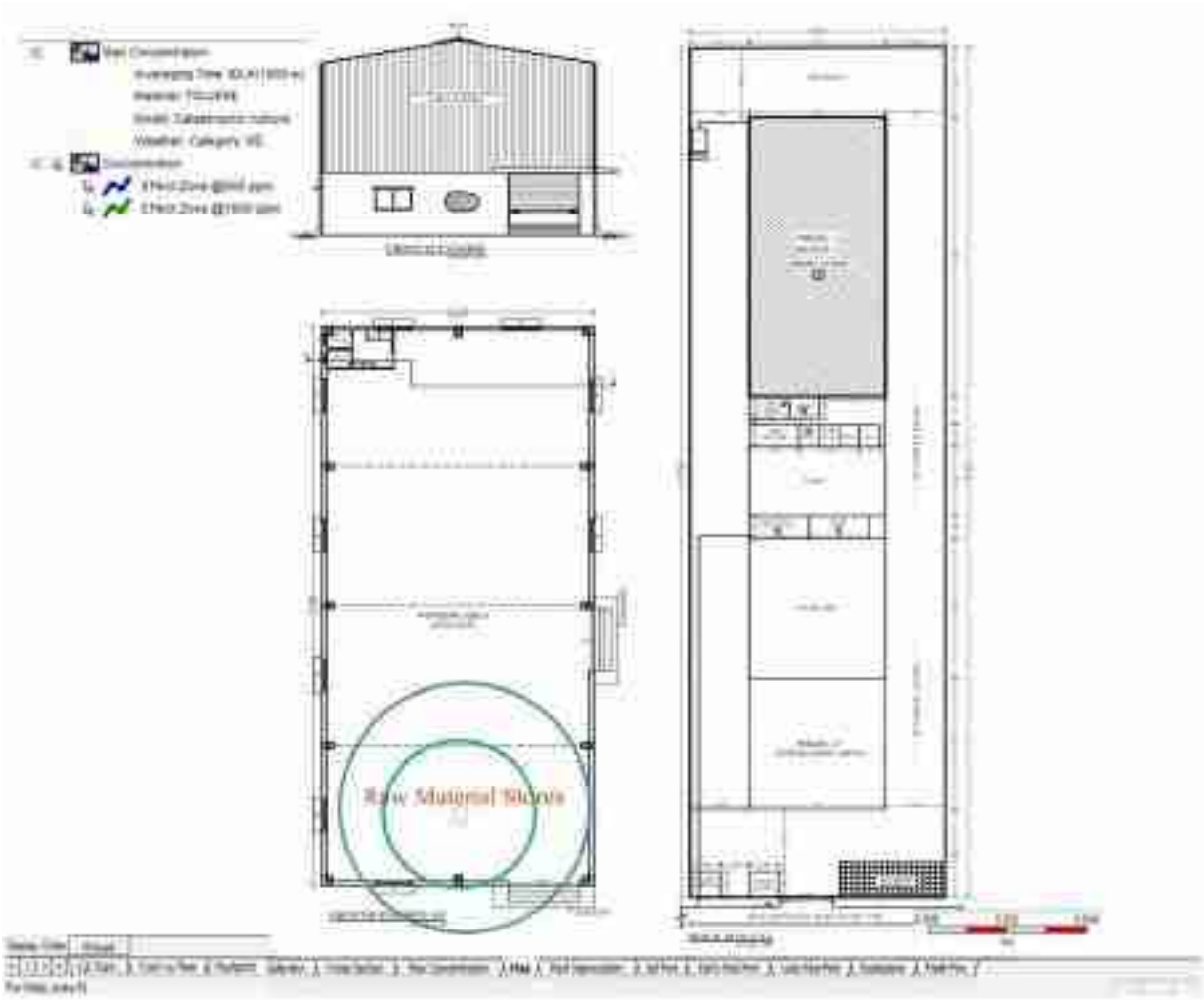


Figure 2-13: Maximum Concentration effect distance Contour due to Catastrophic rupture of storage barrel at weather condition 5/D

Isopropyl Alcohol

Radiation level effect distance and overpressure effect distance due to the release of Isopropyl Alcohol are presented below

Table 2-177: Effect Distance due to Release of Isopropyl Alcohol

Chemical (Storage Barrel)	Failure Scenario	Consequence	Met Data	Effective Distance in meter to Radiation Level			Overpressure Distances in Meters		
				4 kW/m2	12.5 kW/m2	37.5 kW/m2	0.02 bar	0.13 bar	0.2 bar
Isopropyl Alcohol	10 mm Leak	Late pool fire	4.0/C	27	20	10	24	13	13
			3.0/D	29	20	10	39	24	24
			5.0/D	28	20	10	24	12	13
	Catastrophic Rupture	Late pool fire/ Late Ignition	4.0/C	61	44	26	161	180	136
			3.0/D	59	43	25	158	137	192
			5.0/D	55	41	21	161	176	132
		Fireball	4.0/C	31	16	NR	-	-	-
			3.0/D	61	35	NR	-	-	-

			5.0/D	31	14	NR	-	-	-

NR: Not Reached

The contours for effect distance generated due to release of material are presented below:

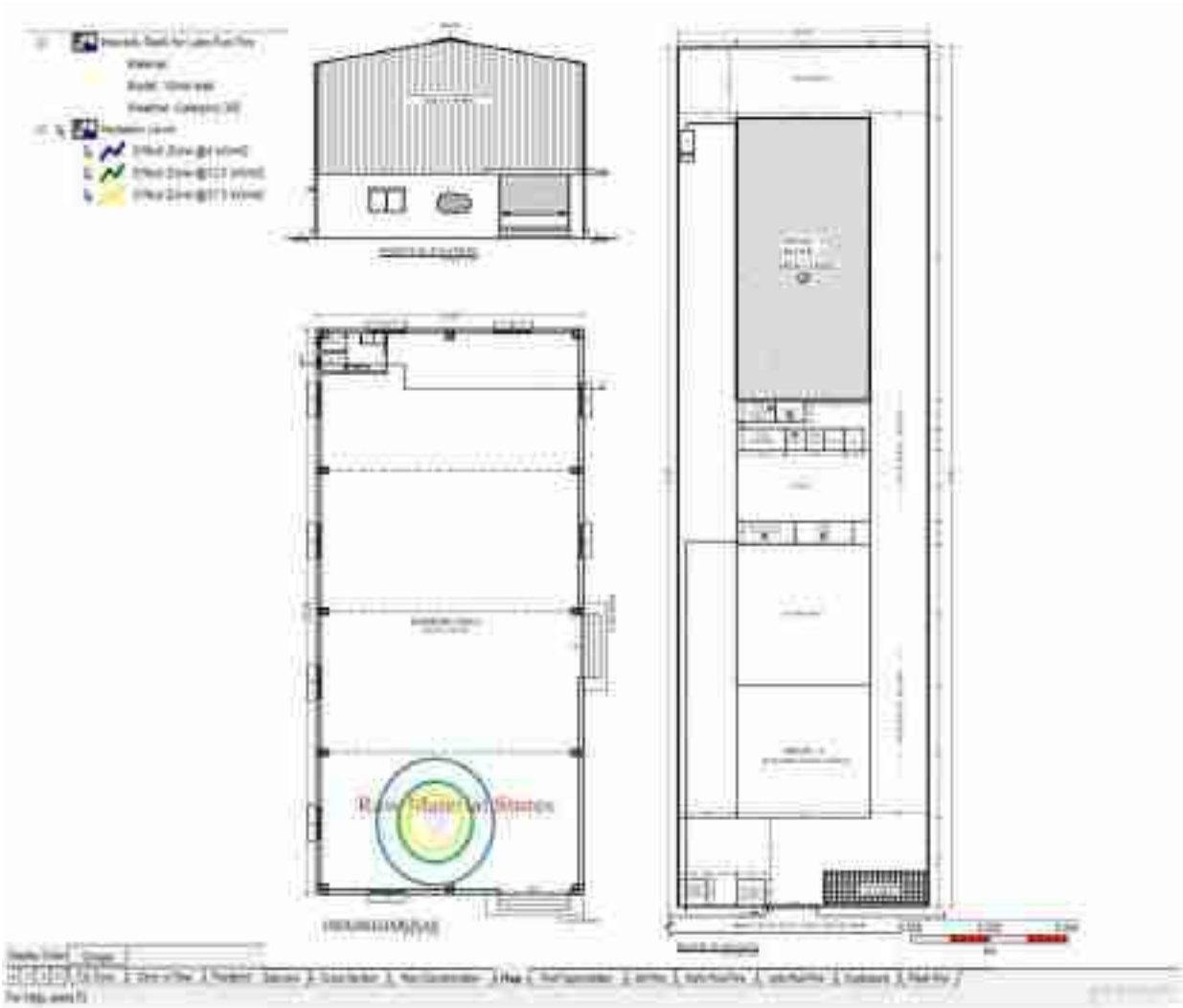


Figure 2-144: Late Pool Fire effect distance Contour due to 10 mm leak in storage barrel /Tank at weather condition 3/D.

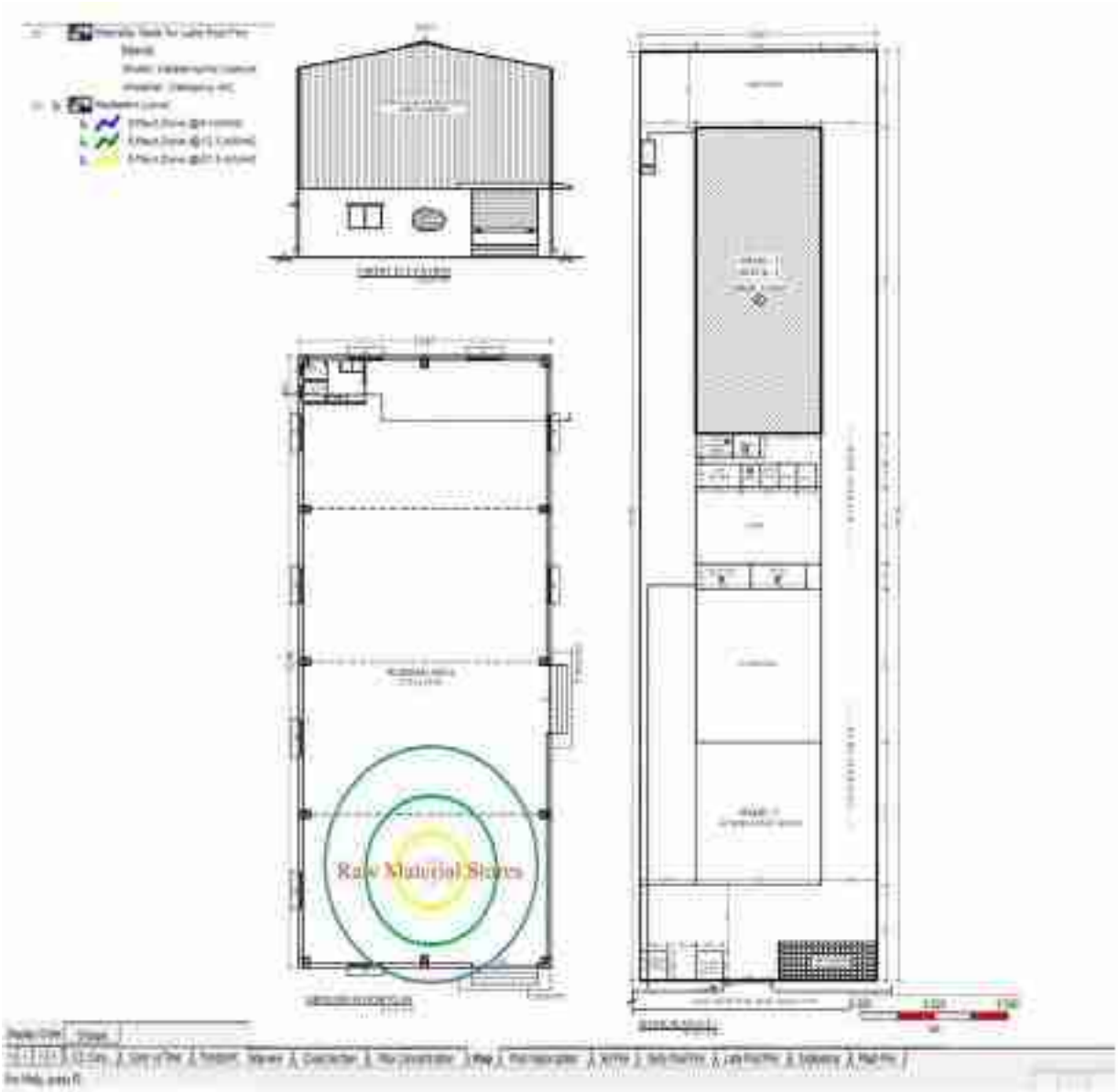


Figure 2-15: Late Pool Fire effect distance Contour due to Catastrophic rupture of storage barrel/Tank at weather condition 4/C

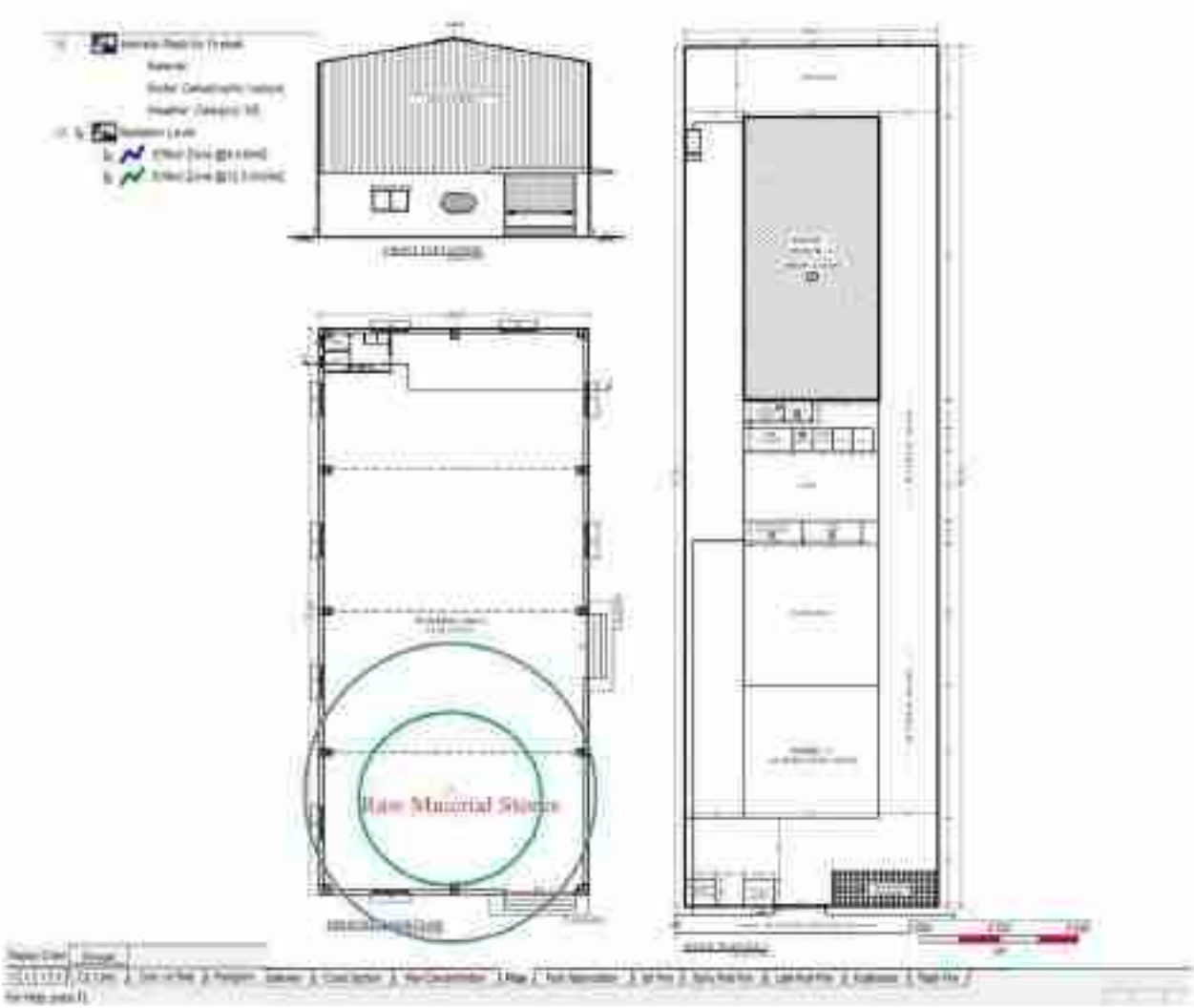


Figure 2-16: Fireball effect distance Contour due to Catastrophic rupture of storage barrel at weather condition 3/D

2.2.4 Results of Consequence Analysis

- Summary of effect distance (in meter) for worst case scenario of hazardous chemical considered for consequence analysis is given below:

Chemical/ Scenario	Effect Distance in Meters at specific Weather condition		
	At Radiation Level 4 kW/m^2	At Overpressure 0.02 bar	IDLH Concentration
Methanol	66 (3/D)	164 (4/C)	-
Acetonitrile Barrel	70 (4/C)	61 (4/C)	-
Ethyl acetate Barrel	75 (5/D)	69 (5/D)	-
Toluene Barrel	39 (5/D)	67 (5/D)	214 (3/D)
Isopropyl	61 (3/D)	161(5/D)	-

- The effect of late pool fire due to 10 mm leak scenario is confined to the site boundary.
- It can be seen from the summarized table above that the risk of late pool fire is highest in worst case scenario of release of Ethyl Acetate in 5/D weather condition for 4 KW/m^2 radiation level.
- Out of all the toxic chemicals like Toluene etc., dispersion of Toluene covers more distance in case of IDLH concentration at 3/D (214m) weather condition.

Preventive Measures will be adopted:

- Evacuation routes will be planned such that alternate route is available from any corner in more than one direction.
- Extra precautions will be taken in loading/ unloading of flammable/toxic chemicals.
- Firefighting arrangements shall be provided as per the guidelines of OISD.
- In case of release of toxic chemicals, evacuation will be done up to 214 meters till there is clarity about which chemical has leaked.
- Barrel/Tank Storage:
  - OISD guidelines will be followed in design, installation and maintenance of UG storage barrel.
  - Separate Isolated Storage area will be constructed as per explosive department requirement.
  - QPPL will be carried out to decide the type of electric installation.

2.2.5 Safety Precautions / Preventive measures

1. Safety Precautions during Construction phase

- Required PPE will be provided to cover occupational injury to foot, head, hearing, and eye
- **Fall Protection:** The Contractor is required to provide fall protection to employees who are working at heights equal to or greater than 1.8 m. The fall protection can be in the form of perimeter protection such as guardrails and toe rails, harness, personal protective equipment (PPE), a safety monitoring system, or a fall protection plan. Activities that require personal fall protection systems include steel erection bolting, riveting, fitting-up and plumbing-up, work over water and some deep excavation work
- **Foot Protection**: If machines or operations present the potential for foot injury, the contractor will provide foot protection with safe design and construction for the work to be performed. Workers and visitors shall not be allowed on a construction site without safety boots. The foot protection will be provided for workers working with concrete or cement. Gum boot shall be provided to avoid contact with cement/RCC mixtures and mortar.
- **Head Protection:** If head hazards remain after all steps have been taken to control them (safety nets for work at heights, proper housekeeping), the Contractor will provide workers with appropriate head protection. Safety helmet

will be recommended. When the worker is carrying load on the head a suitable head protection will be provided.

- **Noise Protection:** Workers shall wear hearing protection devices (ear plugs, ear muffs, canal caps), whenever the diesel operated engines, DG set or other noisy machines are operating in the area. The operation of these machines during night after 10 PM shall be strictly avoided. The workers shall be informed the hazards and long term effect of working in noisy area (e.g. loss reduction in hearing over a period of 5 to 10 years).
- **Eye Protection:** When operations present potential eye injury from physical or chemical elements, the Contractor will select, provide, maintain and required affected workers to use appropriate eye protection. Eye protection is required while working on RCC dismantling, steel fabrication, welding, rough plastering and painting work. Any work which involves looking upside also requires the protection e.g. electrical cabling on walls and ceiling. The various eye protecting devices like safety glasses and goggles, face shields and welding helmets will be provided to workers.
- **Hand protection**: Suitable hand gloves shall be provided for working with cement or mortar. A suitable anti-allergic cream or protecting gel shall be applied on the hands for persons who develop allergy with cement or lime.
- **Electrical Safety**
    - A licensed electrician shall be deployed to complete all temporary wiring and electrical installations required for construction activities.
    - Fuses and circuit breakers (ELCB's) shall be used to protect motherboards, conductors and equipment to avoid short circuiting and electric shock. MCB's and fuses will also to be used to protect the electrical equipment from over current and over voltage.
    - Extension cords for equipment or as part of a temporary wiring system shall not be damaged or compromised in any way and insulation must be of the highest grade.
    - The joints of electrical wires shall be avoided or an extension cord can be used if needed
    - Anytime electrical equipment will be deactivated for repair, or circuits will be shut off, the equipment will be locked out and tagged at the point where it can be energized.
    - Proper earthling will be ensured for all equipment and electrical panels
    - Temporary lights shall not be suspended by their cords.
    - The employer shall provide the necessary safety equipment, supplies and monitoring equipment to their personnel.
    - During the operation stage maintenance of transformer and manning of electrical substation shall be by the competent persons only.

2. Action Plan for Safe Handling of Chemicals and Safety Systems/ Safeguards/ Control Measures to Reduce the Risk of Fire, Explosion and Toxic Release

Following mitigation measures will be followed /practiced during transportation, unloading and handling of flammable and toxic chemicals, in order to ensure health and safety of workers involved in handling hazardous chemicals and avoid the human health impacts.

Table 2-189: Mitigation measures for safe handling of Flammable and Toxic chemicals

S.No.	Activity	Safety Precautions
1.	Transportation of solvents like Toluene, etc. by road.	• Training will be provided to driver and cleaner regarding the safe driving, hazards of Flammable chemicals, emergency handling and use of SCBA sets. • TREM card will be kept with Threshold Limit. • SCBA set will be kept with TL. • Fire extinguishers will be kept with TL. • Flame arrestor will be provided to TL exhaust. • Instructions will be given not to stop road barrel/Tankers in populated area. • Hazard Identification symbol and emergency telephone number will be displayed as per HAZCHEM CODE. • Appropriate PPEs will be kept with TL.
		In case of leak or spill: • Area will be isolated. • Container shall be isolated. • Source of leakage will be checked. • Damaged containers or spilled material shall not be attended without wearing appropriate protective clothing. • Leakage will be stopped, if possible to do so without risk. • Water spray will be used to reduce vapors (but do not put water directly on leak, spill area or inside container). • Combustibles (wood, paper, oil, etc.) will be kept away from spilled material.
2.	Unloading of solvents from barrel.	• Priority will be given for Barrel/Tankers to immediately enter the storage premises at site and will not be kept waiting near the gate or the main road. • Security person will check License, TREM CARD, Fire extinguisher condition; SCBA set condition, Antidote Kit, required PPEs as per SOP laid down. • Store officer will take sample as per sampling SOP from sampling point. • After approval of QC department unloading procedure will be allowed be started. • Following precautions will be taken during unloading: 1. Wheel stopper will be provided to TL at

S.No.	Activity	Safety Precautions
		unloading platform. 2. Static earthling will be provided to road barrel. 3. Barrel unloading procedure will be followed according to check list and implemented. 4. Flexible SS hose connection will be done at TL outlet line. 5. All TL valves will be closed in TL. 6. Only day time unloading will be permitted.
3.	Solvents storage Barrel s safety.	• SS storage barrel will be provided as per IS code. • Vent will be connected to water trap and vent of water trap will be provided with flame arrestor. • FLP type pump & electric fittings will be provided. • Double static earthling will be provided to storage barrel, as per the requirement. • Double Jumper clip will be provided to all solvent handling pipeline flanges. • Dyke wall will be provided to storage barrel. • Dumping /Drain vessel/alternate vessel will be provided to collect the spillage material inside the dyke wall. • Level transmitter will be provided with low level/high level auto cut-off provision. • Workers and Operators handling such materials shall be trained for the hazards (fire/explosion, health, chemical reactivity, etc.) & safety measures associated with them. • NFPA label (hazard identification) along with capacity of chemical will be displayed on respective barrel s & drums. • Pipes and equipment shall be inspected at regular intervals. • All storage areas shall be isolated from all sources of open flame and well posted with “Hazardous Chemical Storage”, “No Smoking”, “Hot work Restricted” signs. • Spark-resistant tools will be used. • Water spray will be used to reduce vapors (by taking care that water is not directed straight away on leak, spill area or inside container). • Combustibles (wood, paper, oil, etc.) will be kept away from spilled material. • Storage area will be provided with adequate firefighting/extinguishing system, Fire hydrant monitor with foam attachment facility, etc. Sand Buckets will be made available.
4.	Solvents transfer from storage barrel/tank to Process Plant.	• Double mechanical seal type FLP type pump will be provided. • Double on / off switch will be provided at barrel farm and process area near day barrel. Pump auto cut off with day barrel high level will be provided. • Flame arrestor will be provided on day barrel

S.No.	Activity	Safety Precautions
		/tank vent. • NRV will be provided on pump discharge line. • Double Jumper clip will be provided to all solvent handling pipelines. • Double static earthling will be provided.

3. Recommendations to Reduce Fugitive Emissions:

- Regular monitoring of plant area will be conducted and records will be maintained. At strategic point of the plants, online detectors will be provided for detection of such emissions.
- Lines of such hazardous chemicals will be tested periodically and such tests may be recorded.
- All lines carrying toxic liquid will be continuous welded and shall be provided with proper slopes and special tongue and groove joints to avoid liquid stagnation and leakage.
- Increase ventilation when using products that emit VOCs like Toluene, etc.
- Spill containment kit will be made available.
- Dyke wall will be provided and PPEs will be given to concerned personnel.
- Only trained personnel will be allowed to carry out work in this area.
- In the process area, all the strategic pumps will be of submerged type so as to eliminate leakages from glands.

4. Fire Fighting System / Fire Control Plan

Considered fire prevention measures at the project planning stage for its upcoming new facility to avoid any outbreak of fire. By looking to the hazardous nature of process and the chemicals that are handled and processed, the chances of outbreak of fire cannot be totally ignored. Hence to tackle such a situation, company has developed proposed, well-resourced and adequate fire protection system/firefighting network. The management has proposed to keep the following extinguishers at site:

Other Firefighting measures proposed for the new facilities:

- Fire load calculation will be carried out and accordingly firefighting facilities comprising of main pump, stand by pump, jockey pump, diesel driven pump, Hydrant Network, automatic fire detection and control system, hose box, hose reels, underground water reservoir, Manual call points, fire alarms, fire buckets, smoke / heat detectors etc. Will be provided as per the GFR and TAC guidelines.
- Also, flame detectors, smoke / temperature actuated heat detectors with alarms, automatic sprinkler system, shall be installed at conspicuous locations as per the requirements.
- Quantinental Pharmachem Pvt. Ltd. will provide Fire Water of adequate capacity to combat the emergency, if arise, the water reservoir shall also be made available, if required.
- Preventive maintenance of firefighting facilities (Fire water pump, drive engines, hydrants, monitors, alarm systems, etc.) shall be carried out periodically.
- Working staff will be trained to operate DCP and CO_2 extinguishers.
- DG set will be available as a separate power backup for fire network.
- Company will do tie up with Fire Brigade and nearby companies, for handling emergency situations.
- Electric driven alarms & sirens will be placed at the conspicuous locations. Hand Bell will be used in case of power failure.

- Factory Layout will be designed in such a way, that it will have a provision for separate entry and exist with adequate margin all around the periphery for unobstructed easy movement of the emergency vehicle / fire tenders without reversing back.

5. Cylinders Storage and Handling

- All compressed gas cylinders will be stored in the upright position.
- Valve protection caps will be placed on compressed gas cylinders that are in storage or are not being used.
- Compressed gas cylinders will not be lifted by the valve protection cap.
- Compressed gas cylinders will not be stored in hazardous areas.
- Compressed gas cylinders will be hoisted on the cradle or compressed gas cylinder basket.
- Compressed gas cylinders shall not be placed against electrical panels or live electrical cords where the cylinder can become part of the circuit.
- The dented, cracked or other visibly damaged cylinders shall not be used.
- If gloves are greasy or oily, do not handle cylinders.
- Cylinders shall not be transported without first removing the regulators and replacing the valve protection caps.
- While opening the valve, stand to the side of the regulator.
- Hoist or transport of cylinders by means of magnets or choker slings shall not be done.
- The cylinder valves will be opened slowly.

6. Safety Precautions for Ammonia

- An automatic leak detection system will be used.
- Water Sprinklers shall be checked for its proper working condition.
- Safety warning postures/signs will be displayed inside the area.
- In event of a spill or leak, escape-type respirator shall be used.
- Non-sparking ventilation systems and intrinsically safe electrical systems shall be used.
- HCl torch shall be made available to be used for the detection of ammonia leakage.
- A dead-end siding shall be provided to limit the movement of barrel ers while storage and handling.
- Excess-flow protection valves shall be provided in the distribution lines.
- Antidotes (Skin): Wash with Lactic Acid, Apply soframycin, (Eye): Benoxynate, (Throat): Smelling Ethanol or Ether.
- Name plate shall be provided for electrical fittings.
- PESO license no., its validity date etc. will be displayed where.

7. Ways to Minimize the Manual Handling of the Hazardous Chemicals

- SOPs, work instructions will be prepared and followed.
- Fork lifts will be used for unloading chemical bags, bags movements within plant, etc.
- Cranes, hoists, pallet trucks, conveyors, etc. shall be used as per the requirement, to eliminate manual handling.
- Lifting tools & tackles will be used, wherever required.

- Trainings will be provided to relevant staff, operators, workers for the risk associated with manual handling of hazardous chemicals, ways to overcome those risk, etc.

8. DO'S & DON'TS

Management has listed some of the Do's & Don'ts activities to strengthen the SAFETY AT WORK, which will be followed strictly:

For Preventive Maintenance

Do's:

- Ensuring that operators/workers etc. follows the SOPs, Safety procedures & standards, work permit system etc.
- Inspection of Storage Area, Earthing & Bonding system.
- Inspection of all Fire Fighting Facilities /Check Alarms operation.
- Checking the availability of Spill Containment Kit.
- Make sure existing fire extinguishers are fully charged and ready for action.
- Inspections of plant, machinery, tools, equipment, premises, work practices, processes, procedures and general environment must be carried out for the health and safety of plant, people and surrounding.
- On-site and Offsite Emergency Plans shall be reviewed and updated, as per the requirement.

Don'ts:

- Don't allow anyone who hasn't received specific safety and operational training to get indulge in any site activity.
- Don't perform any activity without proper permit.
- Don't perform your own maintenance.
- Don't compromise on Design and Engineering part.
- Don't panic if you are in a risky situation.
- Don't allow spilled chemicals to drain to sewers/gutters etc.

Strengthening of HSE (Applicable for Manufacturing Utility Staff)

Do's:

- Follow instructions. Do not take chances. If you don't know, ask.
- Correct or report unsafe conditions.
- Include a timeline for completion of each recommendation.
- Make recommendations that are measurable and trackable.
- Ensure that each recommendation is assigned to an individual to oversee implementation.
- Help keep things clean & orderly. Keep gangways clear.
- Do not Horseplay. Do not run. Avoid distracting others. Avoid throwing things.
- Report all injuries. Get first aid promptly.
- Use, adjust and repair equipment only, when authorized.
- Use right tools & equipment's for the job, use them safely.
- Do not smoke in restricted areas. Do not flick cigarette/beedi in company.
- Use prescribed protective equipment; keep them in good working conditions.
- Respect signs / warnings. Abide by rules laid down for your safety.

Don'ts:

No worker in a factory-

- Shall willfully interfere with or misuse any appliance, convenience or other thing provided in the factory for the purpose of securing the Health, Safety or Welfare of the workers therein:
- Shall willfully and without reasonable cause do anything likely to endanger himself or others; and
- Shall willfully neglect to make use of any appliance or other thing provided in the factory for the purposes of securing the Health or Safety of the workers therein.
- Do not make vague statements, do not overrule supervisor and do not adopt shortcuts.

9. Antidotes Details

Following Antidotes for major Hazardous Chemicals shall be kept available at Site. Other than that, first aid boxes and relevant **Antidotes** for major hazardous chemicals shall be kept available within the premises.

ACIDS

Poisoning due to Acids can be treated by following steps:

- Use alkalis, 4% solution of Sodium Hydrocarbonate, oil, stimulants, demulcent drinks; large draughts of lime water or milk with whiting, baking soda or milk of magnesia;
- Strong soap suds to neutralize acid; olive oil; these to be followed by demulcent drinks.

CAUSTIC

- In case of Skin contact: Wash the affected area with plenty of water
- In case of Eyes Contact: Wash the affected area with plenty of water
- Vinegar water.

10. Safety Precautions system for visitors

Visitor card to be provided to each visitor with audio-visuals along with gate pass & Visitor badge; which will contain the Rules & Information as below:

ID Badges: ID Badges must be worn and visible at all times. They are to be returned to the reception desk/security gate when leaving the premises.

Mobile phone: Mobile phones with a camera function must not be used on these premises. The use of mobile phones is strictly prohibited in designated areas

Electronic devices: Electronic devices may not be connected to the company network without authorization

Smoking is prohibited: Smoking is prohibited on the company premises. The sale and consumption of tobacco products, alcohol and other narcotic substances is forbidden

Personal protective equipment (PPE): PPE must be worn in many areas of site. For your own safety you must wear the appropriate protective equipment when entering these areas.

Alarm Signal: Obey alarm signals and follow the instructions of the fire safety team. A triggered piezo siren signal indicates a fire system alarm and alerts the fire safety team. However, piezo sirens emitting a continuous tone indicate that you must evacuate the building immediately.

Emergency Call: To report an accident or environmental incident, please call our internal emergency number on XXXX/XXXXXX. Please contact the emergency services; if there is any immediate danger. Emergency personnel will provide further instructions. Manual call points can be used to alert the fire brigade directly in the event of a fire.

Emergency Exit: Please leave the danger zone immediately and warn people at risk. In the event of fire, try to put out the fire with a fire extinguisher, if possible. Escape routes are marked in green on the emergency and evacuation plans displayed inside buildings. In the event of an evacuation, please proceed to the appropriate assembly point.

Assembly Point: Make your way to one of the designated assembly points and await further instructions. Report any missing colleagues to management at the assembly point.

First aid boxes: First aid boxes are provided for treating injuries, and qualified first aid stes are on hand during working hours.

3 IMPACT PREDICTION AND MITIGATION MEASURES

3.1 INTRODUCTION

The chapter aims at controlling pollution at the source level to the extent possible with the available and affordable technology followed by treatment measures before they are discharged. The proposed project would create impact on the environment in two distinct phases:

- During the construction phase which may be regarded as temporary or short term;
- During the operation phase which would have long term effects.

The construction and operational phase of the proposed project comprises various activities each of which will have an impact on some or other environmental parameters. Various impacts during the construction and operation phase on the environmental parameters have been studied and mitigation measures for the same are discussed briefly below and elaborated in the subsequent sections.

3.2 ANTICIPATED ENVIRONMENTAL IMPACTS DURING CONSTRUCTION PHASE

This phase involves the activities like erection of civil units, new equipment and machinery, green belt development *etc.* Different components of environment are likely to be effected by the activities. But the impacts will be marginal and for short term only. The green belt development will have positive impacts.

3.2.1 Matrix Representation

Table 3-1: Impact Identification Matrix (Construction Phase)

Activities	Environmental Attributes
	Risk & Occupational Hazardous
Transportation of materials & machinery	√
Construction Power/ Operation of DG set	-
Construction Water	-
Installation of machineries	√
Excavation	√
Site Preparation and Construction of the utility area	√
Wastewater Disposal	-
Waste Disposal	-
Green belt Development	-

Table 3-2:Severity Criteria for Magnitude of Impacts

S. No.	Category	Description of category	Impact	
			Adverse	Beneficial
1.	No impact	-	0	0
2.	No appreciable impact	Short term reversible	-1	1
3.	Significant impact	Long term reversible	-2	2
4.	Major impact	Irreversible but of lesser extent	-3	3
5.	High impact	Irreversible but of medium extent	-4	4
6.	Permanent impact	Severe irreversible impact	-5	5

Table 3-3:Cumulative Score range for beneficial and adverse impacts

S. No	Total score	Outcome
1.	+ve / -ve	Beneficial impact / adverse impact
2.	0-150	No appreciable Beneficial impact / adverse impact
3.	151-300	Appreciable but reversible adverse impact-mitigation measures are needed
4.	301-450	Significant adverse impacts: most of the impacts are reversible. Mitigation measures are crucial.
5.	451-600	Major adverse impacts; most of the impacts are reversible. Alternative site selection to be considered.
6.	>600	Permanent irreversible impact; alternatives to the project need to be explored

Table 3-4: Environmental Impact Matrix without Mitigation Measures (Construction Phase)

Activities	Environmental Attributes
	Risk & Occupational Hazards
Transportation of materials & machinery	-1
Construction power/ Operation of DG set	-
Construction Water	-
Installation of machineries	-3
Excavation	-1
Site preparation and Construction of the utility area	-2
Wastewater Disposal	-
Waste Disposal	-
Green belt Development	-
Cumulative score	**-7**

Major adverse impact score is (-3) for installation of machineries for risk and hazard environmental attributes. Total Cumulative Score for Environmental Parameter Risk & Occupational Hazards without mitigation measures is - 7 which is not appreciable adverse impact during construction phase.

Table 3-5: Impact and Mitigation Measures on Risk and Occupational Hazards

Project Activity	Impact	Mitigation Measures
Transportation of materials	• Chances of accident during transportation of material.	• All transportation within the main working will be carried out directly under the supervision and control of the management. • The vehicles must be maintained in good repairs and checked thoroughly at least once a week by the competent person authorized for the purpose by the Management. • Training will be provided to driver and cleaner regarding the safe driving, hazards of Flammable chemicals and emergency handling • Will provide guard rails / barricade with warning signal for excavated pit. • Will provide escape ladders in case of emergency • Will keep soil heaps away from the edge equivalent to 1.5 m or depth of pit whichever is more. • Battering / benching the sides will be done. • Will not allow vehicles to operate too close to excavated areas • Safe construction practices will be followed under supervisor's direction. • Workers will be provided with adequate PPEs to safeguard them against potential risks also use of PPE's will be ensured.
Excavation	• Falling into the pit will cause personal injury	
Site preparation and Construction of the utility area	• Earth collapse will lead to Suffocation /breathlessness or completely buried.	
Installation of Machineries	• Fall from height, cut injury and fall injury due to construction activities.	

As mitigation

Table 3-6: Environmental Impact Matrix with Mitigation Measures (Construction Phase)

Activities	Environmental Attributes
	Risk & Occupational Hazards
Transportation of materials & machinery	-
Construction Power/ Operation of DG set	-
Construction Water	-
Installation of machineries	-2
Excavation	-
Site preparation and Construction of the utility area	-1
Wastewater Disposal	-
Waste Disposal	-
Green belt Development	-
Cumulative score	**-3**

Significant adverse impact score (-2) in installation of machineries activities for risk and hazard environmental attribute as installation of machineries activity has lots of risk which may happen due to any negligence. Total Cumulative Score for environmental Parameter Risk & Occupational Hazards with mitigation measures is -3 during construction phase which is not appreciable beneficial impact.

3.3 ANTICIPATED ENVIRONMENTAL IMPACTS DURING OPERATION PHASE

This phase of the project is important because it generates long-term impacts as the project implementation phase starts. The primary impacts causing due to the specialty chemicals plant operations, maintenance, gaseous emissions and vehicular movement. Identification of impacts during operation phase is described below in subsection 2.3.1

3.3.1 Matrix Representation

The identification of impacts during operation phase are presented in the form of a matrix in Table 4.17. The scores for various parameters and activities are presented in table 4.18 & 4.30.

Table 3-7: Impact Identification Matrix (Operation Phase)

Activities	Environmental Attributes
	Risk & Occupational Hazards
Vehicle Movement and utilities operation	√
Product and raw material handling, storage and processing	√
Sewage and Effluent generation	√
Solid/ Hazardous Waste Disposal	√
Green Belt Development	-
Employment Generation	√

Table 3-8: Environmental Impact Matrix without Mitigation (Operation Phase)

Activities	Environmental Attributes
	Risk & Occupational Hazards
Vehicle Movement and utilities operation	-2
Product and raw material handling, storage and processing	-4
Sewage and Effluent generation	-1
Solid/ Hazardous Waste Disposal	-2
Green Belt Development	-
Employment Generation	-
Cumulative score	**-9**

High adverse impact score (-4) in risk and hazard for product and raw material handling, storage and processing activity as this activity may led to severe accidents and has more frequency of near miss, severe accidents & fatalities. Total Cumulative Score for various Environmental Parameter Risk and Hazard without mitigation measures is -9 during Operation phase which is not appreciable adverse impacts.

Table 3-9: Impact and Mitigation Measures due to Risk & Hazard

Project Activity	Impact	Mitigation Measures
Vehicle Movement and utilities operation	• Chances of vehicle collision due to vehicle failure. • Tilting of moving vehicle due to overloading. • Chances of fatal incident, severe injury and loss of property due to explosion of boiler.	• Well trained, licensed and certified motor vehicle driver will be given job for transportation of raw material and final product. • Transport vehicle will be properly examined before transportation. • Concern officer will ensure the product and raw material loading as per its capacity before transportation. • Preventive maintenance will be done periodically of boiler.
Product and raw material handling, storage and processing	• Burn injury to workers and loss of money due to spillage and leakage of chemicals handling. • Corrosion and leaching due to spillage and leakage of chemicals.	• Adequate PPE's will be provided to workers for handling chemical, also its use will be ensured. • Standard operating procedure will be prepared and followed by workers. • Products and raw material will be handled, stored and transported as per manufacture, storage and import of hazardous chemical rules, 1989. • Liquid raw material will be packed in tight sealed container and shall be checked and tagged before transportation. • Solid raw material will be packed and covered properly while transporting it through trucks.
Sewage and Effluent generation	• Hearing loss to the workers working in ETP due to high noise generation from pumps and blowers.	• Preventive maintenance of pumps and blowers will be done periodically. • Padding will be done to pumps and blowers. • Ear plugs will be provided to operators and fitters.
Solid/ Hazardous Waste Disposal	• Occupational hazard due to handling of solid/ hazardous waste.	• Adequate PPE's will be provided to the workers. Handling will be done under supervisor's direction.
Employment Generation	• Positive impact on local employment for housekeeping staff and EHS vacancy.	• First preference will be given to local population of surrounding villages.

Table 3-10: Environmental Impact Matrix with Mitigation measures in Operation Phase

Activities	Environmental Attributes
	Risk & Occupational Hazards
Vehicle Movement and utilities operation	-1
Product and raw material handling, storage and processing	-1
Sewage and Effluent generation	-
Solid/ Hazardous Waste Disposal	-1
Green Belt Development	2
Employment Generation	2
Cumulative score	+1

After taking mitigation measures most of the activities have achieved not appreciable adverse impact score (-1) and also achieved not appreciable and significant beneficial impact score (+1) for environmental parameter Risk & Occupational Hazards. Total Cumulative Score for Risk & Occupational Hazards with mitigation measure is +1 not appreciable beneficial impact during operation phase.

3.4 SUMMARY

Impacts on risk and hazard is been introduced in the chapter with their mitigation measures for both during construction as well as operation phase. Matrix study and its representation has also been carried out and briefed in chapter. Total Cumulative Score for Risk & Occupational Hazards without mitigation measures is -7 which is not appreciable adverse impact is during construction phase. Total Cumulative Score for Risk & Occupational Hazards with mitigation measures is -2 during construction phase which is not appreciable beneficial impact.

Total Cumulative Score for Risk & Occupational Hazards without mitigation measures is -9 during Operation phase which is not appreciable adverse impacts. Total Cumulative Score for Risk & Occupational Hazards with mitigation measure is +1 not appreciable beneficial impact during operation phase.

4 ENVIRONMENTAL MONITORING PLAN

4.1 INTRODUCTION

Environmental Monitoring is an essential tool for sustainable development and ensuring effective implementation of environmental management plan and mitigation measures adopted. It also updates the environmental management system for effective conservation of environment in-line with the ongoing project activities/operation. A periodic environment monitoring plan enables the environmental management system with early forecasts for additional action required and modification of ongoing actions for environment management, improvement and conservation. It provides the exact idea for mitigation measures to be implemented as it is linked with actual distraction of environmental quality due to the project activities. Hence, monitoring of critical parameters of environmental quality is very essential in the routine activity schedule of the project operation. Thus, a well implemented environmental monitoring plan enables the proponent to identify the distraction of environmental quality due to the proposed project activities.

4.2 ENVIRONMENTAL MONITORING PLAN

The environmental monitoring plan efficiently identifies gaps in the environmental management system and predicts early signs of need of additional action in order to modify ongoing actions for environment management, improvement and conservation. It provides a regular assessment of mitigation measures implemented for abatement of the possible environmental impacts likely to occur due to the activities of the proposed project, as it is linked with actual deviation of the environmental quality. Hence, monitoring of critical parameters of environmental quality is an essential activity to be included in the routine schedule of project operation. An environmental monitoring program shall be scheduled for the following major objectives:

- To verify the results of the impact assessment study,
- To assess the changes in environmental conditions, if any, during the project operation/activities.
- To follow the trend of parameters which have been identified as critical,
- To monitor the effectiveness of environment management plan & implementation of the mitigation measures planned.
- To identify any significant adverse transformation in environmental condition in order to plan additional mitigation measures.
- To ensure that new parameters other than those identified in the impact assessment study, do not become critical on account of commissioning of the project.

To monitor effectiveness of control measures, the following steps shall be undertaken:

- Monitor daily to assess the effectiveness of the control measures being implemented and explore the need to modify or add new control measures, if a violation is observed and reported.
- Regular monitoring of environmental parameters will be carried out to find out any deterioration in the environmental quality.

4.3 POST PROJECT MONITERING PLAN

Since the project is a Greenfield project, the unit will establish an environmental and safety department which will undertake measures for environmental protection and mitigation of environmental impacts. Several measures have been proposed in the environmental mitigation measures for minimizing the adverse impacts of the proposed project. These will be implemented as per the proposal and monitored regularly to ensure compliance with environmental regulations and also to maintain healthy environmental conditions within & around the unit. A major part of the sampling and measurement activity will be concerned with long term monitoring aimed at providing an early warning of any undesirable changes or trends in the natural environment that could be associated with the plant activity. This is essential to determine whether the changes are in response to a cycle of climatic conditions or are due to impacts of the plant activities. In particular, a monitoring strategy will ensure that all environmental resources which may be subject to contamination are kept under review and hence monitoring of the individual elements of the environment will be done. During the operation phase, Environment management cell (EMC) will undertake all the monitoring work to ensure the effectiveness of environmental mitigation measures. The suggestions given in the environmental monitoring program will be implemented by the EMC by following an implementation schedule.

4.3.1 Occupational Health & Safety

Routine medical examination of personnel will be carried out at regular intervals of all workers to determine any changes in health condition due to the working conditions. Pre-medical check-up will also be carried out at the time of employment. Records related to occupational health check-up will be maintained in hard regularly.

4.4 MONITORING PARAMETERS AND FREQUENCY

The monitoring parameters and frequency of monitoring for the proposed project will be carried out as follows:

Table 4-1:Monitoring parameters and Frequency of monitoring

S. No.	Item	Parameters	Frequency
1.	Medical surveillance program	The health status of all the workers in respect of air borne concentration of hazardous chemicals in ppm	Half yearly
2.	Workplace Monitoring	Ammonia, VOC	Monthly
3.	Safety Audit, HAZOP Report		Annual
4	Driver training		Half yearly
5	Fire training	Fire extinguisher, fire hydrant system operation	Half yearly
6	Mock drill/ ERT Training	Emergency Response Team	Half yearly
7	Inspection PPE's	Quality & quantity of PPE	Monthly

4.5 PROGRESS MONITORING AND REPORTING ARRANGEMENTS

The rational for a reporting system is based on accountability, to ensure that the measures proposed as a part of the environmental monitoring plan get implemented in the proposed project. The monitoring and evaluation of the proposed management measures are critical activities in implementation of the proposed project. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides the necessary feedback for the project management to keep the program on schedule.

In Pre-construction stage, the project manager will select suitable location for dumping construction waste.

In construction stage the project manager will provide dust supersession facility and safety manager will ensure the working of dust suppression facility and if any deviation then will report to project manager for solution.

In operation stage, Plant In-charge/ Unit engineer will manage the disposal of solid waste generation, hazardous waste dumping & storage as per the notification/guideline of statutory bodies and will report to Safety manager. Plant In-charge/ Unit engineer will check whether all the parameter of stack are complying the notification/guidelines of statutory body and will report to safety manager.

4.6 DOCUMENTATION & RECORDS

The environmental department in respect of operation of pollution control facility will maintain following records:

- Instruction manual for operation and maintenance of pollution control,
- Log sheet for self-monitoring of pollution control,
- Instruction manual for monitoring of gaseous parameters
- Monthly and annual progress reports,
- Medical checkup reports of employees.

4.7 BUDGET FOR MONITORING

On regular basis, environment management cell shall inspect the necessity & availability of the materials, technologies, services & maintenance works. The cell shall make appropriate budget for this purpose. Regular record review for change in financial requirement of environment management shall be done and appropriate budgetary provisions shall be made. With other budget, budget for environmental management will also be prepared and revised regularly as per the requirement.

4.8 SUMMARY

Project proponent will establish an environmental and safety department which will undertake measures for environmental protection and mitigation of environmental impacts. Pre-medical check-up will be carried out at the time of employment.

5 DISASTER MANAGEMENT PLAN (DMP)

5.1 INTRODUCTION

In order to be in a state of readiness to face any accident or disaster caused by the project operation, a Disaster management plan is required to be prepared. The plan will cover possible disaster, On and Off-site emergency preparedness plans, establishment of emergency Control Centre (ECC), Location of emergency services and duties of officers / staff during emergency.

5.1.1 Basic Contents of DMP

Basically, DMP contains following aspects

1. Description of site
2. Brief description of the plant
3. On – site Emergency plan
4. Off- site Emergency plan

5.1.2 Definitions and Classification of Emergency

An Incident:

Undesired event giving rise to death, ill health, injury, damage or other loss.

A Major Incident:

Is a sudden, unexpected, unplanned event, resulting from uncontrolled developments during an industrial activity, which causes or has the potential to cause. Serious adverse effects immediate or delayed (death, injuries, poisoning or hospitalization) to a number of people inside the installation and / or to persons outside the establishment, or significant damage to crops, plants or animals or significant contamination of land, water, air or an emergency intervention outside the establishment (e.g. Evacuation of local population stopping of local traffic) or significant change in the process operating conditions, such as stoppage or suspension of normal work in the concerned plant for a significant period of above, or any combination of the above effects.

An Emergency:

An emergency is an abnormal event, which could result in danger to personnel, property and environment. It could be due to fire, Explosion, Heavy spillage of hazardous liquid, toxic gas release etc.

A Major Emergency:

Is one that may affect several departments within it and/or may cause serious injuries, loss of life, and extensive damage to property or serious disruption outside the works? It will require the use of outside resources to handle it effectively.

NOTE: Emergency due to operating conditions, uncontrolled reaction, small fire, small gas leak, spill, failure of power, water, air, steam, cooling media, scrubbing media etc. and which can be locally handled by plant personnel alone (without outside help) is not considered as major emergency.

Disaster: Is a catastrophic situation in which the day-to-day life patterns are, in many instances, suddenly disrupted and people are plunged into helplessness and suffering and as a result need protection, clothing, shelter, medical and social care other necessities of life, such as: Disasters resulting from natural phenomena like earthquakes, volcanic eruptions, storm surges, cyclones, tropical storms, floods, landslides, fierce fires and massive insect infestation. Also in this group, violent drought which will cause a creeping disaster leading to famine, disease and death must be included.

Second group includes disastrous events occasioned by man, or by man's impact on the environment, such as armed conflict, industrial accidents, factory fires, explosions and escape of toxic releases of chemical substances, river pollution, mining or other structural collapses, air, sea, rail and road transport accidents, aircraft crashed, collisions of vehicles carrying inflammable liquids, oil spills at sea and dam failures.

Hazard: Source or situation with a potential for harm in terms of injury or ill health, damage to property, damage to the workplace environment or a combination of these

RISK: Combination of the likelihood and consequence(s) of a specified hazardous event occurring

Classification of Emergency:

LEVEL – 1

The incident or emergency which are confinable, controllable within the plant premises, which under normal circumstances does not affect area outside the said plant battery limit and controlling does not involve / require external help. This situation is called emergency stand by and affected unit / plant have to handle emergency

It may be due to

- Small pipe/valve rupture or similar leakages that do not affect outside premises.
- Release of toxic chemicals for short duration.
- Small fire in the plant.

LEVEL – 2

When the incident or emergency is not controlled within 10 to 15 minutes or does not come under control within 10 to 15 minutes, incident controller, site main controller reviews the situation and decides if situation is Worsening.

It may arise due to -

- Leakage of toxic chemicals for long duration.
- Medium scale explosion confined to the factory premises.
- Medium scale fire inside the factory premises.

LEVEL – 3

After surveying off-site implications of level – 2 emergencies if there is a likely hood of chemical/material gas cloud formation and spreading of cloud in down wind direction affecting neighboring population of industry and villagers and / or in case of following incident IC and SMC are of the opinion that there will be off-site implications.

It may arise due to -

- Heavy / Profuse leakage of toxic / Flammable gases for a long duration.
- Explosion of high magnitude affecting the adjacent area.

- Major fire inside the factory premises.

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

Mode of Emergency

Man made	Natural Calamities	Extraneous
• Heavy Toxic Leakage/ Spillage • Fire • Explosion • Failure of Critical Control system • Design deficiency • Unsafe acts • In-adequate maintenance	• Flood • Earthquake • Cyclone • Outbreak of Disease Tsunami	• Riots/Civil Disorder/Mob Attack • Terrorism • Sabotage • Bomb Threat • War/Hit by missiles • Food Poisoning/Water Poisoning

On-Site Emergency

The On-site emergency plan: deals with, measures to prevent and control emergencies within the factory and not affecting outside public or Environment.

Off-Site Emergency

The Off-site emergency plan: deals with, measures to prevent and control emergencies affecting public and the environment outside the premises

5.1.3 Objectives of Emergency Management System

The objectives of the emergency management system are summarized as under.

- To identify and assess types of emergencies due to different types of hazards.
  - Emission of chemical vapors into the shop floor ambience and any injurious effects of physical contact with corrosive chemicals, inhalation of fumes, vapors and solvents. The consequences will be off minor type and major emergency in this case is not perceived.
  - Fire preceded or followed by explosion. Explosion could be in barrel s, barrels, drums and cylinders due to pressure build up. A safety arrangement will be made in pressure vessels.
- To work out plan with all provisions to handle emergencies and safeguard employees and people in the vicinity of the factory.
- To provide for emergency preparedness and the periodical rehearsal of the plan.
- To plan mode of proper communication and actions to be followed in the event of emergency.
- To keep all necessary information with respect to hazard/accident control and emergency contacts in one document for easy and speedy reference.
- To inform employees, general public and the authorities about the hazards/risk if any and the role to be played by them in the event of emergency.
- To control and contain the accident.
- To effect rescue and treatment of casualties.
- To inform and help relatives of casualties.
- To secure rehabilitation of affected area and restore normalcy.
- To provide information to media and government agencies.
- To preserve record, equipment etc. for investigating cause of emergency.
- To be ready for “mutual aid” if need arises to help neighboring units.

5.1.4 Structure of Emergency Management System

QPPL shall develop an Emergency Management Team. The management structure shall include the following personnel's;

- Site Main Controllers
- Incident Controllers and Deputy Incident Controllers
- Key Personnel's
- Essential Workers

The other elements of Emergency Plan shall be:

- Assembly points
- Emergency control center
- Fire control arrangements
- Medical arrangements
- Other arrangements

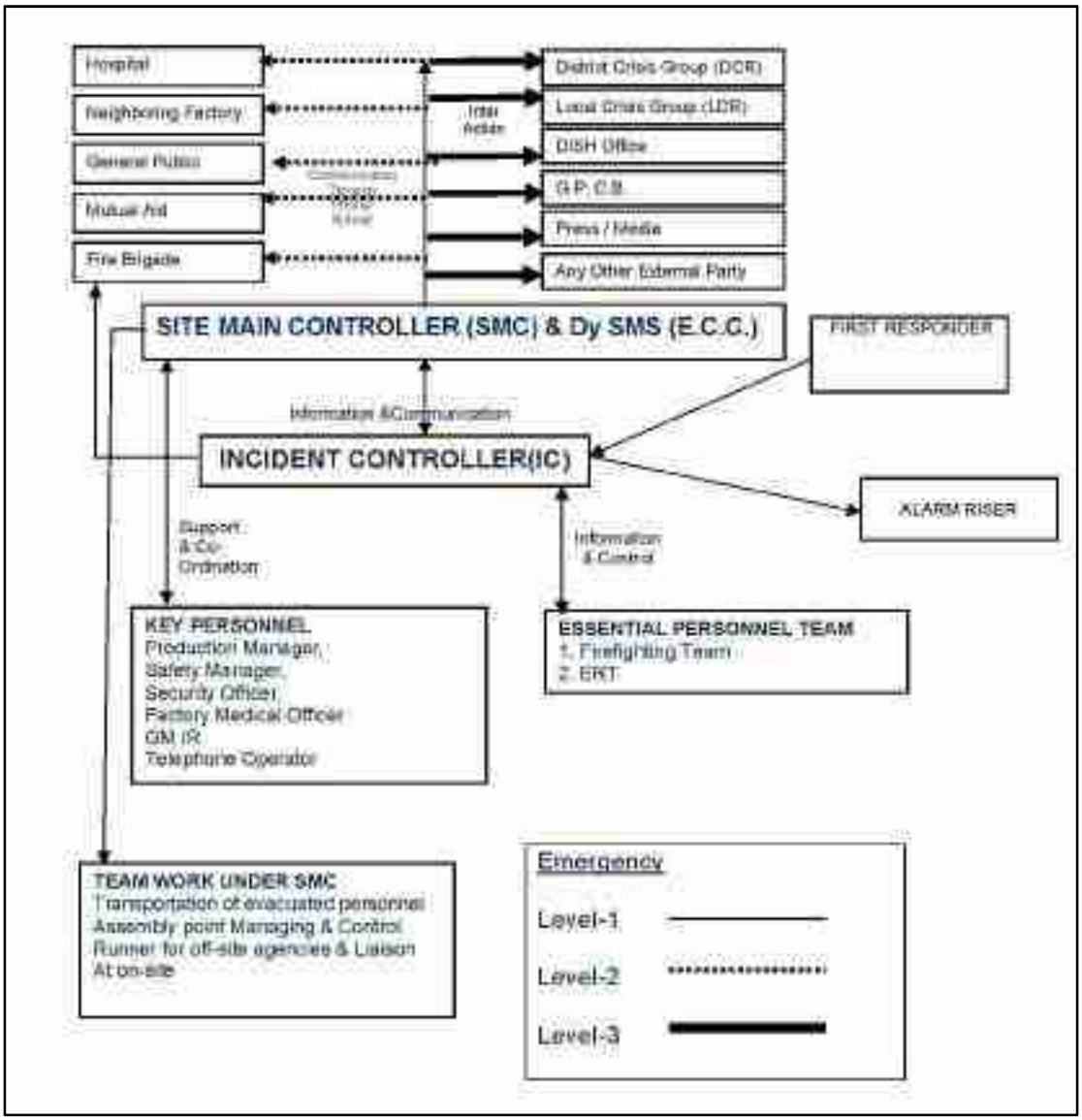


Figure 5-1: Emergency Organization Chart

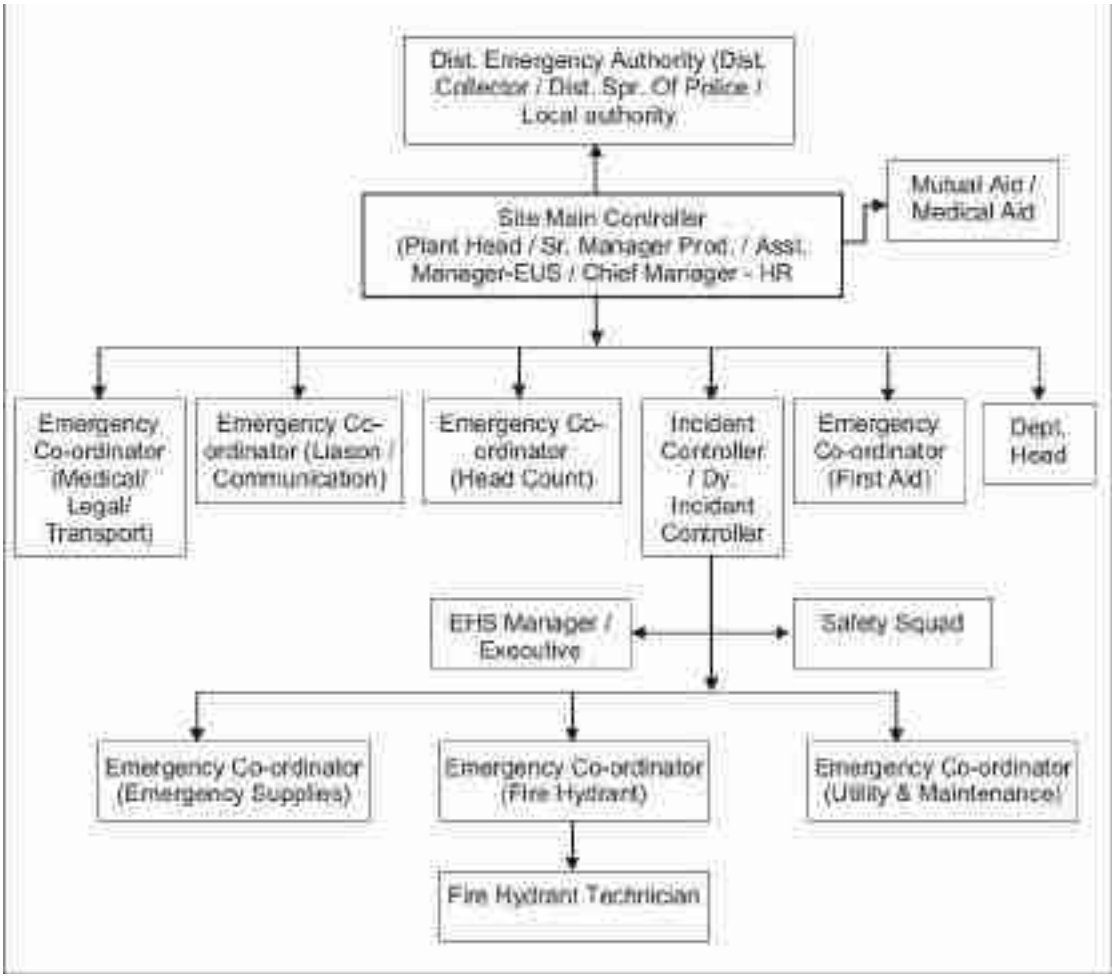


Figure 5-2 Hierarchy of the emergency team

A. Role & Responsibility of Emergency Management Team

Site Main Controller (SMC)

Senior most Executives (i.e. Director & Supervisor) of the company shall be nominated as SMC. His task will be to co-ordinate all internal and external activities from the Emergency Control Centre (ECC) at Main Security Gate, from where all operations will be directed. He shall:

- Immediately on being informed of the emergency and its location, will arrive at the site, review the situation and control further actions.
- Direct all Emergency Operations within the approved area with the following priorities:
  1. Personnel Safety,
  2. Plant, Property and Environment Safety and
  3. Minimum loss of production.
- Co-ordinate to avail services from external agencies like fire brigade, hospitals etc, if called for, following the declaration of major emergency. If necessary, major installations in the vicinity may also be informed of the situation.
- Exercise direct operational control of the unaffected section of the plant.

- In consultation with the advisory team, expedite the shutting down of loading / unloading operations of barrel ers and if necessary, instruct the supervisor / security personnel to evacuate barrel ers.
- Ensure that all employees are evacuated from the affected area and the casualties, if any, are given necessary medical attention. Instruct P & A Assistant / Security for rushing casualties to hospitals if required.
- Liaise with fire and police officials, pollution control board officials and other statutory bodies and advise them of all possible consequence effects outside the premises.
- Arrange for relief of personnel when emergency is prolonged.
- Issue authorized statement or press release to the news – media.
- Ensure preservation of evidence for enquiries to be conducted by statutory authorities.
- Authorize the sounding of “All Clear” and “Evacuation Siren”.
- Arrange for obtaining the head – count of all personnel within the premises and cross-checking with the data from records available for no. of persons within the premises.
- Nominate a person from advisory team, to maintain chronological log of event during the entire period of emergency.

Role of Incident Controller (IC) and Deputy Incident Controller (DIC)

Respective Shift In-charge of the Plant (Site) & Department holds the responsibility of the Incident Controller, if the incident is in their plant/area. Two Production officers in each shift will be identified as Deputy Incident Controllers.

His primary duties shall be to take charge at the scene of the incident. In the initial stage he may be required to take decisions involving the operation of the other plants or to stop or continue any process and to take technical decisions to control the incident. The deputy incident controller will take the charge of incident controller, if he is not available due to any reason. They will be always available in each shift and can take charge of the incident.

Responsibilities/Duties of Incident Controller and Deputy Incident Controller:

- He shall take charge at the scene of incident.
- He shall immediately assess the gravity of risk and alert panel and field operators to start controlling their respective section.
- if the emergency is minor, try to prevent by using internal resources like fire extinguishers in case of fire, and cover the spillage by sand in case of liquid spillage.
- He will work under the direction of the SMC, but till his arrival he may have to execute following responsibilities.
    - He will ensure that all the Key Personnel are called.
    - Direct for evacuation of plant and areas likely to be affected by the emergency.
    - He shall communicate to the SMC the type of outside help needed.
    - He shall direct all emergency operations within the affected area with the following priorities.
    - Personnel safety, including of surrounding community.
    - Minimum damage to Plant, Property and Environment.
    - Appropriate actions to minimize loss of Production and Material.
    - Give information to the head of firefighting and rescue team and other emergency services.
    - Depending on the incident, instruct partial or total shut down, isolations, depressurization, Nitrogen purging, firefighting and rescue operations.

- Instruct upstream/downstream units to take emergency shutdown /cutting off supply and other appropriate actions and emergency evacuation help etc.
- Direct for search of casualties.
- Evacuate non-essential workers/visitors/contractors to safe assembly points.
- Brief site main controller and keep him informed about the developments.
- Preserve evidences. This will be necessary for investigation for cause and concluding preventive measures.

Key Personnel

Senior officers of various departments like Fire, Security, Safety, Administration, Engineering, Project, Production, Transport, Pollution control, Technical Services and Stores shall be nominated as Key Personnel in their respective fields. As necessary, they shall decides the actions needed to shutdown plants, evacuate personnel, carryout emergency engineering work, arrange for supplies of equipment's, utilities, carryout environment monitoring, provide catering facilities, liaise with police, fire brigade and other local authorities, relative of casualties, hospital, press & neighboring industries, action at assembly points, outside shelters and mutual aid center under the direction of the SMC. All the key personnel and other called in so to assist, shall report to the ECC. They shall be available at any time on duty or on call or on holidays.

The responsibilities and duties of key personnel are as follows.

Production Manager

- To keep in touch with IC & SMC in assessing/ controlling the emergency.
- To guide essential personnel team.
- To guide personnel for safe close down of the plant.
- To guide transport for safe shifting of materials from one place to other.
- To guide mutual aids services and the teams.
- To keep informed the SMC about developments.
- To make arrangement like emergency light, water etc.
- To assess the emergency & evacuate the neighboring factory workers and neighboring population through SMC.
- To inform the effect of emergency and steps to be taken to avoid the effects of a radiation etc.

Safety Manager

- To assist incident controller in controlling emergency
- To help site main controller in communication.
- To provide necessary equipment like FFE (Firefighting Equipments), PPE & RPE.
- To guide transport for safe shifting of materials from one place to other.
- To guide mutual aids services and the teams.
- To keep informed the site main controller about developments.
- To make arrangement like emergency light, water etc.
- To assess the emergency & evacuate the neighboring factory workers and neighboring population through SMC.
- To inform the effect of emergency and steps to be taken to avoid the effects of a Fire etc.

Security officer

- To help incident controller & site main controller at the time of emergency.

- To cordon the area and inform incident controller or site main controller about the development of emergency.
- To fight the fire with available internal FFE.
- To make arrangement for evacuating workers from the place of accident and guide non- essential workers towards company assembly point.
- To carry out head counting at assembly point &search of missing persons.
- To ensure that the roadway to plant is clear for emergency vehicles. Obtain assistance to keep roadway clear and to stop non-emergency traffic from entering.
- To direct their personnel (Response force & Task force) for evacuation of non-essential workers & Crowd control.
- To liaise with mutual aid services for their help and guide to them.
- To blow emergency siren & all clear siren on receiving message from IC/SMC through telephone office.

Factory Medical Officer

- To take charge of Occupational Health Centre.
- To provide treatment/ first aid to the affected persons and if necessary, send them to hospitals for further treatment.
- To keep liaison with hospitals and inform them about the type of emergency help required as per discussion with Site main control.
- Arrangement for adequate stock of antidotes, lifesaving drugs and special medicines.
- To keep the record of persons given first aid/ treatment and send them to hospitals with their name.
- To keep ready the list of blood groupings.
- To inform site main controller about the developing situation.
- To guide/instruct first aider, first aid & Rescue team in case of any emergency.
- To keep ready the list of first aider.
- To identify of all the hospitals for facilities to render medical aid to victims of exposure to dangerous chemical substances, burns and other specific injuries. (State authorities, local authorities, ESICS, Private, Railways/Voluntary institutions, trusts etc.) & report to SMC
- To keep provisions of buffer stock of essential medicines like intravenous fluids, dressing materials, splints, oxygen cylinders, suction apparatus etc. Keeping in view the large number of third degree burns, heat radiation.

General Manager-IR

- To assist site main controller & incident controller in controlling emergency.
- To guide mutual aids services and the teams.
- To keep informed the site main controller about developments.
- To make arrangement like emergency light, water, etc.
- To arrange external help like Medical, Fire, etc
- To assess the emergency & evacuate the neighboring factory workers and neighboring population through SMC.
- To inform the effect of emergency and steps to be taken to avoid the effects of a Fire etc.
- To deal with external communication like media & external agencies

Adjacent Plant in-charge

- To assist site main controller & incident controller in controlling emergency
- To help site main controller in communication.

- To guide mutual aids services and the teams.
- To keep informed the site main controller about developments.

Telephone Operator

- He will guide all visitors of admin building to move at assembly point.

Essential Workers (EW)

Essential Workers shall be those who shall be trained in Fire Fighting and First Aid. One Supervisor and two helpers from each shift will be identified as EW's & shall supposed to report at EMERGENCY SITE to take instructions from IC or DY. IC Such work instructions will include:

- To rush at the site for help with fully equipped. I.e. firefighting equipment, SCBA sets, etc.
- To decide line of action in consultation with incident controller & Key personnel and take appropriate measures to extinguish the fire & to control spillage.
- Firefighting and spill control till a Fire Brigade takes the charge.
- To help the Fire Brigade and mutual aid teams, if it is required.
- Shutting down plant and making it safe.
- Emergency engineering work e.g. isolating equipment, material process, providing temporary by-pass lines, safe transfer of materials, urgent repairing or replacement, electrical work, etc.
- Provision of emergency power, water, lighting, instruments, equipments, materials, etc.
- Movement of equipment, special vehicle and transport to or from the scene of the accident.
- Search, evacuation, rescue and welfare.
- The injured will be given First Aid.
- To help & assist Factory Medical officer.
- Moving barrel or other vehicles from area of risk.
- Carrying out atmospheric test and pollution control.
- Manning of assembly points to record the arrival of evacuated personnel. Manning for outside shelters and welfare of evacuated persons there.
- Assistance at causalities reception areas to record details of causalities.
- Assistance at communication centers to handle outgoing and incoming calls and to act as messengers if necessary.
- Manning of works entrances in liaison with the police to direct emergency vehicles entering the work, to control traffic leaving the works and to turn away or make alternative safe arrangements for visitors, contractors and other traffic arriving at the works.
- Informing surrounding factories and the public as well as directed by the Site Main Controller.
- Any special help required.

B. Other Elements of DMP

Assembly Point:

In affected and vulnerable plants, all nonessential workers (who are not assigned any emergency duty) will be evacuated from the area & they shall report to specified assembly points. Assembly Points shall be located at a safe place, well away from area of risk and least affected by the down wind direction.

To ensure that workers will not have to approach the affected area to reach the assembly points, proper location and numbers will be marked at assembly points. Each assembly point shall be manned by a nominated person to record the names and dept. At each assembly point, duties of assembly point In-charge will also be displayed in brief. Before reaching an assembly point or subsequently, if it is required to pass through an affected area or due to presence of toxic substances, suitable PPE's including respirators, helmet etc., shall be issued & made available with workers.

Emergency Control Center (ECC):

The Emergency Control Center is the place or room from where the operations to handle the emergency are directed and coordinated. Safe and easily approachable room has been earmarked/identified as the Emergency Control Room.

Telephone and other facilities required with necessary documents shall be displayed in ECC for ready reference. Designated trained personnel will operate ECC. In case of Major Emergency, the Site Main Controller will operate from ECC.

The ECC center will be equipped with the following facilities.

- Internal and external telephone including STD facility
- Telephone directory/ Telephone nos. of mutual aid centers
- First Aid
- Muster roll of workers
- Identity card register
- Layout plan of the factory showing the location of hazardous materials, assembly point, first aid centers etc.
- Map of surrounding area with fire extinguishers location
- M.S.D.S
- Copy of ON SITE OFF SITE PLAN
- Stationeries like- note book, pen, pencils etc.
- S.B. Apparatus
- List of Government Agencies /Local press agencies with phone no.
- Sand Buckets & Hydrant Network
- Adequate numbers of PPE's

Public Awareness

The provision of a liaison officer of factory to serve information with public, personnel manager can play this role. Company can develop a formal public information procedure during an incident.

This may include pamphlets, newspaper stories, periodic radio, TV announcements and instructive programs for school, inmates of hospitals, as well as for the dependent aged persons. They provide accurate information to the general public in order to prevent panic and protect themselves as well as others.

As certain information will need to be communicated quickly, one person would be identified to serve as spokesperson. It is strongly recommended that the individual identified has training and experience in public information spokesman can identify for media, the appropriate individual who have specialized knowledge about the event and its consequences.

The claim of command would therefore include this spokesperson other members of the response team would be instructed to direct all communication, and public relation issues to this one person.

Fire Control Arrangements (Fire Fighting, Gas Leak Control and Rescue Operation)

Fire is classified in following three classes. The appropriate fire extinguishers are used to extinguish the different class of fire.

1. **Class A:**General Fire - Cotton Waste, Paper, Rubbish and Scrap: water, ABC powder type
2. **Class B:** liquid Fire - All solvents, Resin, Paints, LDO, HSD: Mechanical foam, ABC type
3. **Class C:** Gaseous /Electrical fire - Gaseous fire & panels etc.: CO_2, DCP/ABC

Sufficient number of fire hydrant valves and riser valves will be arranged to fulfill fire extinguishing need of the plant. Apart from this, fire extinguishers will be kept at various locations inside plant and those will be hydrostatically tested and refilled at intervals as specified by statutory body.

- Foam type
- Dry chemical powder type
- CO2 type

Fire drill will be carried out by all the security guards apart from safety persons to keep them ready fortnightly. Sufficient amount of firefighting water will always be stored in storage barrel for firefighting works. In case of power failure, diesel driven fire engine pump has arranged to generate the power for emergency lighting and to run water pump.

Role of Manager (Fire and Safety)/Shift In-Charge (Fire & Safety)

Incident Controller shall direct the firefighting and Emergency operation. His duties include

4. Keep the constant touch with the SMC/In-charge - EHS.
5. Direct the crew members to the scene of emergency and arrange replenishment of Manpower/equipment/extinguishing media etc.

Role of EHS Representative:

1. On being notified about the location of fire/ gas leakage, he shall immediately proceeds to the help.
2. Decides his line of action in consultation with Incident controller and takes appropriate measures to handle the emergency.
3. Shall assess the severity of the incident & shall immediately report to emergency controller about the gravity of the situation.
4. He shall also assess the extra requirement required if any, from the neighboring industry.

Fire crew members

1. On hearing fire alarm & emergency siren, they shall immediately reports to control room and proceed to the scene of emergency and work under the direction of IC/ Dy IC.
2. The personnel availability at the scene of incident shall be made optimize.

Emergency Squad Members

1. On hearing Emergency Siren, they shall immediately reports to site main controller, safety in charge or incident controller.

2. They shall combat the emergency situation as per the direction of site main controller, safety in charge or incident controller.
3. They will help for safe evacuation.

Medical Services

The roles of Medical officers are as follows;

- He will report immediately to the SMC/IC.
- He will render necessary treatment, at Occupational Health Center.
- He will arrange for Hospitalization and Treatment at outside hospitals, if required.
- He will mobilize in getting the services of External medical agencies, other Para – medical services etc. and transportation services etc.
- He will arrange for extra medical assistance/antidotes, from out, if required.
- He will arrange for first-aid trained volunteers for necessary help.
- He will liaise with the Government Health Authorities for treatment of the affected persons nearby.

Role of Security In-Charge (Security Officer)

- On hearing the emergency siren, he shall find out the location of the incident (fire / gas leak / spill / explosion) and inform the location of the same to the key personnel coming to the plant.
- He will depute the security guards for managing gates and traffic control at the incident site & send remaining guards to the site of incident.
- He will prevent unauthorized entry in to the site
- He will render assistance as demanded by the safety in-charge.
- He will mobilize additional security force for help, if required.
- He will direct ambulance(s) and emergency vehicle(s) to the scene of incident.
- He will help evacuate persons within the scene of incident.
- As directed by the site main controller, he may be required to address the public of surrounding villages for warning / evacuation.

Role of Mutual-Aid Members

- Company will have Mutual Aid with various nearby factories.
- On receiving the call, they shall proceed immediately with fire squad & fire tenders.
- They will be guided to the place of the incident by the main gate security guard.
- The fire squad in-charge will report to the safety in-charge of the unit in which the incident has occurred.

Other Arrangements

Other arrangements include external transport (transport center), heavy vehicles, lift/cranes, generator sets to supply emergency power, environment monitoring equipment, special instruments/equipment's, rescue items etc. shall be made available (if required) from nearby Industries /locations, when available resources do not meet the requirements.

Standard Operating Procedure (Shall Be Followed During Emergency)

- As soon as emergency alarm is heard, all essential workers shall report to IC or SMC.
- They shall carefully listen to the instructions given by IC or SMC
- According to the type of emergency/accident, they shall get equipped with PPE/Firefighting equipment and devices.

- The runner among the workers shall inform SMC/IC and key personnel if they are not at site.
- The messenger amongst the workers shall deliver messages to nearby units as per the instructions of SMC/IC.
- The in-charge of medical arrangements shall prepare first-aid and other required facilities for the injured.
- The other essential workers shall try to control the emergency as per the instructions given to IC.
- IC would keep SMC informed about the status of control measures being taken at the site and ask for other requirements eg. Mutual aid, equipment etc. if he find necessary.
- SMC would co-ordinate with outside agencies regarding control measures being taken, need for external help, evacuation, medical treatment etc.

Security system

- A premise is covered by fully fencing and Main gate is secured by guard for 24 hours.
- All transport vehicles are checked at the gate for driver licenses, MSDS, Emergency Information Panel and for any unwanted / undesired threat material etc.
- Security staff takes round throughout the factory for security of plant & others.
- CCTV camera installed at all critical locations.

Communication System

Communication System is a Crucial Factor while handling emergency. Company has quick & effective Communication System through which, any situation, which can lead to emergency, can be informed or known to…

1. All persons working inside the plant.
2. Key Personnel outside during normal working hours & during off-duty hours.
3. Outside emergency services, Statutory and Local Authorities &
4. Neighboring facilities and public leaving in vicinity.

Each and every section, Plant & Department of the Factory will be connected by internal telephones with SMC, Supervisor or IC's. External Phone at Office and Residence and Mobile shall also be made available with Key Personnel and top executive of the factory. The Communication System shall begin with raising the alarm declaring the emergency, Telephone messages and Procedure to communicate the emergency to other persons & General Public.

Raising the Alarm

As soon as incident takes place inside the factory and is noticed by someone, the first step shall be to raise the nearest manual emergency bell to alert the nearby people. Next, he/she shall inform the security persons to raise the emergency siren located at the factory gate. The security personnel sound the siren.

The alarm sound informs the I.C and the S.M.C that an emergency has been created and emergency organization plan to be activated. The I.C. rushes to the site and shall takes charge of the scene.

Declaring the Major Emergency

Major emergency is declared after sufficient and thorough check because the declaration of major emergency puts many agencies on action and it may disturb the running system, which may be Costly at, time or its Consequence may be Serious. Therefore, major emergency must not be decided on whims or immature judgment or without proper thought. Looking to all the above, we shall nominate the persons (SMC: Director & Incident Controllers) who can declare the emergency; we have selected them on the basis of their knowledge & experience. These persons will be technically qualified and experienced. The decision about major emergency shall be taken as early as possible and without wasting time so that control action can be started immediately.

Telephone Message

A Telephone operator who is precise, sharp, attentive and quick in receiving and noting the message and subsequently effective in further Communication, shall be appointed. A form to record emergency telephone calls will be available with telephone operator or Person available in Emergency Control Center, who shall record such calls during emergency. Telephonic messages shall be given out by the telephone operator to Site main Controller and key personnel as per the instructions of the Incident Controller. Telephonic messages will also be given to authorities and external agencies to describe the type of emergency. All details of emergency will be collected/delivered according to this format, available with the telephone operator.

Communication of Emergency & Statutory Information

Communication of Emergency

An effective system to communicate emergency shall be made to communicate about the emergency situation as mentioned below:

- Inside the factory i.e. workers including key personnel and essential workers, on duty & inside during normal working hours.
- To key personnel and essential workers not on duty and outside during normal working hours.
- To the outside emergency services and the Government authorities.
- To the neighboring factory & the General Public in the vicinity.

Statutory Information

a) Information to Workers

Set of Statutory information regarding types of hazards and their prevention and control as directed in the Factories Act shall be prepared by the unit. This information shall be printed in the local language and will be given in the form of booklet to all workers including contract workers.

b) To the outside emergency services and authorities

Statutory information in the form of booklet will be given to outside emergency services and authorities, if required.

c) To neighboring firms and the general public

Statutory information in the form of booklet will be given to neighboring units and the general public of the villages in the vicinity of the unit, if required.

Emergency Time Activities

The probable emergency situation that can arise in the unit and the corresponding control actions as described below shall be followed:

Toxic Releases

Source / Incident –

- Pressure release due to failure of
- Stuffing box gland packing
- Pressure release valve
- Vessel / pipeline failure

Following Control Actions will be taken –

1. Anyone who notices the release shall sound emergency alarm.
2. SMC/IC who is at site, shall immediately rush to the scene and assess the situation. For toxic release from a reactor, he activates the on-site plan as -

- He evacuates all the persons to safe assembly point.
- He calls in DIC (if DIC is not present there) and asks essential workers to wear self-breathing apparatus and if the reaction is exothermic, start cooling water flow in the reactor jacket and cool the reactor as soon as possible.
- The essential workers stop all the charging pumps of that reactor and the nearby reactors.
- He informs mutual aid teams and asks for necessary help.
- He arranges first-aid / hospitalization for the affected persons.
- Mutual aid teams shall be asked for help in the form of first-aid, transport etc.
- When the leak stops and the air shall clear of toxic release, IC tells essential workers to sound all clear.
- The vessel / rupture disc/gland packing will be attended by maintenance department.
- The incident shall be recorded
- SMC arranges to inform families / relatives of injured / dead.
- SMC issues authorized statement to press / media.
- SMC informs Factories Inspector about the incident and related information

Chemical Spill

Most of the storage barrel s shall be located in Storage Barrel Yards. Dyke walls shall be constructed around the barrel yard. Neutralizing material shall be kept available. For dilution, water connection will be provided on all sides of barrel farms. Sand buckets shall be available for covering spillage of flammable / corrosive materials.

Safety Awareness among the workers

Details of training and periodic retraining programs for the personnel of safety and fire department

Security guards who act as firemen during fire emergency are trained, retrained and refreshed on regular basis. Safety professional is sent for external training and some training program also conducted at works site by external experts of the field.

Details of Training and retraining programs for the workers

Training programs on safety aspects with special attention to firefighting are regular feature of company. Plant organizes 3-4 sessions every month on safety aspects and cover good number of workmen in these programs.

All these training programs would at least include the following:

- Lectures
- Seminars and workshop
- Practical Exercises
- Distribution and practice safety instructions
- Safety quiz contests/competitions for individual as also for groups
- Display of safety posters and safety slogans at convenient and conspicuous places.
- Explanation of instructions (in the language easily understood by workers) about the possible hazards involved in handling of chemicals ad methods to deal with such hazards failing which possible emergency situation are likely to arise.
- Developing safety instructions for every job and ensuring practice to these instructions/ booklets or manuals by workers.
- Educating workers about the
    - Physical and health hazards arising out from the exposure of handling substance
    - Measures taken to ensure safety and control physical and health hazards.
    - Measures to be taken by workers to ensure safe handling, loading and unloading.
    - Storage and transportation of hazardous substances
    - Meaning of various labels and marking used on containers of hazardous substances and to whom to report
    - Measures to be taken in case of any spillage or leakage.

On-Site Emergency Planning

#	Code of Practice	Objective	Line of Action
1	In Case of Fire at Factory/Hazardous chemicals storage area/ Diesel/ FO or storage area.	To deal with Fire efficiently and quickly at different locations in the factory including diesel storage barrel/tanks and electrical Panel.	• Any person notices any sign of fire shall start shouting **FIRE, FIRE** (**Aag**, **Aag**) to seek assistance and also immediately take steps to give warning by blowing the siren continuously and take steps to extinguish the fire by using fire extinguishers available near the site of fire • After giving information reach the spot, remove man and machinery and take steps to tackle the fire in accordance with the firefighting

			instructions. Inform at security office to get Ambulance if required.
2	In case of Heavy Spillage, Leakage of hazardous chemicals.	To deal with the incidence of hazardous chemicals spillage or leakage efficiently and quickly	• Any person who notices any leakage or spillage of hazardous chemicals from storage barrel , pipe line or from any equipment should try to warn the nearby persons and report to the shift supervisor without any delay. • The Person should not go near the spill unless he is wearing a proper PPE and has been fully trained to handle the chemicals leaks.

The Fire layout has been enclosed as annexure with this report demarcating the assembly points, fire hydrant line, fire extinguishers etc. The details of hydrant line/pump are given under as:

Detail of Hydrant Pump	Motor	Pump
1) Jockey pump Detail	Make : Crompton Greaves HP: 7.5 RPM: 2910 Frame: ND 132 M	Make: KSB RPM: 2946 Head: 56 Rate of Flow: 180 LPM
2) Main Pump Detail	Make: Crompton Greaves HP: 15 RPM: 2910 Frame: ND 132 M	Make: KSB RPM: 2946 Head: 56 Rate of Flow : 900 LPM
Detail of Sprinkler System Pump		
4) Jockey pump Detail	Make: Crompton Greaves HP: 7.5 RPM : 2910 Frame : ND 132 M	Make: KSB RPM: 2946 Head: 56 Rate of Flow: 180 LPM
5) Main Pump Detail	Make : Crompton Greaves HP: 15 RPM : 2910 Frame : ND 132 M	Make: KSB RPM: 2946 Head: 56 Rate of Flow : 900 LPM

Total Hydrant points will be 12 Nos. and 5 Nos. of Water + Foam Monitors will be provided with 4 Nos. of Hose reels and 8 Nos. of Hose Boxes. Total 20 Nos. of Fire Extinguisher with 12 Nos. of Fire buckets will be provided in the premise. The 20 Nos. of automated water sprinklers will be provided to control the fire immediately at fire prone area.

5.2 OCCUPATIONAL HEALTH & SAFETY PROGRAMME

QPPL has prepared the Occupational Health Surveillance Program which shall be followed right from the project construction & erection phase and the same shall be updated for the upcoming new facility, if required.

The details of the same are described in the following sections.

5.2.1 Occupational Health

Occupational health needs attention both during construction & erection and operation & maintenance phases. However, the problem varies both in magnitude and variety in the above phases.

5.2.2 Hospital Facilities /Factory Medical Officer & OHC

- Company shall made formal agreements with nearby hospitals having facilities to attend fire and toxic effect cases, emergency cases, attending the affected persons in the emergency arising out of accidents, if any, etc.
- A qualified doctor will be appointed as FMO on retainer ship basis. Apart from him, required medical facilities applicable as per Maharashtra Factories Rules and Factories Act shall also be made available.
- All types of first aid related accessories, Medicines & Antidotes as prescribed by FMO, etc. shall be made available at conspicuous locations.

5.2.3 Ambulance Van & First Aid Box

An Emergency Vehicle shall be made available round the clock to be used as an Ambulance during emergency.

First Aid Boxes will be made available at the different location in the plant. Training shall be given to employees for First Aid.

5.2.4 Plan for Periodic Medical Checkup

Periodic Medical Examination shall be conducted as per the following schedule;

Workers employed will be examined by a Qualified Medical Practitioner/ Factory Medical

Officer, in the following manner:

1. Before employment, to ascertain physical fitness of the person;
2. During employment, every six months (blood & physical examination) as per Maharashtra Factories Rules, to ascertain physical fitness of the person to do the particular job;

5.2.5 Details of Occupational Health Impacts and Safety Hazards

Occupational Hazards Identification	Occupational Health Impacts
Exposure to Toxic & Corrosive Chemicals	Toxication, Irritation,
Exposure to Chemical Dust, Spillage/leakage, Overflow	Severe irritation to eyes & skin, Respiratory disorder, Fatality, etc.
Slip/trip, fall, electric shock, etc.	Body Injury, Burns, Skin sensitization, Fall Injury, Electrocution, Damage to nearby equipment's, Fatality, etc.

The personal protective equipment (IS approved) like safety Helmet, Safety shoes/ Gumboots Hand gloves, Gas Mask / Nose Mask, PVC apron, SCBA Set, PVC pressure suit, goggles, hood, etc. will also be provided to the required personnel.

5.2.6 Details of Work Place Ambient Air Quality Monitoring Plan

Work zone monitoring will be carried out by independent competent third party every month. Records will be kept in Form as per Maharashtra Factories Rules. Location for samplings shall be identified. Ambient Air & Noise Monitoring shall be done every

3 months as per CCA requirements. Following information will be incorporated in the format for maintaining records of work zone monitoring:

- Location/Operation monitored
- Identified contaminant
- Sampling instrument used
- Number of Samples
- Range of contaminant concentration as measured in sample
- Average concentration
- TWA concentration of contaminant (As given in Second Schedule of Factories Act)
- Reference method used for analysis
- Number of workers exposed at the location being monitored
- Signature of the person taking samples
- Other relevant details

5.2.7 Monitoring of the Occupational Injury & It's Impact on Workers

Following action plan will be prepared & followed to monitor the occupational injury to workers:

- Each workplace will be evaluated for the existing work conditions.
- Unsafe Act and Unsafe Practices will be identified.
- Unsafe equipment's, unsafe areas, etc., will be identified.
- Area will be checked for proper Ventilation and Illumination.
- Air-borne concentration of toxic chemicals will be measured and records will be kept.
- Evaluation of training & on the job work.

Impact of the above mentioned unsafe conditions on workers will be studied and remedial measures for the same will be adopted.

5.2.8 Provision of Industrial Hygienist & Health Evaluation of Workers

1. It is proposed that management will develop a plan to check and evaluate the exposure specific health status evaluation of workers.
2. Workers will be checked for physical fitness with special reference to the possible health hazards likely to be present, where he/she is being expected to work before being employed for that purpose. Complete medical examinations including PFT, Urine and Blood examination, Liver Function tests, chest X-ray, Audiometry, Spirometry Vision testing, ECG, etc. shall be carried out. However, the parameters and frequency of such examination will be decided in consultation with Factory Medical Officer and Industrial Hygienists.
3. While in work also, all the workers will be periodically examined for the health with specific reference to the hazards which they are likely to be exposed to during work. Again, the parameters and frequency of such examination will be decided in consultation with Factory Medical Officer and Industrial Hygienists. Plan of monthly and yearly report of the health status of workers with special reference to Occupational Health and Safety, will be maintained.

5.2.9 Safety Trainings & Mock Drills

Safety trainings (on Safe Material Handling, First Aid, & all Safety Aspects) shall be provided every 15 days by the Safety Officers with the assistance of faculty members called from other Professional Safety Institutions and Universities. In addition to

regular employees, limited contractor labors will also be given safety training. To create safety awareness, safety films shall be shown to workers and leaflets shall be distributed.

Mock Drills

To evaluate the effectiveness of emergency preparedness and to spread the awareness among employees mock drill will be carried out at the interval of every six months.

After completion of the mock drill, summary report shall be made and corrections will be done if any weakness has been observed.

Frequency of Mock Drills

On-site emergency: Once every 6 months

Off-site emergency: Once every year

6 OH&S MANAGEMENT PLAN

Occupational Health and Safety (OHS) is an area concerned with the safety, health and welfare of persons engaged in work or employment. Main aim of occupational safety and health plan is to foster a safe and healthy work environment, which may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment. OHS is widely referred as occupational health, occupational and non-occupational safety includes safety for activities outside work. It is important to the company for moral, legal, and financial reasons. Implementation of good OHS practices can also reduce employee injury and illness related costs, including medical care, sick leave and disability benefit costs.

OH&S Management Plan is a system to address potential adverse impacts, to introduce standards of good practice to be adopted for project activities.

6.1 OBJECTIVES OF OH&S

Following are long-term objectives of the OH&S Management Plan for the environmental attributes:

- To comply with all the regulations stipulated by Central /State Pollution Control Boards related to applicable laws.
- To create good working conditions.
- To encourage support and conduct developmental works for the purpose of achieving OH&S standards
- To encourage and achieve highest performance and response from individual employees and contractors.
- To plan out the complete strategy to take care of stakeholder engagement.
- To contribute significantly for sustainable development.

6.2 CONSTRUCTION PHASE

Proposed project will be carried out in industrial area. There will be construction of Production plant, Office & laboratory area, Storage area, ETP, Utility area, etc. Anticipated impacts due to proposed project during construction phase are discussed in earlier section. Following OH&S management plan will be implemented to mitigate any adverse impact or reduce the magnitude of impact.

- Regular maintenance of construction vehicles and equipment will be carried out to reduce the noise level within plant premises.
- Emission from construction machineries as well as vehicles will be minimized as under:
    - Regular maintenance of vehicles/ machineries
    - Use of vehicles with PUC certificates
    - All construction machineries/equipments and vehicles will be turned off, when not in use.
- During the transportation of dusty materials, loaded trucks will be covered to avoid PM level in air. Regular spraying of water will be done for dust suppression.

- Basic PPEs like ear plug/muff, safety helmet, face mask, safety gloves, safety goggles, safety shoes, safety harness etc. will be provided to worker. PPEs will be properly checked before providing to the workers.
- First aid facilities shall be kept at designated locations and same shall be used for construction workers during construction phase.

6.3 OPERATION PHASE

The industry will maintain comprehensive OH&S management plan in place for the proposed unit which will cover all the safety measures to mitigate improvised health effects. To maintain high standards in health, safety and environment; various activities will be undertaken at the site. The following key safety measures will be implemented for proposed project:

- SOP's for safe operation will be prepared
- Emergency control room will be established
- Ventilation will be provided to take care of heat evacuation.
- Firefighting network including fire extinguishers, fire hydrant system etc. covering entire plant will be provided
- All firefighting equipment and warning devices will be kept in perfect working conditions at all the times. It will be seen that all personnel are aware of the implications of environmental pollution and simple practices to avoid pollution
- On site – Off site emergency plan will be prepared.
- Provision of industrial hygienist, monitoring of the occupational injury and maintain the record of the same as per requirement of Maharashtra Factories Rules
- Health checkups will be organized at regular intervals
- First aid boxes at appropriate place and safety training will be provided
- Necessary safety training will be imparted to unskilled workers/ trainee/ employees in various aspects, viz. handling of the materials, precautionary measures to be taken while working, how to use the safety equipments, etc. to minimize the chances of any accidental mishaps.
- All safety and health precaution will be taken, although workplace monitoring for NH3, and VOC is suggested to identify any adverse health effect on workers
- Safety awareness programs will be conducted regularly for workers and contractors associated with the industry.
- Drinking water availability shall be ensured at several locations within the plant
- Personnel protective equipment such as safety shoes, safety goggles, hand gloves, gum boots, safety helmet, safety harness for working at height and breathing apparatus set kit will be given to all workers and staff. Additional PPEs will be readily available at the workplace.
- Wind socks will be provided at various locations to know the direction of wind in case of a leak or fire.
- Provision of Emergency Exit and Assemble point

Housekeeping

Proper housekeeping is an essential part of sound environmental management. It will be rigorously seen that there is no accumulation of wastes, especially combustible wastes inside the plant area. Regular maintenance of greenbelt area.

6.3.1 Dust other Chemicals being suspended in the Environment

The possibility of suspended particles going into the body of the workmen, either in the form of inhalation, ingestion or through skin absorption are least and negligible as because the entire operation at the plant will be performed under closed loop condition, right from charging till discharging, hence it's a rare possibility that the workmen will come in direct contact with raw material or final goods.

At the same time the level of PM and RSPM will be least and nominal value. But even though the same will be under periodical surveillance as per applicable legislations and any minor deviation from the same will be dealt immediately and will be corrected.

Further to this all of the workmen will be provided with complete set of appropriate PPEs, like nose mask / nose respirator, gloves, helmet, protective uniform and clothing, eye protections etc.

6.3.2 Occupational Hazards Specific Pre-placement and Periodic Monitoring

As per policy and norms all of the workmen will be put to medical examination and testing periodically and at set interval and based on the medical report actions will be taken. Based on the medical examination report/feedback, workmen will be counseled and put in different area /job rotation kind of activities. Following tests will be conducted periodically:

- Lab investigations, like fasting blood sugar, post prandial blood sugar, urine routine
- Hematology profiles including, complete blood count, ESR, blood grouping and RH type,
- Lipid profile
- Liver Function Test including, SGOT, SGPT, Total Bilirubin, Direct Bilirubin, Total Protein, Albumin, A/G Ratio, AIKP GGT
- Non-Invasive Investigations including, Chest X-ray, ECG, Pulmonary Function Test, Vision Test, Audiometry.

6.3.3 Action Plan for OHS Standard Implementation

This program will:

- Identify hazards in the workplace
- Eliminate or minimize the potential for injuries and disease
- Limit financial losses resulting from injuries and disease
- Be monitored to ensure that it meets its goals and requirements

Roles and responsibilities

Roles and responsibilities of all working personnel will be defined. The purpose is to help everyone understand their own roles and the roles of others so they can work toward common health and safety goals.

Employer's responsibilities

Employers have both general and specific responsibilities related to hazard control and worker health and safety. In carrying out these duties, management—from the chief

executive officer through to the first-level supervisor—can demonstrate their commitment to health and safety in the workplace.

General responsibilities are as under;

- Ensure the health and safety of the associates and contract personnel present at the workplace.
- Establish health and safety policy (included in EHS policy).
- Provide general direction to all about their responsibilities and roles in providing a safe and healthy workplace.
- Provide specific direction and delegate authority to those responsible for health and safety.
- Consult and cooperate with individuals carrying out occupational health and safety duties.
- Provide workers with the information, instruction, training and supervision necessary to protect their health and safety.
- Provide supervisors with the support and training necessary to carry out their health and safety responsibilities.
- Provide and maintain protective equipment, devices, and clothing and ensure that they will be used.

Hazard control responsibilities are given below:

- Identify potential hazards through regular inspections and either laminate or control the hazards without delay.
- Remedy any workplace conditions that are hazardous to worker health or safety.
- Develop written safe work procedures.
- Encourage workers to express concerns and suggest improvements on health and safety issues, for example, through safety talks, meetings or consultation with worker representatives.

Supervisor's responsibilities

Supervisors give health and safety the same priority as productivity or quality control. They must know and comply with occupational health and safety requirements. A supervisor is defined in the Occupational Health and Safety Regulation as "a person who instructs, directs and controls workers in the performance of their duties." Any worker (management or staff) who meets this definition of supervisor has the responsibilities of a supervisor for the workers under their control.

General responsibilities are as under-

- Ensure the health and safety of all workers under their direct supervision.
- Know the QPPL requirements that apply to the work being supervised and ensure that they are followed.
- Ensure that workers under their supervision are made aware of all known or reasonably foreseeable health and safety hazards where they work.
- Consult and cooperate with safety committee members or EHS-Officer, and cooperate with others carrying out occupational health and safety duties.
- Ensure that the appropriate personal protective equipment and clothing are available, properly worn when required, and properly inspected and maintained.
- Investigate unsafe conditions reported to them and ensure that corrective action is taken without delay.

Workers' responsibilities

Workers have general responsibilities for their own health and safety and that of other workers. In addition, they have the responsibility to refuse unsafe work; discriminatory action cannot be taken against them for refusing to do unsafe work.

General responsibilities are as under:

- Cooperate with the Safety committee and EHS officers, and any other person carrying out occupational health and safety duties.
- Learn and follow safe work procedures.
- Be alert to hazards, and report hazards or problems to the supervisor or employer.
- Use the protective clothing, devices, and equipment provided.
- Perform work in a safe manner. Do not engage in horseplay or work while impaired by alcohol, drugs or other causes.

OHS Program

OHS Program will be implemented and a safety committee will be formed comprising personnel form management, supervisors and contractors.

OHS program will be designed to address the specific needs of the individual workplace. OHS program will have the following seven elements:

1. An OHS policy statement, aim of the program and the responsibilities for health and safety
1. Regular inspection of premises, machinery, tools, equipment, and work practices
2. Appropriate written instructions for workers
3. Periodic management meetings to discuss health and safety issue
4. Investigation of accidents and other incidents in order to take action to prevent similar incidents
5. Records and statistics
6. Instruction and supervision of workers

OHS policy

The OHS policy typically states

1. The employer's commitment to the OHS program
2. The employer's commitment to protect the health and safety of workers
3. The aims and priorities of the OHS program
4. The responsibilities of the employer, supervisors, and workers

Regular inspection

Regular inspections of the workplace are intended to:

1. Identify conditions and unsafe acts with the potential to cause injury or disease
2. Determine necessary corrective measures
3. Prevent development of unsafe work conditions

Three different kinds of inspections are described below:

1. Regular, planned workplace inspections:
   Include inspection of buildings, structures, grounds, excavations, tools, equipment, machinery, work methods and practices for hazards that might cause injury or disease. These inspections are scheduled at appropriate intervals to prevent unsafe conditions developing. Depending on the risk category inspections would be scheduled daily, weekly, or monthly.
2. Equipment inspections:
   Workers would be trained to inspect their machinery, tools and equipment regularly, as per the manufacturer's recommendations.
3. Special inspections:
   A special inspection would be carried out after a malfunction or accident to ensure that work does not resume until it is safe to do so.

Written Instructions

Written procedures will be used to train new workers and establish a consistent level of work performance. A written safe work procedure lists the steps in doing a task safely.

For some tasks, safety issues will be addressed verbally in PEP talks or during training. For preparing written procedures, the following will be considered:

1. The level of hazard
2. The number of workers doing the work
3. How frequently the work is being done
4. The severity of injuries that might result if correct procedures are not followed
5. Recommendations for written procedures as a result of an inspection or investigation

Written safe work procedures will be developed in consultation with the workers who do the job. Workers will be provided with copies or procedures will be posted in the area where the work activity occurs.

Procedures are reviewed whenever a job changes, new equipment is introduced or workers return after an extended absence. In addition, work procedures will be adjusted as the result of recommendations from an inspection or from an investigation into an incident.

Management meetings

Management meetings will be conducted to review health and safety activities and incident trends.

Investigations

Investigation of accidents and incidents that have the potential to cause an injury and /or health effect.

Records and statistics

Records typically include:

1. Inspection reports and records of corrective actions taken
2. Incident investigation reports and records of corrective actions taken
3. Worker orientation records
4. Records of worker and supervisor training showing the date, names of attendees, and topics covered
5. Records of meetings and PEP talks at which safety issues were discussed
6. Supervisors' notes and logs of safety contacts
7. Safety & Management committee meeting reports showing steps taken to address health and safety issues
8. Contractor pre-qualification documents
9. Equipment logbooks and maintenance records
10. First aid records, medical certificates, and Periodical tests
11. Forms and checklists showing requirements for safe work procedures
12. Sampling and monitoring records for work around harmful substances
13. Emergency response plan, record of drills, and any resulting improvements

Statistics

Accident and injury statistics will be used for identifying trends and for measuring the effectiveness of health and safety activities and programs.

Instruction and supervision of workers

Adequate supervision includes:

1. Ensuring proper training of workers

2. Observing workers after training to ensure that they continue to follow safe work procedures
3. Making informal inspections on a daily basis to ensure safe work procedures are being followed, including the proper use of protective equipment, devices, and clothing provided
4. Enforcing safety rules and safe work procedures
5. Conducting informal discussions (PEP talks) with workers to discuss specific safety issues as they arise.

$$---End\ of\ the\ QRA\ Report---$$