Additional Studies

1 Introduction

Increasing use of hazardous chemicals as raw materials, intermediates and finished products in chemical manufacturing industry has attracted attention of the Government and the public at large in view of the chemical disasters that have occurred in the past. The serious nature of the accidents, which cause damage to the plant, personnel and public, has compelled industries to pay maximum attention to the safety issues and also to effectively manage the hazardous material and operations. It is mandatory for the industries handling hazardous chemical to maintain specified safety standards and generate an on-site emergency plan and keep it linked with off-site emergency plan. The safety management includes the implementation of preventive methods or accident prevention methods to avoid incident or accident and handling of emergency in case of accident. Special studies were carried out on risk and hazard management for the CSC plant at MIDC Paithan.

1.1Objective of the Risk and Hazard analysis

1. Identify hazards and nature of hazard in the process, storage and handling of hazardous chemicals.
2. Carry out Qualitative Risk Assessment (**QRA**) for the process and suggest mitigation measures.
3. Carry out Quantitative Risk Assessment for the storage of hazardous chemicals and estimate the threat zones for Most Credible and Worst case scenarios
4. Suggest mitigation measures to reduce the risk / probability of the accident to the minimum.
5. Incorporate these measures for ensuring safe operations and safe layout and for effective preparation of On-site and Off-site emergency plans
6. Suggest Guidelines for on-site and off - site emergency plan

1.2 Methodology

A] Identify hazards based on

- Processes description received.

- Identify Hazardous Chemicals handled and stored.
- Inventory of Hazardous chemicals
- Proposed storage facilities for hazardous chemicals
- Plant layout
- Safety measures to be adopted by the company

B] Hazard Assessment:

- By Qualitative Risk Assessment
- By Quantitative Risk Assessment by Hazard index calculations and estimate threat zones by using ALOHA.

C] Recommendations:

- Recommend mitigation measures based upon the above
- Recommending guidelines for the preparation of On-site Emergency plan.

2 Hazard Identification

Following are the major areas of hazard identified:

1) Reaction and separation sections of Production unit.
2) The storage and handling of hazardous raw materials.

2.1 Reaction and Separation Sections of Production Unit

Qualitative Risk Assessment

The manufacturing processes are described earlier in the **Chapter 2**. Basically these involve reactions carried out in batch reactor, separation and recovery of solvents (Used as reaction media), neutralization, followed by separation and purification of the product. In this manufacturing plant, the major hazard lies in the Reaction Section and the Separation Section. The hazards identified are;

1. Fire and explosion
2. Toxic release
3. Exposure to hazardous chemicals

3 Process and Reaction Details

First Reaction conditions for the following products is same: 4- Chloro 2-Nitro Aniline, 5- Chloro-2-Nitro Aniline, 4- Nitro -2-Chloro Aniline, 2- Nitro Aniline, 4- Nitro-m-Phenylene Di-amine, 2-Amino 3-chlro 5-trifluoro methyl pyridine, 8-amino Quinaldine.

Condition: Reaction with Ammonia at 30-32 kg/sqcm pressure at 160 to 170˚C, except the raw materials are different, in a batch stirred reactor. Details of respective raw materials are given in the following **Table 1**.

Table 1: Details of Raw Materials

Sr. No.	Product	Raw material	Reaction Medium	Purification
1.	4- Chloro-2-Nitro Aniline	2, 5 Dichloro Nitrobenzene	Water	-
2.	5- Chloro-2-Nitro Aniline	2, 4 Dichloro Nitrobenzene	Water	Methanol
3.	4- Nitro-2-Chloro Aniline	3, 4 Dichloro Nitrobenzene	Water	-
4.	2- Nitro Aniline	Ortho Nitro-Chlorobenzene	Water	-
5.	4- Nitro-m-Phenylene Di-Amine	2, 4 Dichloro Nitrobenzene	Water	-
6.	2-Amino 3-Chlro 5-Trifluoro Methyl Pyridine	2, 3 Dichloro 5 Floro Methyl Pyridine	Water	-
7.	8-Amino Quinaldine	8 Chloro Quinaldine	Water	-

3.1 Process in General for all the above products:

27% Ammonia solution is prepared by passing Ammonia, at controlled flow from the Ammonia cylinder through the water in a tank, connected to the Ammonia absorber and 27 % Ammonia solution is charged in an autoclave. 2, 5-Dichloro Nitrobenzene is charged in the Ammonia solution. The resultant mixture is heated to 160-170 °C and pressure developed of 30-32 kg/cm^2 is maintained for 8 h. The reaction mass is cooled and pressure of Ammonia is vented through a tank, where the Ammonia is collected. The reaction mass is cooled to ambient temperature and then filtered on nutch filter. Mother liquor is collected. The wet product from nutch filter is centrifuged and washed with plane water. The wet product is dried in tray dryer. Dry product is unloaded and packed.

Hazards Identified:

1. Handling of Ammonia cylinders and solution preparation, hazard is leakage of Ammonia through piping, escape of unabsorbed Ammonia to the atmosphere during preparation of 27 % Ammonia solution.
2. Exothermic reaction, uncontrolled addition or temperature may lead to the condition of runaway reaction and may cause explosion. Impact of which will be serious leading to loss of property, injury and fatalities. Threat zone for Ammonia and other gases from the reactor can affect areas outside the plant premises.

Mitigation Measures:

It is strongly recommended to take all the preventive measures to minimize the probability of the accident to the minimum and make the process and reactor operation as intrinsically safe as possible, because prediction of realistic estimation of the extent of damage and damage control after the accident is extremely difficult in case of reactor accident.

4 HAZOP Study

The most effective and recommended method for identification of hazards in reaction and separation sections and for incorporating necessary changes in SOPs and to provide effective instrumentation alarms and interlocks as mitigation measures to make the process / plant operation inherently safe, the HAZOP has been carried out for the processes identified above for critical reaction steps and Ammonia handling and Ammonia solution preparation.

All the recommendations of HAZOP study particularly for exothermic reactions will be strictly implemented in the plant.

Major Hazard in Reactions

It is known that highly exothermic reactions and even mildly exothermic reactions can lead to the uncontrollable rise in temperatures and pressures in the reactors and ultimately to the conditions of run-away reaction, (mostly in highly exothermic reactions and which use solvents as reaction media or and flammable and explosive chemicals) and this results in catastrophic explosion and fire.

The major reason for occurrence of uncontrollable rise in temperature is accumulation of un-reacted reactants. This has to be avoided at any cost.

For this basic and the most important mitigation measures suggested are:

1. Setting up a (Standard Operating Procedure) SOP for all critical operations, reactions and separations.
2. Once the SOP and operating parameters have been finalized, strictly following it, 24X7, particularly for batch operations without any change of procedure.
3. Must have in built system to check that the procedures (SOP) are not violated at any time, and no short cuts are taken in batch processes. Manufacturing and production are in majority batch processes.
4. Have following alarm and interlock system (essential for highly exothermic reactions and alarms recommended for all exothermic reactions)

- Utility failure alarm
- Agitator failure alarm
- High temperature alarm
- Alarm for High rate of addition of limiting reactant, which is added at controlled rate.
- Raw material (limiting reactant) addition rate should be controlled by flow control loop (FT, FIC, FCV). Controlling parameter being reactor temperature.

- FCV and/or On-Off valve should be interlocked with the reaction mass temperature and agitator tripping.

Reactions at high pressure:

For the reactions carried out at more than atmospheric pressures following mitigation measures will be adopted:

- Reactor will be designed at pressure, which will be double than operating pressure.
- Rupture Disc and safety relief valve will be installed on the reactor to control excess pressure.

Hazard:

Release of hazardous / toxic gases, like Ammonia in the reactions, which have TLV and IDLH values in the range of 25-300 ppm is common hazard that can be identified. The exposure to these gases can be harmful to the workers in the plant and to the environment, in case of leakage through flange joints and getting released into the atmosphere.

Mitigation Measures:

1. Installation of efficient scrubbers / absorbers and ensuring proper operation as per design conditions.
2. The appropriate PPEs and breathing devices should be readily available and all the operators and staff should be trained in use of these PPEs.
3. Emergency instructions, in local languages should be displayed prominently near the work place.
4. It is also recommended to install gas leak detectors for highly toxic gases at appropriate locations.

Raw Materials used for other two products are given in the **Table 2**

Table 2: Details of Raw Materials

Sr. No.	Product	Raw Materials	State
1	Albendazole	4-Phenyl Sulphanyl Benzene 1, 2-Diamine	Solid
		Cyano Crabamate	Solid
		Methanol	Liquid
		Acetic Acid	Liquid
2	Fenbendazole	4-Propyl Sulphanyl Benzene1,2-Diamine	Solid
		Cyano Crabamate	Solid
		Methanol	Liquid
		Acetic acid	Liquid

Manufacturing Process: The manufacturing process for Albendazole and Fenbendazole are described in **Chapter 2.** The manufacturing process does not involve the pressure reaction or run away or exothermic reaction. The hazardous raw materials include solvent Methanol and hazardous chemical, Acetic Acid. There is no toxic and any other gas generated during the reaction.

Hazards and mitigation measures:

Hazard involves in handling of Methanol and Acetic acid. These are further detailed out as follows:

5 Storage and Handling of Hazardous Raw Materials

5.1 Hazardous Chemicals stored inTanks: Storage details of class A solvents are presented in **Table 3,** while that of raw materials stored in over ground tanks is provided in **Table 4.** Identified hazards and mitigation measures are also discussed as below:

Table 3: Storage of Class A Solvent

Sr. No.	Chemical	Qty. required per month	Maximum Qty. stored MT/cum	Size of tank in Diameter and Height	Number of Tanks	Clear Distance between each tank
1	Methanol	10 m^3	20 m^3	Dia – 2.5m Length – 5.0m (Horizontal U/G Tank)	1	NA

Hazard Identification:

Major hazard is pool fire in case of Methanol leakage, during unloading of Methanol tanker from the hose connecting tanker to the underground Methanol tank.

Mitigation Measures for safe storage of flammable solvents in Underground tanks:

1. It is necessary and mandatory to follow the, guidelines, rules and regulation given in Petroleum storage Rules 2002 for maintaining the clear distance between the tanks, distance of tank-farm location in the factory layout.
2. It is necessary and mandatory to obtain approval of CCE (Chief Controller of Explosives)

3. It is necessary to barricade the tank farm and put necessary sign of safety precautions, license number etc.
4. The minimum recommended separation distance from any underground tank to any building line is at least 2m, to avoid undermining the building foundations. It is advisable to increase this distance to 6 m for a basement or pit, to minimize the risk of vapour accumulation.
5. Corrosion is one of the main causes of equipment failure. Hence it is absolutely necessary to provide corrosion protection, to the internal and external surface of the tanks. Protection may be provided by paints or other coatings.
6. Cathodic protection may be used as an additional precaution as per the Indian and /or the international standard AP 620.
7. Coatings should be inspected for thickness, continuity and hardness prior to installing the tank.
8. For underground tanks, a bituminous coating can be applied using the appropriate standards.
9. Internal corrosion may result from the accumulation of water in the tank. A means to remove such water may be necessary. Caution is essential when draining water from beneath the product.
10. Reliance on a single valve to retain the tank contents is not sufficient. Two permanent in-line valves to the drainage point are recommended or temporary replacement of the blanking plate by a second valve during the draining operation.
11. Similarly, underground tanks requires:

- Foundations and adequate support (concrete or masonry);
- To be securely anchored or weighted to avoid flotation from flood water or a high water table;
- Backfilling with inert material such as rounded pea gravel or with concrete. Large stones or rocks may damage the protective coating on the tank. (Note: concrete is not suitable for double-skin tanks).
- Protection from loadings from above ground, particularly from traffic. A reinforced concrete slab may be suitable. Alternatively the area around the tank should be fenced off, with the perimeter of the tank clearly marked.
- An excavation of sufficient size to prevent damage to the tank's protective coating and to allow safe work during installation and backfilling.

Mitigation measures during unloading Material from the tankers:

1. Flexible hoses should only be used, taking the precaution to keep the length to the minimum.
2. Hoses should be made to a standard suitable for the application and should be compatible with the materials handled.
3. They should be adequately supported (for example by slings or saddles or steel braided) so that the bend radius is not less than the minimum recommended by the manufacturer.
4. When they are not in use, flexible hoses should be protected from accidental damage, extremes of temperature and direct sunlight.
5. They should be inspected daily for signs of leaks, wear and mechanical damage and examined and pressure tested annually or according to the manufacturer's recommendations.
6. Hoses should be electrically continuous or bridged with an earthing cable to avoid electrostatic charging.
7. **Bonding and Earthing:** Static electricity is generated when movement separates charge which can then accumulate on plant and equipment and on liquid surfaces. If the plant is not earthed or the liquid has a low electrical conductivity, then the charge may be generated faster than it can dissipate. Eventually, there may be an electrical discharge or spark. If this has sufficient energy it could ignite a flammable gas or vapour.

- To minimize the accumulation of electrostatic charge and prevent incendive sparks, all metal parts of the storage installation should be bonded together and earthed.
- A maximum resistance to earth of 10 ohms is recommended. It should be possible to disconnect the earthing facilities for periodic test measurement.
- For Further advice on earthing and bonding, it is recommended to follow the relevant Indian or International standards in BS 7430.40
- If the liquid has a particularly low electrical conductivity and is being stored above its flashpoint, it may be advisable to store it under a blanket of nitrogen or inject it with a static dissipating additive; if used, these degrade with time and the concentration and effectiveness should be monitored.

- QRA is calculated for Methanol leakage during tanker unloading in the later part of the report.
- Short term exposure: The substance is mildly irritating to the eyes. The substance may cause effects on the blood. This may result in the formation of methaemoglobin. The effects may be delayed. Medical observation is needed.
- Long term exposure: The substance may have effects on the blood and liver. This may result in the formation of methaemoglobin, anaemia and liver impairment.

Table 4: Raw Materials Stored in Over Ground Tanks

Sr. No.	Chemical	Maximum Quantity required Per month	Maximum Quantity stored MT/cum	Size of tank in Diameter and Height	Number of Tanks	Clear Distance between each tank	NFPA rating
1	3, 4-Dichloro Nitro Benzene	22260 kg	23000 kg	Dia. - 2.5 m Height – 4 m	1	2 m	Not listed
2	2, 4-Dichloro Nitro Benzene	22260 kg	23000 kg	Dia. – 2.5 m Height – 4 m	1	2 m	Nh=2 Nf=1
3	Ortho Nitro Benzene	28550 kg	23000 kg	Dia. – 2.5 m Height – 4 m	1	2 m	Nh=3, Nh=1, Nr=1

Mitigation Measures for Bulk storage in over ground tanks:

Location of the tank:

When selecting the location of storage tanks, the consideration should be given to the distance of the proposed tank farm from:

- The site boundary
- Roadways and site thoroughfares
- Occupied buildings
- Storage or processing of other hazardous substances particularly incompatible substances such as strong alkalis and oxidising agents; water courses and boreholes.

The tanks aboveground must be installed on the strong foundation (that supports for horizontal tanks). These should normally be of concrete with the required load bearing strength and thickness.

Dyke walls:

The tanks must be covered with the dyke walls**.** The purpose of the dyke wall is to:

- Prevent the liquid entering drainage or other water systems.
- Prevent the spread of the liquid, which could present a hazard to other plant or personnel both on and off site;
- Prevent contamination of land.
- Allow the controlled recovery or treatment of the spilled material.

The dyke walls and floor should be constructed of materials resistant to the chemical being stored.

The bund should have sufficient capacity to contain the largest predictable spillage. A bund capacity of 110% of the capacity of the largest storage vessel within the bund will normally be sufficient. Consideration should be given to the provision of individual dyke walls for each tank to prevent damage to other tanks, if a leak occurs. Chemicals which react with the each other should not share the same bund.

- The dyke walls should have sufficient strength to contain an spill.
- Rainwater should not be allowed to accumulate in the bund.
- Provision must be made for the removal of bund contents (e.g. acid spills or rainwater).
- These can be, providing a sump and a manually controlled sump pump, should be provided.
- Bund liquids should be analyzed as necessary before removal or disposal to prevent contamination of drainage systems.

If a drain valve is used, it should be kept locked in the closed position and only used by authorised personnel. The drain valve and any associated piping should be made of materials compatible with the chemical stored.

5.2 Hazardous Chemicals stored in Drums or Bags:

Details of all these are given in the **Annexure 7{I}**.

1) 2, 3-Chloro 5-Trifluoromethyl Pyridine, which is liquid, stored in 40 drums, maximum quantity stored is 10 MT. NFPA rating is not listed. Following information is available from MSDS:
   - It is harmful if swallowed.
   - It is harmful if swallowed or if inhaled

- It may cause an allergic skin reaction. It causes serious eye damage. It is harmful if inhaled.
- It is toxic to aquatic life with long lasting effects.
- To avoid exposure and contact, and for dealing with leakages, the measures given in MSDS must be followed.

2) All other are solid raw materials.
3) These solid raw materials and products are not highly hazardous and toxic as Nh, Nf, Nr values are less than 3.
4) 100 cylinders of Ammonia are stored in separate shed.

5.3 Hazards in storage and handling of Ammonia Cylinders:

Ammonia: Ammonia gas cylinders with various capacities 50 to 150 lbs are available with pressure Ammonia 114 psig (7.76 atm) at 21˚C, pressure varying with room temperature.

Hazard: Leakage of Ammonia affecting workers in the area and leakage of Ammonia from the piping from Ammonia cylinder bank to the tank use for the preparation of 27 % Ammonia solution. Safety Measures in Handling of cylinders is given in **Annexure II.** Mitigation measures for handling of Ammonia, properties, measures to be taken in case of leakage are given in **Annexure III.**

6 QRA for Methanol leakage

Road Tanker assumed to be of same volume as that of the storage tank and diameter of 2 m and length of 6.4 m.

QRA has been carried out for three scenarios under the following conditions:

Atmospheric Data: (Manual Input of Data)

Wind: 4 m/sec from NW at 3 m

Ground Roughness: open country	Cloud Cover: 0 tenths
Air Temperature: 35° C	Stability Class: D
No Inversion Height	Relative Humidity: 5%

Scenario 1: There is sudden leakage and ignition after release of 500 liters Methanol, before ignition and there is pool fire

Scenario 2: The leakage of Methanol through 5 mm hole in the unloading hose, during tanker unloading and there is pool fire

Scenario 3 :(Worst Case scenario): There is total failure of unloading hose of 100 mm diameter (hose getting disconnected), when tanker is 85 % full and there is fire. Threat zones predicted are summarsed in **Table 5** as below:

Table 5: Predicted Threat Zone

Scenario	Amount Released/ burned	Flame Length	10.0 kW/(sq. m) = potentially lethal within 60 sec)	5.0 kW/(sq. m) = 2nd degree burns within 60 sec	2.0 kW/(sq. m) = pain within 60 sec
Scenario 1	390 kg	4 m	Less than 10 m	Less than 10 m	Less than 10 m
Scenario 2	50.9 kg in 50 min	1 m	Less than 10 m	Less than 10 m	Less than 10 m
Scenario 3	12,627 kg in 50 min	10 m	23 m	28 m	37 m

Mitigation Measures based on QRA

1. Tankers unloading point should be minimum 4 to 5 m away from the storage.
2. Flame arrestors should be installed on all tankers at the exhaust, as soon as the tanker enters the factory area.
3. All ignition sources to be totally eliminated.
4. Trained fitters should connect and disconnect the hose and unloading operation should be carried out under supervision.
5. Firefighting arrangement around the tank area should be maintained in proper condition.

7 QRA for Ammonia leakage:

Quantitative Risk analysis was carried out for following conditions: Atmospheric Data: (Manual Input of Data)

Wind: 4 m/sec from NW at 3 m
Ground Roughness: open country
Air Temperature: 35° C
No Inversion Height
Cloud Cover: 0 tenths
Stability Class: D
Relative Humidity: 5%

For following three Scenarios:

Scenario 1 :Worst case Scenario: Failure of Pressure reducing Control and Gas flow rate through pipe to the tank with water for 1 h without absorption.

Scenario 2: Same as above predicting distance covered till IDLH value

Scenario 3: MCS Leakage through 5 mm hole in piping with 6 atm ammonia pressure for a minute.

Table 6: Predicted Threat Zone

Scenario	Amount of NH_3 released	(300 ppm = IDLH)	1100 ppm = AEGL-3 (60 min)	(160 ppm AEGL-2 (60 min)	(30 ppm AEGL-1 (60 min)
Scenario 1		----	79 m	208 m	523 m

Scenario 2	876 kg for 1 h	149 m	----	208m	523m
Scenario 3	3.01 g in 1 min	Less than 10 m	----	Less than 10 m	Less than 10 m

Recommendations based on QRA:

1. PRV should be placed as close to the cylinder Bank as possible.
2. Leak detectors should be installed near the cylinder, reactor and near absorber outlet.
3. In case of major leak SCBA should be readily available and all leakages must be attended with PPEs.

8 On-site Emergency Plan:

Company will prepare On-site Emergency Plan based on the following guidelines, before the plant start-up.

8.1 Guidelines for the preparation of on-site emergency plan:

This has not been prepared as the project is at its early stage of execution. However, this will have to be made as per Factory Act; approval is needed before the plant startup. Guidelines suggested for preparing Emergency plans. This can be made as per the following guidelines suggested below:

On-site and Offsite emergency plan will be prepared as per the factory act and will be prepared as per Rule no. 12 of factory act (control of Industrial Major Accident Hazard Rules, 2003) as per the guidelines given in Schedule 6.

Objectives of Onsite Emergency Plan will be:

1. To control emergency situation arising out of possible hazards identified in the factory fire, explosion, and toxic leakage.
2. To identify all possible hazards, its consequence, areas affected.
3. To estimate areas affected.
4. Define actions to be taken in case of emergency.
5. Identify persons responsible to take necessary actions to deal with situation.
6. To localize emergency and if possible, eliminate it.
7. To avoid confusion, panic and handle the emergency in a planned manner.
8. To minimize loss of life and property to the plant, as well as to the neighborhood.
9. To carry out rescue operations
10. To treat injured persons and transfer to the nearest hospital for treatment.
11. To restore normalcy.

It will specify names of key personnel as;

1. Chief Controller (Generally he is Factory Chief)
2. Incidence Controller (Generally he is plant in charge, where emergency has occurred or shift in charge after General Shift).
3. Under Chief Controller, three teams are formed

   Rescue Team

   Service Team

   Welfare Team
4. Liaison Officer

   The nature of responsibilities of these Key personnel & Teams are clearly defined. Reporting chain of command will be clearly defined.

   Following documents will be required and will form essential part of the Onsite and offsite Emergency Plan.

- Factory layout showing location of all plants, location of hazardous storage, location of Emergency control center.
- Factory layout showing designated assembly areas.
- Block diagram of manufacturing processes.
- List of hazardous chemicals stored.
- MSDS of all hazardous chemicals. (**Annexure IV**)
- List of Antidotes.
- List of Key Factory personnel with contact numbers and addresses.
- List of employees trained in firefighting with contact numbers.
- List of employees trained in first-aid and rescue operations.

5. List of Telephone numbers and addresses of outside government and other agencies mainly;

- Nearest Police station.
- Nearest Fire Brigade Station.
- Ambulance services.
- Nearest Government and other Hospitals.
- Blood Bank.
- Maharashtra State Electricity Board (MSEB)
- Maharashtra Pollution Control Board (MPCB)

6. Emergency Action Plan in case of all possible hazards identified.
7. Procedure for reporting emergency will be clearly defined.

8. Actions to be taken by personnel where emergency has occurred
9. Actions to be taken by personnel at other location will be clearly defined and
10. Precautions /Actions to be taken after emergency will be clearly defined.

Training and Mock Drill:

It is absolutely necessary to train & carryout mock drills for success of emergency plan during actual emergency. Emergency procedures should be laid down clearly and convincingly to everyone on site, particularly the Key Personnel & Essential Workers.

9 Disaster Management Plan:

This will be prepared after the preparation of On-site emergency Plan in co-ordination with industries round and local Government authorities (**Annexure V**).

10 Occupational Health Center (OHC)

The company will establish OHC as per the Factory act, Rule 73 clearly states the requirements, rules for pre-employment and regular medical check-up, trained man-power required to be employed in OHC, need for 24x7 Ambulance availability.

Since the workers will be dealing with hazardous and toxic chemicals following is suggested:

It is clear that the parameters for periodic health checkup for workers has to be based on and decided on the hazardous chemicals handled in the process (Raw material, intermediates, solvents, products), their toxic properties and the extent to which shop floor workers, including contract labors, operators, officers are exposed to these chemicals.

Detailed information on the groups of hazardous chemicals, chemicals included in the group, their use, target organs, (organs which are affected by the exposure to these chemicals) and corresponding medical tests to be carried out is available.

It is expected that the parameters based on such or similar tables, hazardous properties of chemicals (available in MSDS) have to be finalized by the OHC doctor in consultations with the safety officials of the company.

Frequency of periodic examinations will depend upon the exposure, TLV values, extent of these chemicals in air, based upon air monitoring.

Periodic medical examination, in comparison with pre medical checkup results will reveal the ill effects on the worker's health. This will help early detection of the disease and the effect on organs tec. This should be used for suitable corrective action to prevent further deterioration.

Suitable medical treatment should be initiated for the worker.

If air monitoring shows presence of hazardous chemicals more than TLV values, suitable action needs to be initiated immediately to improve process conditions / pollution measures.

For less hazardous industries, same health parameters as per pre-employment checkup should be included in periodic medical checkup.

11 Health Management Plan:

Health management plan has been prepared and it will be implemented after commissioning of plant. Attached as **Annexure VI.**

12 EHS policy:

Company has clearly defined EHS policy and it will be known to all employees and it will be displayed properly in the plant premises. EHS Policy is given in **Annexure VII**.

13 Safety Guidelines for transportation of Solvent & Hazardous Chemicals

Following recommendations will be followed while fixing the transport agency for transporting Class A solvents and other hazardous chemicals:

Recommendations for transport of Class A chemicals and hazardous chemicals

Class A Solvents transport: Rules to be followed and precautions to be taken. The Petroleum Act and the Petroleum rules 2002 clearly specify in PART IV "Transport on Land by Vehicles" Under Rules 62 to 86 mandatory for the transportation of Class A chemicals.

A. Rule No 63: The CCE Approval required for tank and vehicle used for transportation.
B. Rule No 64: this deal with tank capacity limits and solvent filling limits in the tank.
C. Rule No 65: This clearly specifies that the vehicle approved for Class A solvent will not be used for transportation of any other purpose.
D. Rule No 69: No other article can be transported in the vehicle transporting Class A chemical.
E. Rule No 70: This makes it mandatory to have spark arrestor fitted to the exhaust pipe of the vehicle and engine air intake fitted with effective flame-arrestor.
F. Rule No 71: This specifies Electrical installation requirement for the tanker.
G. Rule No 72: This specifies that it is mandatory to carry Fire Extinguisher of minimum 10 kg capacity.
H. Rule No 73: This specifies that it is mandatory to have at least one person with knowledge attending the vehicle 24X7 during parking.

I. Rule No 74: This specifies regarding parking of vehicle in the public place.
J. Rule No 76: This specifies for loading and unloading of the tanker.
K. Rule No 78: This specifies precautions against static charge.
L. Rule No 79: This specifies precautions against electrical hazard: No loading or unloading unless the engine is switched off.
M. Rule No 83: This specifies tanker loading and unloading to be restricted between sunrise and sunset.
N. Rule No 84: This prohibits smoking / open flame etc.

Common Guidelines for transport and handling hazardous chemicals and Class A solvents:

It will be ensured that during the transportation contents are not spilled. Personnel, including the driver and cleaner are properly trained about the hazardous properties of the material being carried and for transport of hazardous material, in general.

- Tanker must be RTO approved and tested and approved by CCE for Class A solvents. Frequently tested for integrity. Certificate must be available.
- Vehicle must have safety equipment / PPEs and antidote, if necessary.
- It is mandatory that driver possess a valid driver's license.
- The maximum speed limit is prescribed.
- Driver will be instructed to park the tanker at safe place and they should be available in the near vicinity.
- TREM (Transport Emergency) cards are to be provided to the drivers.

Annexure I: Hazardous Materials store in drums or Bags

Sr. No.	Chemical	Liquid/Gas at storage Conditions	Maximum Quantity required Per month	Maximum Quantity stored MT/Kgs/ liters	Size of Drum /carboy	Number of drums/ carboys	Nature of Hazard Toxic/Reactive/ Fire (From NFPA rating)
1	2, 5-Dichloro Nitrobenzene	Solid	33390 Kg	20 MT	50 Kg Bag	400 Bags	Toxic
2	2, 3-Dichloro 5-Trifluromethyl Pyridine	Liquid	13200 Kg	10 MT	250 Kg Drums	40 Drums	Toxic
3	8-Chloro Quinaldine	Solid	11250 Kg	5 MT	25 Kg Bag	200 Bags	Toxic
4	4-Chloro 2 Nitro Aniline	Solid	30000 Kg	10 MT	25 Kg Bag	400 Bags	Toxic
5	5-Chloro 2 Nitro Aniline	Solid	20000 Kg	8 MT	25 Kg Bag	320 Bags	Toxic
6	2-Chloro 4 Nitro Aniline	Solid	20000 Kg	10 MT	25 Kg Bag	400 Bags	Toxic
7	2-Nitro Aniline	Solid	25000 Kg	10 MT	25 Kg Bag	400 Bags	Toxic
8	2-Amino 3 Chloro 5 Tri Floro Methyl Piridine	Solid	12000 Kg	5 MT	25 Kg bag	400 Bags	Toxic
9	4-Nitro Meta phenyline Dimine	Solid	2000 Kg	2 MT	25 Kg bag	80 Bags	Toxic
10	8-Amino Quinaldine	Solid	10000 Kg	4 MT	25 Kg Bag	160 Bags	Toxic
11	Albendazole	Solid	20000 Kg	5 MT	25 Kg Bag	200 Bags	Toxic
12	Fenbendazole	Solid	20000 Kg	5 MT	25 Kg Bag	200 Bags	Toxic
13	Ammonia	Gas	25000 Kg	5 MT	50 Kg Cylinder	100 Cylinders	Hazardous / Toxic

Annexure II: Safety Measures in handling Cylinders

Risks and Hazards from Gas Cylinders:

Gas cylinders can be hazardous due to both their physical (size and weight) and chemical characteristics. Hazards from gases are also subject to the chemical properties of each gas. These may be one or more of the following:

1. Fire or explosion from the release of flammable gases near ignition sources (e.g. acetylene or LPG). Refer to MSDS for Upper and Lower Explosive Limits (UEL and LEL)
2. Spontaneous combustion from oxidizing gases (e.g. Oxygen or Nitrous Oxide), Exposure limits for all gases, especially toxic or corrosive gases (e.g. Anhydrous Ammonia); refer to MSDS for Time Weighted Exposure Limit (TWA) and Short Term Exposure Limit (STEL), Asphyxiation from non-toxic, non-flammable gases by displacement of Oxygen (e.g. Nitrogen, Carbon Dioxide or Argon), Incorrect storage
3. Leakages

Each compressed gas cylinder has unique hazards based on its contents. Some are filled with inert gases; especially those used in arc welding. Many gases are flammable, explosive, toxic, or a combination.

Bulk Cylinder Storage: Gas stores should be located outdoors, preferably in a secure, cage protected from sunlight. Storage indoors is not recommended unless the building has been designed for that purpose with appropriate fire rated walls and ventilation. Where gases are stored indoors, additional safety considerations and control measures need to be given consideration.

Specific Storage precautions Requirements in manifolds: Cylinders in Use shall be in an upright position. If cylinders have been lying on their side, place the cylinder in the upright position and wait for 60 minutes before using. If Acetylene has been laid on its side, then it is recommended that the cylinder shall not used be for 12-24 hours.

Secure cylinders using a special purpose built non-abrasive coated chain, strap or cable that will not scratch the cylinder markings and paint work or a racking system.

Completely close the valves, and keep the valve protection devices, such as caps or guards, securely in place when cylinder is not in use.

1. Store cylinders in a dry, well-ventilated area. Place them in a location where they will not be subject to mechanical or physical damage, heat or electrical circuits to prevent possible explosion or fire.
2. Keep cylinders away from pedestrian traffic.
3. Full and empty cylinders should be stored separately in clearly marked areas.
4. Objects should not be stored on top of gas cylinders

5. Gases denser than air need to be stored with caution to avoid storage where these gases can accumulate in low lying areas.
6. Gas cylinders should not be located where they may block stairs, exits, ladders or walk ways. Ensure an up to date and accurate inventory is kept. Keep inventory quantities as low as possible.
7. Segregate Incompatible Gases

Using Gas Cylinders

Always use gas cylinders in well ventilated areas. Do not use gas cylinders in confined spaces unless qualified to do so and the appropriate PPE is used. Know the gas you are using and possible reaction products. Additional mechanical ventilation may be required. Seek expert assistance in designing and installing mechanical ventilation systems. Ensure the correct regulator is used for the purpose.

- Ensure there is a suitable emergency response procedure in place. Wear appropriate PPE for the gas been used, refer to MSDS. Ensure connections, fittings and lines are leak tight and suitable for use.
- Ensure that flammable and oxidizing gases are not used near ignition sources.
- Disconnect empty cylinders from equipment to avoid backflow issues. Always close the cylinder valve when not in use. DO NOT use an empty cylinder as a waste receptacle. Fit non-return valves in line if required.
- Do not use a gas cylinder that shows evidence of damage or corrosion. The gas cylinder is a rented item; its integrity is the responsibility of the gas supplier. If the cylinder contents cannot be clearly identified, Do not use it.

Leaks

Leaks from gas cylinders are potentially very dangerous, depending on the properties of the gas. If a gas cylinder is found to be leaking then appropriate measures should be put in place to limit risk.

If a flammable gas is found to be leaking then it should be treated as if the cylinder were on fire.

Leaking toxic gases are extremely dangerous. Immediately evacuate the area and follow the normal school/faculty emergency response procedures. The fire brigade shall be called and informed of the type of leaking gas. DO NOT re-enter the area until it is deemed safe to do so by professionals.

Annexure III: Measures for Handling Ammonia

"Ammonia is a natural constituent of the atmosphere but exists in concentrations below the level which is hazardous to humans, animals, plants or materials.

High concentrations of Ammonia gas are corrosive to mucous membranes; can cause damage to the eye, throat and upper respiratory tract; and can produce residual damage and even death to humans and animals.

High concentrations are also toxic to most plant life and have corrosive effects on materials."

Concentration in Air	Effect
20 µg/m^3 (0.027 ppm)	- Average atmospheric background concentration.
30 - 36,000 µg/m^3 (0.04 - 50 ppm)	- Odor threshold.
1.44 mg/m^3 (2.0 ppm) Max one hour concentration limit	A limit of 0.50 ppm may be desirable if a surrounding buffer is not possible.
18 mg/m^3 (25 ppm)	Threshold limit value to which it is believed workers may be exposed continuously for 8 hours without adverse effects
280 - 490 mg/m^3 (390 - 680 ppm)	- Concentration range where Ammonia gas produces eye, nose and throat irritation and may injure respiratory mucous.
360 mg/m^3 (500 ppm)	- Suggested maximum short-term atmospheric concentration due to uncontrolled release of ammonia resulting from equipment failure, safety valves discharging or any other single release.

The flammable limits of Ammonia are from 15% to 25% by volume in air; however, Ammonia is difficult to ignite in spite of this. Gaseous Ammonia will dissolve readily in water at a rate of approximately 700 volumes/volume of water.

Melting Point: -77.4°C

Boiling point: -33.4°C

Density: 0.677 g/cc

* Due to the chilling effect of evaporation, ammonia vapor resulting from a large spill may move downwind as a visible cloud some distance before dissipating or rising.

Vapour Concentration(ppm)	General Effect	Exposure Period
(1)	**(2)**	**(3)**
1-5	Odour detectable by most person	Prolonged repeated exposure produces no injury
25	No adverse effect for average worker	Maximum allowable concentration for 8 hour working exposure
35	No adverse effect for average worker	Exposure should not be longer than 15 minutes and should not occur more

Vapour Concentration(ppm)	General Effect	Exposure Period
		than four times per day
400 to 700	Nose and throat irritation Eye irritation with tearing	Infrequent short (1/2 hour) exposure ordinarily produces no serious effect
2 000 to 3 000	Conclusive coughing Severe eye irritation	No permissible exposure. May be fatal after short exposure
5 000 to 10 000	Respirator spasm. Rapid asphyxia	No permissible exposure. Rapidly fatal

Liquid Anhydrous Ammonia produces skin burn on contact.

ACGIH Short Term Exposure Limit (STEL) – 35 ppm

Notes

1. ACGIH (TLV-TWA) – The TWA concentration for a conventional 8 hour work day and 40 hour work week, to which it is believed that nearly all workers may be repeatedly exposed, day after day for lifetime without adverse effect.
2. ACGIH (TLV-STEL) indicates Short Term Exposure Limit. A 15 minutes TWA exposure that should not be exceeded at any time during a work day, even if the 8 hour TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the TLV-STEL should be less than four times per day and there should be at least 60 minutes between successive exposures in this range.

Labelling

Consignments or smaller containers shall carry an identifying label or stencil depicting the symbol given in Fig. 2 of IS 1260 (Part 1) and the following information shall also be given in the lower half of the label.

Ammonia **Warning** ! Hazardous Liquid And Gas Under Pressure

Liquid Causes Burns; Gas Extremely Irritating

- Do not breathe gas.
- Do not get in eyes, on skin, on clothing.
- In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. Call a physician at once in case of burns, especially to the eyes, nose and throat, or if the patient is unconscious.
- Keep cylinders away from heat and sun. Do not store with flammable or explosive materials. Never drop cylinders.
- Be sure connections are tight. Use no oil or lubricants on valves.
- Never refill cylinders.
- Keep the cylinders up-right (vertical) with its valve at the top and secure it properly.

Preventive Measures

Employee Education and Training

Safety in handling Ammonia depends, to a great extent, upon the effectiveness of employee education, proper safety instructions, intelligent supervision and the use of safe equipment.

The education and training of employees to work safely and to use the personal protective equipment or other safeguards provided for them is the responsibility of supervisor. Workers should be thoroughly informed of the hazards that may result from improper handling of Ammonia. Each employees should be fully informed as to what to do in an emergency.

Employee education and training should include the following:

a. Instruction and periodic drill or quiz regarding the locations, purpose and use of respiratory protective devices and other personal protective equipment and action to be taken during emergency.
b. Instruction and periodic drill or quiz regarding the locations of safety showers, eye baths, bubbler drenching fountains or the closest source of water for use in emergencies.
c. Instructions to avoid all unnecessary inhalation of vapours of Ammonia and all direct contact with the liquid.
d. Instruction and periodic drill or quiz regarding the location, purpose and the use of emergency fire fighting equipment. Instruction to strictly prohibit smoking in storage area.
e. Instructions to report to the proper authority all equipment failures and any unusual odour of Ammonia.

Personal Hygiene

Emergency showers and eye baths should be placed at convenient locations wherever Anhydrous Ammonia is used in quantity. Every employee should understand that direct contact with the chemical requires the instant application of large amounts of water to the affected area. These safety showers should be tested periodically for their proper functioning. Skin, eye and respiratory protective equipment will often be necessary.

Physical Examinations

Pre-placement Examinations:

Most employees may be assigned to processes in which the use of Anhydrous Ammonia is carefully controlled. Under some circumstances the physician carrying out pre-placement examinations may wish to exclude from exposure people with the following disabilities:

a. Those with only one functioning eye;
b. Those with severe faulty vision; and
c. Those with chronic diseases of the nose, throat or lung.

Periodic Health Examination

Usually periodic health examinations will not be conducted solely by reason of the employee exposure to Ammonia.

Personal Protective Equipment
Availability and Use:

While personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation and intelligent conduct on the part of employees working with Ammonia, it is, in many instances, the only practical means of protecting the worker, particularly in emergency situations. One should keep firmly in mind that personal protective equipment protects only the worker wearing it, and other unprotected workers in the area may be exposed to danger.

The correct usage of personal protective equipment requires the education of the workers in proper employment of the equipment available to him. Under conditions which are sufficiently hazardous to require personal protective equipment, its use should be supervised and the type of protective equipment selected should be capable of control over any potential hazards.

Eye Protection

Gas-tight chemical goggles or full face mask should be worn when handling Ammonia where leaks or spills may occur. Water wash or water sprays should be available in areas where ammonia leaks, spills or splashes may be encountered.

Respiratory Protection

Severe exposure to Ammonia may occur in tanks during equipment cleaning and repairs, when decontaminating areas following spills, or in case of failure of piping or equipment. Employees who may be subject to such exposures shall be provided with proper respiratory protection and trained in its use and care. Available types are described below.

NOTE– Respiratory protective equipment shall be carefully maintained, inspected, cleaned and sterilized at regular intervals and always before and after use by another person.

Self-contained breathing apparatus:

It permits the wearer to carry a supply of oxygen or air compressed in the cylinder (the self-generating type produces oxygen chemically) and allows considerable mobility. The length of time a self-contained breathing apparatus provides protection varies according to the amount of air, oxygen or regenerating material carried.

Compressed Oxygen should not be used where there is danger of contact with flammable liquids or vapours, especially in confined spaces such as tanks or pits. A special type of self-contained breathing apparatus may be used which is provided with a small cylinder of compressed air for escape but is supplied with air through an air line for normal work purposes.

Positive pressure hose masks

These are supplied by blowers and require no internal lubrication. The wearer shall be able to use the same route for exit as for entrance and shall take precautions to keep the hose line free of entanglement. The air blower shall be placed in an area free of contaminants.

Air-line masks

These are supplied with clean compressed air and are suitable for use only where conditions will permit safe escape in case of failure of the compressed air supply. These masks are usually supplied with air piped to the area from a compressor. It is extremely important that the air supply is taken from a safe source and that is not contaminated by oil decomposition from inadequate cooling at the compressor. The safer method is to use a separate compressor of the type not requiring internal lubrication. Pressure reducing and relief valves as well as suitable traps and filters, shall be installed at all mask stations.

Chemical cartridge respirators

These may be used to avoid inhaling disagreeable but relatively harmless concentrations of Ammonia vapour. These respirators, however, are not recommended for protection where toxic quantities of Ammonia may be encountered. While using cartridge care must be taken to check the oxygen content in the area. It should be more than 16.5 percent (v/v) and chemical cartridges, whose life is over, must not be available for use.

Caution: Filter type respirators do not offer protection against gases and are unsuitable for use when working with Ammonia.

Head Protection

Where there is no danger from falling objects, safety or 'hard' hats are considered unnecessary, soft, brimmed hat or caps should be worn to give protection against liquid leaks and splashes.

Foot Protection

Rubber boots or safety-toed rubber boots should be used as required. Rubber boots should be thoroughly cleaned and ventilated after contamination.

Body, Skin and Hand Protection

Rubber or other protective gloves should be worn where any danger of contact with Ammonia may occur. Impermeable wears may also be used.

For the protection of the skin, cotton shirt, trousers and underwear should be worn (cotton resists alkalis better than wool).

In case of emergency, a rubber apron or rubber coat may provide sufficient protection, but in areas of high Ammonia concentration a complete gas suit should be worn.

For optimum protection of the body, the collar should be kept buttoned, glove (gauntlets) should be tucked inside of sleeves, and trouser legs should be left outside of boots.

It is also suggested to have a valcro type tight fitting strap to have the legs and arm areas tight enough to avoid Ammonia gas entry into the protective suit.

In area of high Ammonia concentration, Ammonia may be absorbed by perspiration on the body even though appropriate protective clothing is worn. Severe discomfort may be minimized or prevented by the application of protective oil to such body areas in addition to the wearing of protective clothing.

8.5 Spills and Leaks

Leaks of Ammonia should be searched for, preferably with Hydrochloric Acid solution or with either Chlorine gas or Sulphur Dioxide gas using a small cylinder of the compressed gas. A white cloud is produced in the presence of Ammonia. Because of the fire risk, Sulphur candles should not be used.

If leaks or spills occur, only properly protected personnel should remain in the area. In cases where leaks cannot be valved off, use large volumes of water sprayed directly on the leak and maintain contact until the contents have been discharged and the tank is empty. Leaking cylinders should be removed to the outdoors or to an isolated, well-ventilated area and the contents transferred to other suitable containers. All spills should be flushed away promptly with water.

In handling or operating any type of Ammonia system, always be sure that all valve connections and pipe lines are in proper order and condition before starting the operation. Keep compressors and motors clean and in good condition.

During cold weather keep all steam traps warm, whether or not tanks are in service.

Never, under any circumstances, close all valves on a full line of liquid Ammonia unless protected by pressure relief or liquid expansion device.

9 FIRST-AID

9.1 General Principles: After severe exposure to Ammonia gas, it is important to move the patient from the contaminated area promptly. In case of contact of the liquid with the eyes or skin, immediate flushing with large quantities of running water is imperative. In all cases of serious injury, call a physician at once giving him a complete account of the accident.

9**.2 Contact with Skin and Mucous Membranes**: Speed in removing Ammonia from contact with the patient and in moving the patient to an uncontaminated atmosphere is of primary importance.

If skin contact is extensive and emergency showers available, the employee should get under the shower immediately. Contaminated clothing and shoes should be removed under the shower. In other instances flushing with large amounts of running water should be continued for at least 15 minutes.

9.2.1: Under no condition should salves or ointments be applied to the skin or mucous membrane burns during the 24-hour period following the injury. Subsequent medical treatment is otherwise the same as for thermal burns.

9.3 Contact with the Eyes: If even small quantities of ammonia enter the eyes, they should be immediately and continuously with water for a minimum of 15 minutes. The eyelids should he held apart during the washing to ensure the contact of water-with the tissues of the eye surface and lids. A physician should be called at the earlier possible moment. After the first 15 minutes period of irrigation, if a physician is not available, the irrigation should continue for a second period of 15 minutes. It is then permissible as a first-aid measure to instill 2 or 3 drops of 0.5 percent Pontocaine solution or an equally effective aqueous topical anesthetic. No oils or oily ointment should be instilled unless ordered by a physician. The employee should be sent to a physician, preferably an eye specialist, as soon as possible.

9.4 Ingestion: If liquid Anhydrous Ammonia has been swallowed, call a physician immediately. If the patient is conscious and able, he should drink large amounts of water to dilute the chemical. Do not induce vomiting if the patient is in shock, extreme pain or is unconscious. If vomiting begins, place the patient face down with head lower than hips, this prevents vomitus from entering the lungs and causing further injury.

9.5 Inhalation: Exposed persons should be removed at once to an uncontaminated area. If the exposure has been to minor concentrations for a limited time, usually no treatment will be required.

9.5.1: When there is severe exposure to higher concentrations and if Oxygen apparatus is available, oxygen may be administered but only by a person authorized for such duty by a physician. If the patient is not breathing, an effective means of artificial respiration should be initiated immediately. Call a physician.

9.5.2: The patient should be kept comfortably warm but not too hot and should be kept at rest.

9.5.3: Never attempt to give anything by mouth to an unconscious patient.

10 Cleaning and Repairs

10.1 Preparation of Tanks and Equipment

10.1.1: Tank and equipment cleaning and repairing should be done under the direction of thoroughly trained personnel who are fully familiar with all of the hazards and the safeguards necessary for the safe performance of the work.

10.1.2: In addition to the precautions generally recommended for tank work, such as procurement of written approval of supervision, testing for Oxygen content, use of rescue harness or life belt and life line, provision of grounded equipment in good condition for portable lights and power tools and stationing of thoroughly trained ‘watchers’ outside and tank entrance, additional precautions are recommended as follows:

a. Make sure that all pressure has been relieved from tank. Use of compressor is frequently made to remove bulk of gas remaining after the liquid has been removed.

b. Pressurize and depressurize the tank with air till Ammonia content inside the tank becomes nil. After stopping the compressor, slowly vent the tank. Make sure that any gas escaping does not enter working area or expose other person.
c. Fill tank completely with water and drain out. Repeat if any Ammonia gas remains.
d. Keep adequate vents in open condition to avoid vacuum formation during filling the tank with water.
e. If oil is found in the tank and requires to be removed, it should be done by steaming and draining and not by the use of solvents.
f. Provide adequate fresh air supply.
g. Use proper personal protective equipment.
h. Flush all lines completely with water until no ammonia remains.
i. Blank off lines; do not depend on shut-off valves.

10.2 Entering Tank

10.2.1: No one should enter a tank or confined space until a work permit has been signed by an authorized person, indicating that the area has been tested and found to be safe. Furthermore, no workman should enter a tank or vessel that does not have a manhole opening large enough to admit a person wearing his safety harness, life line and emergency respiratory equipment. It should be ascertained that the tank or vessel can be left through the original entrance.

10.2.2: One man on the outside of the tank should keep the men in the tank under observation and another man should be available nearby to aid in rescue if any of the men in the tank are overcome.

10.2.3: A supplied-air respirator or self-contained breathing apparatus, together with rescue harness and life line should always be located outside the tank entrance for rescue purposes, regardless of the type of respiratory equipment or air supply which is provided for employees inside the tank.

10.2.4: If a tank cleaner or repairman is overcome, he should be removed to fresh air immediately, artificial respiration should be applied if breathing has stopped, and a physician summoned at once.

10.3 Repair Work

10.3.1: No welding and cutting of any type should be conducted on tanks or lines until they are completely free of Ammonia and certified by competent person as well as safety work permit issued.

10.3.2: Before refilling the tank with Anhydrous Ammonia, the tank should be thoroughly dry and vented to safe location.

11 Waste Disposals:

11.1: Waste disposal of Ammonia and materials containing Ammonia depends to a great extent upon local conditions. Be sure that all central, state, and local regulations regarding health and pollution are followed.

11.2: If not prohibited, waste may be disposed of by diluting with large quantities of water and washing into sewers.

Annexure IV: Material Safety Data Sheet for Products & Raw Material

{Products}

Sr. No.	Raw materials/ products	Formula	State	Odor	Mol. Wt (g/mole)	Flash Point (^{0}C)	Melting Point (^{0}C)	Boiling Point (^{0}C)	LD_{50} (mg/kg)	Stability	Hazard	Color	Sp. Gr. (g/cc)	UEL %	LEL %	Odor threshold (ppm)
1.	2- Nitro Aniline	$C_6H_6N_2O_2$	Crystals	slight odor	138.13	168	70 - 74	284	NA	Stable	Irritation to eye, skin, inhalation, ingestion	orange to brown	1.1	NA	NA	NA
2.	4- Chloro 2-Nitro Aniline	$C_6H_5ClN_2O_2$	Powder	Weak, characteristic	172.57	191	114-118	>290	400	Stable	Irritation to eye, skin, inhalation, ingestion	Orange	1.37	NA	NA	NA
3.	4- Nitro -2-Chloro Aniline	$C_6H_6N_2O_2$	Solid	NA	138.12	198.90	148.5	331.7	450	Stable	Irritation to eye, skin, inhalation, ingestion	Yellow	1.424	NA	NA	NA
4.	2-Amino 3-Chlro 5-Trifluoro Methyl Pyridine	$C_6H_4ClF_3N_2$	Solid	Odorless	196.57	NA	90.00 93.00	NA	NA	Stable	Irritation to eye, skin, inhalation, ingestion	White	NA	NA	NA	NA
5.	5- Chloro-2-Nitro Aniline	$C_6H_5ClN_2O_2$	Solid	NA	172.56	NA	126 - 129	NA	NA		Irritation to eye, skin, inhalation, ingestion	Yellow-orange	NA	NA	NA	NA
6.	4- Nitro-m-Phenylene Di-Amine	$C_6H_7N_3O_2$	Powder	NA	153.14	NA	196-201	NA	681	Stable	Irritation to eye, skin, inhalation, ingestion	Brown-red	NA	NA	NA	NA
7.	8-amino Quinaldine	$C_{10}H_{10}N_2$	NA	NA	158.2	NA	NA	NA	NA	Stable	Irritation to eye, skin, inhalation, ingestion	NA	NA	NA	NA	NA
8.	Albendazole	$C_{12}H_{15}N_3O_2S$	NA	NA	265.33	NA	NA	NA	2,400	Stable	Irritation to eye, skin, inhalation, ingestion	NA	NA	NA	NA	NA

Sr. No.	Raw materials/ products	Formula	State	Odor	Mol. Wt (g/mole)	Flash Point (^{0}C)	Melting Point (^{0}C)	Boiling Point (^{0}C)	LD_{50} (mg/kg)	Stability	Hazard	Color	Sp. Gr. (g/cc)	UEL %	LEL %	Odor threshold (ppm)
9.	Fenbendazole	$C_{15}H_{13}N_3O_2S$	Solid	Odorless	29.3	NA	NA	NA	>10000	Stable	Irritation to eye, skin, inhalation, ingestion	Brownish-Grey	NA	NA	NA	NA

{Raw Materials}

Sr. No.	Raw materials	Formula	State	Odor	Mol. Wt (g/mole)	Flash Point (^{0}C)	Melting Point (^{0}C)	Boiling Point (^{0}C)	LD_{50} (mg/kg)	Stability	Hazard	Color	Sp. Gr. (g/cc)	UEL %	LEL %	Odor threshold (ppm)
1.	**2- Nitro Aniline**															
1.	2,5 Dichloro Nitro Benzene	$C_6H_3Cl_2NO_2$	Flakes	NA	192	152	52.8	267	1210	Stable	Irritation to eye, skin, inhalation, ingestion	Yellow	NA	9.2	1.5	NA
2.	Ammonia	NH_3	Liquefied gas	Ammoniacal	17	NA	-77.7	-33	4000	Stable	Corrosive	Colorless	NA	NA	NA	As low as 5 ppm
2.	**5- Chloro-2-Nitro Aniline**															
1.	2,4-Dichloro Nitro Benzene	$C_6H_3Cl_2NO_2$	crystalline	NA	192	130	29 - 32	258	NA	Stable	Irritation to eye, skin, inhalation, ingestion	Light Yellow	NA	NA	NA	NA
2.	Ammonia	NH_3	Liquefied gas	Ammonical	17	NA	-77.7	-33	4000	Stable	Corrosive	Colorless	NA	NA	NA	As low as 5 ppm
3.	Methanol	CH_3OH	Liquid	Alcohol	32.04	NA	-97.6	64.5	NA	Stable	Flammable	colorless	0.7915	36.50	6.72	NA
3.	**Ortho Chloro Para Nitro Aniline**															
1.	3, 4 Di Chloro Nitro Benzene	$C_6H_3Cl_2NO_2$	Needles	NA	192	123	40.50 - 42.00	255.0 - 256.0	NA	Stable	Irritation to eye, skin, inhalation, ingestion	Yellow to Brown	NA	NA	NA	NA
2.	Ammonia	NH_3	Liquefied gas	Ammonical	17	NA	-77.7	-33	4000	Stable	Corrosive	Colorless	NA	NA	NA	As low as 5 ppm
4.	**Ortho Nitro Aniline**															
1.	Ortho Nitro Chloro Benzene	$C_6H_4ClNO_2$	Solid	NA	NA	126	31 - 33	246	NA	Stable	Irritation to eye, skin, inhalation, ingestion	Slight yellow	NA	NA	NA	NA
2.	Ammonia	NH_3	Liquefied	Ammonical	17	NA	-77.7	-33	4000	Stable	Corrosive	Colorless	NA	NA	NA	As low as 5 ppm

Sr. No.	Raw materials	Formula	State	Odor	Mol. Wt (g/mole)	Flash Point (^{0}C)	Melting Point (^{0}C)	Boiling Point (^{0}C)	LD_{50} (mg/kg)	Stability	Hazard	Color	Sp. Gr. (g/cc)	UEL %	LEL %	Odor threshold (ppm)
			gas													
5.	**4 Nitro Metaphenylene Diamine**															
1.	2,4-Dichloro Nitro Benzene	$C_6H_3Cl_2NO_2$	crystalline	NA	192	130	29 - 32	258	NA	Stable	Irritation to eye, skin, inhalation, ingestion	Light Yellow	NA	NA	NA	NA
2.	Ammonia	NH_3	Liquefied gas	Ammonical	17	NA	-77.7	-33	4000	Stable	Corrosive	Colorless	NA	NA	NA	As low as 5 ppm
6.	**2-Amino, 3-Chloro, 5-(Trifluoromethyl), Pyridine**															
1.	2, 3 DiChloro 5 (Trifluromethyl) Pyridine	$C_6H_2Cl_2F_3N$	Liquid	NA	215.99	79	NA	NA	NA	Stable	Irritation to eye, skin, inhalation, ingestion	Colorless	NA	NA	NA	NA
2.	Ammonia	NH_3	Liquefied gas	Ammoniacal	17	NA	-77.7	-33	4000	Stable	Corrosive	Colorless	NA	NA	NA	As low as 5 ppm
7.	**8-Amino Quinaldine**															
1.	8-Chloro Quinaldine	$C_{10}H_{10}N_2$	NA	NA	158.2	NA	NA	NA	NA	Stable	Irritation to eye, skin, inhalation, ingestion	NA	NA	NA	NA	NA
2.	Ammonia	NH_3	Liquefied gas	Ammoniacal	17	NA	-77.7	-33	4000	Stable	Corrosive	Colorless	NA	NA	NA	As low as 5 ppm
8.	**Albendazole**															
1.	4-Phenyl Sulphanyl Benzene 1,2-Diamine	$C_6H_8N_2$	Solid	NA	108.14	NA	62	284	67.7	Stable	Irritant to skin, eye Inhalation & ingestion	NA	NA	NA	NA	NA
2.	Cyano Crabamate	$C_{12}H_{14}N_2O_2$	NA	NA	218.25	NA	NA	NA	NA	Stable	Irritant to skin, eye Inhalation & ingestion	NA	NA	NA	NA	NA

Sr. No.	Raw materials	Formula	State	Odor	Mol. Wt (g/mole)	Flash Point (^{0}C)	Melting Point (^{0}C)	Boiling Point (^{0}C)	LD_{50} (mg/kg)	Stability	Hazard	Color	Sp. Gr. (g/cc)	UEL %	LEL %	Odor threshold (ppm)
3.	Methanol	CH_3OH	Liquid	Alcohol	32.04	NA	-97.6	64.5	NA	Stable	Flammable	Colorless	0.7915	36.50	6.72	NA
4.	Acetic Acid	$C_2H_4O_2$	Liquid	Pungent	60.05	39	16.6	118	3310	Stable	Irritant to skin, eye Inhalation & ingestion	Colorless	1.049	19.9	4	0.48
9.	**Fenbendazole**															
1.	4-Propyl Sulphanyl Benzene 1,2-Diamine	$C_6H_8N_2$	Solid	NA	108.14	NA	62	284	67.7	Stable	Irritant to skin, eye Inhalation & ingestion	NA	NA	NA	NA	NA
2.	Cyano Crabamate	$C_{12}H_{14}N_2O_2$	NA	NA	218.25	NA	NA	NA	NA	Stable	Irritant to skin, eye Inhalation & ingestion	NA	NA	NA	NA	NA
3.	Methanol	CH_3OH	Liquid	Alcohol	32.04	NA	-97.6	64.5	NA	Stable	Flammable	Colorless	0.7915	36.50	6.72	NA
4.	Acetic Acid	$C_2H_4O_2$	Liquid	Pungent	60.05	39	16.6	118	3310	Stable	Irritant to skin, eye Inhalation & ingestion	Colorless	1.049	19.9	4	0.48

Annexure V: On-site emergency Plan

CRYSTAL SURFACTANTS & CHEMICALS

Plot No B-31/2, MIDC Area, Paithan

District Aurangabad – 431107, Maharashtra, India

ON SITE EMERGENCY PLAN

YEAR 2018

OBJECTIVES OF THE PLAN

The object of the plan is to lay down steps to handle emergency situation that may arise due to leakage/spillage, explosion and fire of the various chemicals, fuels in the plant, which may have any adverse effect on employees and public at large is to minimize and normalcy is restored within shortest possible time.

Emergency Response Plan (action plan) has been drawn to fix responsibility & actions to be taken by various groups to meet & contain the emergency within shortest possible time & within minimum loss to men, materials, machines & property.

It is responsibility of all individuals in their respective areas to ensure success of this plan.

of various personnel and agencies to control the emergencies This plan shall be circulated for benefit/training of all individuals working in plant.

The plan is a basic document which provided information required at the time of emergencies, roles and responsibilities.

Some of the important objectives of the plan are:

- To control the emergency, localize it and if possible eliminate it.
- To avoid confusion, panic and to handle the emergency with clear-cut actions.
- To minimize loss of life and property to the plant as well as to the neighborhood.
- To make head count and carry out rescue operations.
- To treat the injured persons.
- To preserve records and to take steps to prevent recurrence.
- To restore normalcy

1 INTRODUCTION

1.1 Name and Address of the Person Furnishing the Information:

Mr. G.D.Agrawal	**:**	**Occupier – Partner**
Mr. A,V, Deshmukh	**:**	**Partner**
Reg. Office & Factory		Crystal Surfactants & Chemicals B-31/2, MIDC Area Paithan, Dist - Aurangabad – 431148. Maharashtra Tel. No. +91 9325213509.

1.2 Company Profile

- Mr. G.D. Agrawal is the occupier and the Partner, Mr. A.V. Deshmukh is partner of the company.
- Company will run its activities in General Shift along with A Shift (07:00Hrs to 15:00 Hrs) & B Shift (15:00 Hrs Hrs to 23:00 Hrs.) shifts & C Shift (23:00 Hrs to 07:00 Hrs.).
- **Approximately 40 employees will be employed for running the plant.**
- Distribution of Employees required in proposed plant:
- 1) Company employees: 25 nos.
- 2) Contractor's employees: 10 nos.
- 3) Security : 03 nos.

Occupier	:	Mr. G. D.Agrawal

Production & capacity details

No.	Class Of Goods	Proposed Installed Capacity	Proposed production in 1st year
1	PARA CHLORO ORTHO NITRO ANILINE (PCONA)	30 MT / Month	60 % of Capacity
2	5 Chloro 2 Nitro Aniline	20 MT / Month	60 % of Capacity
3	ORTHO CHLORO PARA NITRO ANILINE (OCPNA)	20 MT / Month	60 % of Capacity
4	ORTHO NITRO ANILINE (ONA)	25 MT / Month	60 % of Capacity
5	4 NITRO METAPHENYLENE DIAMINE (4NMPD)	2 MT / Month	60 % of Capacity
6	2 AMINO 3 CHLORO 5 (TRIFLUOROMETHYL PYRIDINE)	12 MT / Month	60 % of Capacity
7	8 AMINO QUINALDINE	10 MT / Month	60 % of Capacity
8	FENBENDAZOLE	20 MT / Month	60 % of Capacity
9	ALBENDOZOL	20 MT / Month	60 % of Capacity

1.3 Key Management Persons

Sr.no	Name	Designation	Cell
1	Mr.G.D.Agrawal	Partner	+91 9325213509
2	Mr.AV.Deshmukh	Partner	+91 9370097701

1.4 Brief Manufacturing Process

Process in General for all the above products:

27% Ammonia solution is prepared by passing NH3, at controlled flow from the NH3 cylinder through the water in a tank, connected to the NH3 absorber. And 27 % ammonia solution is to be charged in an autoclave. 2, 5-Dichloro Nitrobenzene is charged in the ammonia solution. Heat the resultant mixture to 160-170 °C and pressure developed of 30-32 kg/cm2 is maintained for 8 hrs. Cool the reaction mass and vent pressure of ammonia through a tank where the ammonia is to be collected. The reaction mass is cooled to ambient and then filtered on nutch filter. Mother liquor is collected. The wet product from nutch filter is to be centrifuged and washed with plane water. The wet product is to be dried in tray dryer. Dry product is to be unloaded and packed.

Albendazole

4-(Propylsulfanyl) benzene-1,2-diamine and ammonium salt of methyl-N-Cyano carbamate is to be charged in methanol at ambient temperature. The reaction mass is to be stirred for 20-30 minutes and acetic acid is added. Heat the reaction mass to reflux and temp is to be maintained at 50 to 60 deg C for 3-5 hrs. After completion of reflux cool the reaction mass to ambient temperature and centrifuged. The product is to be washed with methanol and spin dried. The wet product unloaded from centrifuge is to be dried in tray dryer to get dry Albendazole. Mother liquor is subjected to distillation to recover methanol. Cool the concentrate reaction mass and filter to get Ammonium acetate which is sold to recycler. The solvent residue is to be dried and recycled.

Fenbendazole:

Manufacturing Process: 4- Phenyl Sulphanyl benzene 1, 2 diamine and Cyano Carbamate are to be charged in methanol and acetic acid in a stainless steel reactor and heated to reflux. The reflux is to be maintained for 6-7 hrs and then cooled to ambient temperature. The reaction mass is to be centrifuged and washed with methanol. The wet product is to be unloaded and dried in tray dryer.

Dry product as fenbendazole is to be unloaded and packed. The mother liquor is to be distilled out to get recovered methanol which is recycled. The concentrates after distillation is to be cooled and centrifuge to get solid ammonium acetate which is sold to recycler. Solvent residue of the mother liquor is to be recycled to the next batch.

No Pressure Reaction or Run away or exothermic reaction.

Hazardous raw material solvent handled is Methanol and hazardous chemical is Acetic Acid.

No toxic and any other gas in generated during the reaction.

List of Raw Material Product Wise

Sr. No.	Name of Product	Raw Materials
1	PARA CHLORO ORTHO NITRO ANILINE (PCONA)	1. 2, 5 Di Chloro Nitro Benzene 2. Anhydrous Ammonia
2	5 Chloro 2 Nitro Aniline	1. 2, 4 Di Chloro Nitro Benzene 2. Anhydrous Ammonia 3. Methanol
3	ORTHO CHLORO PARA NITRO ANILINE (OCPNA)	1. 3, 4 Di Chloro Nitro Benzene 2. Anhydrous Ammonia
4	ORTHO NITRO ANILINE (ONA)	1. Ortho Nitro Chloro Benzene 2. Anhydrous Ammonia
5	4 NITRO METAPHENYLENE DIAMINE (4NMPD)	1. 2, 4 Di Chloro Nitro Benzene 2. Anhydrous Ammonia
6	2 AMINO 3 CHLORO 5 (TRIFLUOROMETHYL PYRIDINE)	1. 2, 3 DiChloro 5 (Trifluromethyl) Pyridine 2. Anhydrous Ammonia
7	8 AMINO QUINALDINE	1. 8 Chloro Quinaldine 2. Anhydrous Ammonia
8	FENBENDAZOLE	1. 4-(Propylsulfanyl) Benzene-1, 2 -Diamine 2. Sodium Salt of Methyl –N-Cyanocarbamate 3. Acetic Acid 4. Methanol
9	ALBENDAZOLE	1. 4-(Propylsulfanyl) Benzene-1, 2 -Diamine 2. Ammonium Salt of Methyl –N-Cyanocarbamate 3. Acetic Acid 4. Methanol

1.5 LOCATION OF THE FACTORY

Crystal Surfactants & Chemicals is located at Plot No B-31/2, MIDC Area, Paithan, Dist-Aurangabad. - 431107, Maharashtra. Nearest railway station Aurangabad is 40K.m. away from the factory.

Medical Treatment is concerned which may be required during emergency and routine activities as well. It will be rendered through Bhujbal Hospital, which is situated at 0.1 Km from factory premises. In case of injury of moderate/major nature concerned injured person could be sent to nearby Hospital located at Paithan10 Km and at **20** minutes distance by vehicle.

In case of Fire, Fire fighting services could be rendered by MIDC Paithan Fire Brigade which is situated at 0.7 Km & Paithan Nagar Parishad Fire station at 10 Km.

1.6 SHIFTWISE (AVG) OF EMPLOYEES REQUIREDIN PROPOSED PLANT:

SHIFT&TIME	MALE	FEMALE	TOTAL
A 07:00 to 15:00 Hrs.	**10**	**00**	**10**
B 15:00 to 23:00 Hrs.	**10**	**00**	**10**
C 23:00 to 07:00 Hrs.	**10**	**00**	**10**
GENERAL 9:30 to 18:00 Hrs.	**10**	**00**	**10**

2 KEY PERSONNEL OF THE ORGANISATION & RESPONSIBILITIES

Key Personnel Of The Organization & Responsibilities Assigned To Them In Case Details Of Emergency Organization

Emergency organization is a part and parcel of a good On-Site and Off-Site emergency plan, without which all resources, facilities etc. Even available with us, can not be put into services at a right time as time is the key factor in tackling an emergency.

It is not possible to envisage and detail every action which should be taken in emergency and to harness the basic elements of emergency preparedness such as gravity of emergency, communication of information, On-Site action for process and emergency controls, mobilization of internal and external resources for fire and toxicity control, warning people at right time, Evacuation, Medical Preparedness, Pollution control etc.

Emergency organization is set up specifying duties and responsibilities of all to make best use of all resources and to avoid confusion while tackling the emergency.

On-Site emergency plan highlights the flow of information and co-relation among various action groups within the factory.

Emergency organization and arrangements include:

- Site Main Controller
- Site Incident Controller
- First Aid Team
- Fire Fighting Team
- Admin & Security
- Emergency Control Centre (ECC)
- Assembly Points

Responsibility will be automatically delegated in absence of concerned person/s in following manner.

MAIN CONTROLLER:

Senior most person of Site will be the Site Main Controller for handling the emergency. The Responsibility will be automatically delegated as per the following manner in absence of concerned person.

Unit Head of Production site (G shift) ⟶ Production Officer / Shift In charge (In Shift)

INCIDENT CONTROLLER:

The area in which emergency would occur, the senior most person / HOD will be the Incident Controller for handling the emergency. The Responsibility will be automatically delegated as per the following manner in absence of concerned person.

Production Manager (G Shift) ⟶ Senior most operator in shift (In Shift)

FIRST AID TEAM

There will be approx.**6** employees in first aid Team. Employees will be selected from different shifts and from all the departments. First Aid team shall be given an extensive training of handling of medical emergency.

They have to play the role of first aider in an emergency.

FIRE FIGHTER TEAM

There will be approx.**8** employees in Emergency Team. Employees will be selected from different shifts and from all the departments.

Emergency team has been /shall be given an extensive training of handling of emergency including the firefighting.

SECURITY TEAM

There will be adequate employees in Security Team.

RESPONSIBILITY DURING EMERGENCY:-

SITE MAIN CONTROLLER:

He will retain overall responsibility for the factory and its personnel. As soon as he is informed of the emergency he shall proceed to the emergency control centre [Security Office] and meet the HR & Admin. Manager. His duties shall be:

- Assess the magnitude of the situation and decide if staff needs to be evacuated from their work places.
- Exercise direct operational control over areas other than those affected.
- Maintain a continuous review of possible development and assess in consultation with Incident Controller and other Key personnel as to whether shutting down of the plant or electricity or any section of the plant and evacuation of persons is required.
- Liaison with Senior Officials of Police, Fire Brigade, Directorate of Industrial Safety, MPCB Officials and provide the advice on possible effects of the emergency on areas outside the factory premises.
- Control rehabilitation of affected areas on discontinuation of emergency.
- Issue authorized statements to News media, and ensures that evidence is preserved for inquiries to be conducted by statutory authorities.

- To declare the emergency evacuation by blowing the siren and declaring the all clear position after the emergency.

SITE INCIDENT CONTROLLER:

On receiving the first information of an emergency or incident he will rush to the scene of the occurrence and take overall charge and report to Site Controller. On arrival he will assess the scale of emergency and decide if major emergency exists or is likely and inform the Communication Officer accordingly.

- Direct all operations within the affected areas with the priorities for safety of personnel and minimum damage to the plant, property and minimum loss of materials.
- In case of absence or Pending arrival of Site Controller, assume the duties of his post and, in particular.

(a) Direct the shutting down and evacuation of plant and areas likely to be adversely affected by the emergency.

(b) Ensure that all Key personnel and outside help are called in.

- Provide advice and information to the Fire Fighting and First Aid squad & Security Officer and the local fire service as and when they arrive.
- Ensure that all non-essential workers / staff of the areas affected are evacuated to the appropriate assembly points, and the areas are searched for casualties.
- In the event of failure of electric supply and internal telephones, set up communication point and establish contact with Emergency Control Centre.
- Report on all significant developments to the P. & A manager.
- Have regard to the need for preservation of evidence so as to facilitate any inquiry into the causes and circumstances, which caused or escalated the emergency.

ROLE OFSECURITY STAFF

- To announce through telephone or messengers to the Incident Controller and Site Controller that incident has occurred in such and such zone.
- On the sounding of the siren advises Fire Fighting and First Aid squad about the incident zone
- Do not allow any vehicle or tanker inside the factory, except essential vehicles such as fire tenders/foam tender, govt. agencies, mutual aid staff, ambulance etc.
- Lead the external helping teams to reach the accident site.
- Count and note down the fire fighters working in the operation.
- To control traffic movements into the factory and ensuring that alternative transport is available when need arises.
- Do not allow any un-known / un-authorized person to enter in the premises.

- Check about public in vicinity and ask them to evacuate.
- Help fire squad team to evacuate non-essential personnel and non-technical staff.

FIRST-AID SQUAD:

Members of first-aid Squads will report to the Incident Controller on hearing of the alarm in day time. They will administrate necessary First Aid to victims till Ambulance / Emergency Vehicle reaches the site. The Ambulance / Emergency vehicle driver, if safe to do so, shall collect the emergency vehicle and park nearest to the scene of the incident. First aider shall shift the victims in Ambulance / Emergency vehicles & inform the incident controller that the Emergency Vehicle is leaving the site, giving the name of the patient and destination i.e. hospital or and request the Site Main Controller / Site Incident Controller to inform the destination (hospital, etc.) advising them about the casualties reaching there.

FIRE FIGHTING SQUAD

The duty Fire fighting Squad under the command of the Incident Controller shall be responsible for fire fighting and rescue. On hearing the alarm, they shall proceed to the place of incident. The men at security gate shall find out the location of the emergency and proceed to the site of the occurrence. At the incident scene, a team members detailed for this purpose will check squad members against roll-call sheet. At the site, all the squad members will respond to the advice and information given by the Incident Controller On arrival of the local fire brigade, they will also assist in fire-fighting work with the advice of the Incident Controller.

AMBULANCE / EMERGENCY VEHICLE DRIVER

Ambulance / Emergency vehicle driver is expected to do the following.

- Immediately start vehicle and reach rescue squad assembly point (near security gate).
- Take note of wind direction.
- Take the injured to the hospital as directed.

GENERAL INSTRUCTIONS

- Speed is essential.
- Clarity of information and instructions to all concerned persons and authorities should be maintained.
- During emergency situations telephone systems are to be used only for essential communication to combat the emergency.
- In case of communication failure, send messengers by cycle or any other transport available.
- Ensure that only trained persons are deputed for combating the situation and safety procedures are followed strictly.
- Ensure that **MOCK DRILLs** of the On-Site Emergency Plan are conducted regularly.

- Adequate quantities of absorbents / materials for dangerous substances should be kept ready, always, e.g. dry sand, dry earth, lime, blank granules etc.

EMERGENCY DO'S & DON'TS

Do's	Don'ts
Any One Notice An Emergency	
Inform To Supervisor & Incident Controller Immediately And Raise The Alarm	DO NOT Panic & Avoid Running All Over The Place.
Get Back To Your Normal Work Place (If Safe) Or Else Report To The Assembly Point	DO NOT Enter The Site Unless Informed, If You Are Out Side & Emergency Siren Is Heard
Contractor Personnel	
Stop Work In Safe Manner On Hearing Emergency Siren	DO NOT Enter The Site Until It Is Cleared For The Normal Work By Incident Controller
Assemble At The Assembly Point	
Security	
Keep The Main Gate Closed	DO NOT Allow Visitors To Enter
Keep The Road Clear For The Movement Of Fire Tenders & Other Emergency Vehicles	DO NOT Allow ANY VEHICLES OTHER THAN Fire Tender & Ambulance
Control Traffic At Gates	
Visitors	
Leave The Place And Assemble At The Assembly Point	DO NOT Enter The Site If Emergency Siren Is Heard
All Other Employees On Site	
On Hearing Emergency Siren Get Back To Work Place (If Safe) And Get Instructions From The Supervisor.	DO NOT Panic / Run Here And There
	DO NOT Go To The Site Of An Incident Unless Instructed Specifically By The Incident Controller.

CHAPTER 3 OUTSIDE ORGANISATIONS INVOLVED

A types of accident which are likely to occur in the factory are:

- SPILLAGE OF LIQUIDS FROM THEIR CONTAINMENT
- FIRE IN STORAGE AREA / PROCESS PLANT
- FIRE IN ELECTRICAL INSTALLATION / TRANSFORMER
- TOXIC GAS LEAK – AMMONIA
- STRUCTURAL COLLAPSE
- FLOOD
- EARTH QUAKE
- TERRORISM
- SABOTAGE
- FOOD POISONING

B The following outside organizations which will be required to help during the course of an emergency mitigation.

Fire Brigade	Paithan MIDC Fire Brigade
Fire Brigade	Paithan Nagar Parishad Fire Brigade
Local Police Department	Paithan MIDC Police Station
DISH	Jt. Director DISH Aurangabad
M.P.C.B.,	Regional Officer M.P.C.B Aurangabad
Municipal Corporation,	Paithan Municipal Corporation,
District Authorities	District Authorities Aurangabad
Nearest Hospital	Bhujbal Hospital

CHAPTER 4 LIASON BEWEEN THE ORGANISATIONS

Medical Treatment is concerned which may be required during emergency and routine activities as well, it is rendered through Bhujbal Hospital, which is situated at 0.1 Km from factory premises. In case of injury of moderate/major nature concerned injured person could be sent to nearby Hospital located at Paithan10 Km and t **20** minutes distance by vehicle.

In case of Fire, Fire fighting services could be rendered by MIDC Paithan Fire Brigade which is situated at 0.7 Km & Paithan Nagar Parishad Fire station at 10 Km.

The company will sign MOU with hospital & Ambulance services. The company will share the information with MIDC Paithan Fire Brigade & Paithan Nagar Parishad Fire Brigade.

The following emergency facilities can be made available from neighboring industries during any kind of emergency situation.

1. Ambulance Services.
2. Occupational Health Centre.
3. Doctors and Para Medical Staff.
4. Technical Staff to assist in emergency.
5. Neutralizing Compounds.
6. First-Aid equipment, Safety equipment, Self Contained Breathing Apparatus.

The company will share information with neighboring industries. The contact numbers of all Emergency services & neighboring industries shall be displayed at ECC.

5 INFORMATION ON THE PRELIMANARY HAZARD ANALYSIS

A TYPES OF ACCIDENTS

1. Handling of Ammonia Cylinders and solution preparation, hazard is leakage of Ammonia through piping, escape of unabsorbed Ammonia to the atmosphere while preparation of 27 % Ammonia solution.
2. Leakage of Ammonia at High pressure through Autoclave.
3. Fire during unloading of Methanol tanker

B SYSTEM, ELEMENTS OR EVENTS THAT CAN LEAD TO MAJOR ACCIDENT IN THE PROPOSED PLANT

EVENTS	CAUSES	EFFECT
Small Spill of Hazardous Chemical.	Batch transfer hose / pipeline failure. Gasket failure. Pump gland leakage.	Localized.
Large Spill of Hazardous Chemical.	Failure of bottom valve or nozzle of the storage tank / spillage during Tanker unloading	Localized.
Fire	Any spill of flammable chemical (Small or large) may catch fire on finding source of ignition. Methyl Alcohol, (Methanol) is a flammable substances used in the factory. Electric equipments like transformer, circuit breakers & electric installations, etc. may catch fire due to short circuiting.	Localized.
Explosion	Reaction parameters going wrong may cause explosion in the reactor. Failure of controls on Boiler may cause explosion. Air receiver of compressor may explode due to improper maintenance and testing.	Local
Release of toxic gas.	Failure of gaskets or pipelines of toxic gas may cause emission of toxic gas. Ammonia will be a toxic gas used in the factory	Local / Off-Site potential.
Structural Collapse	Earthquake, Poor Maintenance.	Localized.

C HAZARDS

HAZARDS ARE SAME AS GIVEN IN TABLE A & B

D SAFETY RELEVANT COMPONENTS

1 Plant will be operated as per Standard Operating Procedure (SOP) after adequate training

2 There will be strict supervision by daily check of log sheets

3 Nobody will be authorized to change any procedure / SOP without permission of the owner & Occupier of the factory. Procedure can be changed only after complete technical analysis.

4 After HAZOP study adequate instrumentation / alarms & interlocks will be installed & SOP will be finalized after HAZOP study.

5 Adequate equipment & scrubbing system will be involved for absorption of Ammonia to keep air concentration below TLV

6 Adequate warning system will be installed in case of any hazardous event.

7 Adequate PPE will be used & training will be given to plant personnel about use of PPEs & handling of Emergency.

6 DETAILS ABOUT SITE

a) LOCATION OF DANGEROUS SUBSTANCES:

Location of Storage of over ground tanks, underground tanks & Warehouse for hazardous chemicals is given in the factory layout which is given in annexure.

Details about the quantity stored is given in the annexure

b) SEAT OF THE KEY PERSONNEL:

The seat of the key personnel will be located in the office building. This office building is located near the main gate.

c) EMERGENCY CONTROL CENTRE / ROOM

Emergency Control Centre /will be located in the Security Main Gate. It is a focal point in case of any major untoward incident. All the operations for mitigating the emergency will be directed from the Emergency Control Room by the Site Controller. Emergency Control Room will be equipped with the following items:

- On-Site Emergency Plan.
- List of key personnel with their telephone numbers
- List of outside agencies such as Hospitals, Ambulances, Fire Brigades, Police Station, District Authorities, MPCB officials, DISH officials with telephone numbers
- Factory Layout Plan, Material Safety Data Sheets.
- Note pads, pencils and register to record messages received and any instruction
- Emergency lights / torches. Stretchers
- Emergency protective wears such as SCBA, PVC suits, helmets, PVC hand gloves, Gas Masks, gum boots, etc.

7 DESCRIPTIONS OF HAZARDOUS CHEMICALS AT PLANT

A Chemical (Quantities & toxicological) data:

Various types of hazardous chemicals are being used in the manufacturing operations in the factory. These chemicals are flammable, toxic and/or corrosive. All these chemicals have potential to lead to severe accident / incident such as fire, explosion, emission, etc.

Quantities and toxicological data of all these chemicals are given in the following table.

No.	CHEMICAL	NFPA CODE			TOXICITY			
		Nh	Nf	Nr	LD 50	LC 50	TLV	STEL
					Mg/Kg	-	ppm	ppm
1.	3, 4 DCNB	2	1	0	953	10 gm/m3/4H	N/L	N/L
2.	2, 4 DCNB	2	1	0	N/A	N/A	N/L	N/L
3.	ONCB	-	-	-	144	3200 mg/m3/4Hr	N/L	N/L
4.	Methanol	2	3	0	5628	-	200	250
5.	Anhydrous Ammonia	3	1	0	-	7338 ppm / 1 Hr	25	35
6.	2, 5 DCNB	2	1	0	1000	N/L	N/L	N/L
7	2, 3 Di Chloro 5 trifluro Methyl Piridine	2	0	0	N/L	N/L	N/L	N/L
8	8 Chloro Quinaldine	1	1	1	N/A	N/A	N/A	N/A
9	4 Chloro 2 Nitro Aniline	4	1	0	400	N/A	2	5
10	5 Chloro 2 Nitro Aniline	4	1	0	N/L	N/L	N/L	N/L
11	2 Chloro 4 Nitro Aniline	-	-	-	1250	-	N/L	N/L
12	2 Nitro Aniline	3	0	0	1600	2529 mg/ m3/4Hr	2	20
13	2 Amino 3 Chloro 5 Tri Floro Methyl Piridine	2	0	0	-	-	N/L	N/L
14	4 Nitro Meta phenyline Dimine	-	-	-	N/A	N/A	N/A	N/A

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) CODE:
Nh : Health
Nf : Flammability
Nr : Reactivity

Other Abbreviations
N/A - (Data) Not available
N/L - Not Listed

8 LIKELY DANGERS TO THE PLANT

The Causes for accidents could be as follows:

I) Disaster due to natural calamities such as:

- Flood
- Earth quake
- Storm/cyclone

II) Disaster due to external factors such as:

- Sabotage
- Civil Riots

III) Disaster due to Emergency on account of Plant & Process Hazards

- Heavy spillage of Flammable, Toxic chemical (Methyl Alcohol)
- Fire of Flammable (Methyl Alcohol)
- Uncontrolled Fire in Boiler, Boiler Fuel storage area
- Toxic Gas Release (Release of Ammonia gas)
- Electrical Fire
- All other fires
- Contact of Incompatible chemicals

IV) Disasters due to other Probable factors such as::

- Food poisoning
- Honeybee Attack
- Snake Bite
- Medical Emergency to any Employee

9 ENUMERATE EFFECTS

9.1 Stress and Strain during Normal Operation:

Like all chemical manufacturing plants, lots of operations are being carried out in the factory. This includes unloading of Raw Materials, transfer of these raw materials from storage tanks to reactors, Amminolysis (Amination), cooling, filtration, drying, distillation etc.

Some kinds of stress and strain are always associated with these normal manufacturing operations of the chemical plant. Unexpected incidents may occur during these operations either due to hazardous chemicals, wrong operations or improper maintenance. The following incidents are considered:

1. Continuous release of chemical due to failure of transfer lines.
2. Overflow of chemicals.
3. Pressurization or failure of gaskets.
4. Failure of reactor / storage tank.

9.2 Fire and Explosion inside the Plant and Effect If Any, of Fire and Explosion Outside:

MAXIMUM CREDIBLE LOSS SCENARIO (MCLS)

Maximum Credible Loss Scenario (MCLS) is one of the techniques used to access the events in realistic and practical way. An MCLS can be described as the most credible incident or as an incident with a maximum damage distance, which is still believed to be probable. The analysis does not include quantification of the risk involved in the incident and probability of occurrence of an incident.

Worst Case Scenario - Catastrophic failure of storage tank and continuous release of gas into the atmosphere and leading to disastrous situation is considered. But the probability of such event is very low

QRA for Methanol leakage

Road Tanker assumed to be of same volume as that of the storage tank and diameter of 2 meters and length of 6.4 M

QRA has been carried out for three scenarios under the following conditions:

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 4 meters/second from NW at 3 meters	
Ground Roughness: open country	Cloud Cover: 0 tenths
Air Temperature: 35° C	Stability Class: D
No Inversion Height	Relative Humidity: 5%

Scenario 1: There is sudden leakage and ignition after release of 500 liters Methanol, before ignition and there is pool fire

Scenario 2: The leakage of Methanol through 5 mm hole in the unloading hose, during tanker unloading and there is pool fire

Scenario 3 (Worst Case scenario): There is total failure of unloading hose of 100 mm diameter (hose getting disconnected), when tanker is 85 % full and there is fire

Threat zones predicted are:

Table

Scenario	**Amount Released/burned**	**Flame Length**	10.0 kW/(sq m) = potentially lethal within 60 sec)	5.0 kW/(sq m) = 2nd degree burns within 60 sec	2.0 kW/(sq m) = pain within 60 sec
Scenario 1	**390 kgs**	**4 M**	**Less than 10 meters**	**Less than 10 meters**	**Less than 10 meters**
Scenario 2	**50.9 Kgs in 50 min**	**1 M**	**Less than 10 meters**	**Less than 10 meters**	**Less than 10 meters**
Scenario 3	**12,627 Kgs kilograms in 50 min**	**10 M**	**23 M**	**28 M**	**37 M**

Consequences of Methyl Alcohol Spill:

It is a flammable liquid and its spillage / leakage may cause fire and / or explosion.

It poses moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. Vapours can flow along surface to distant ignition source and flash back. It is very sensitive to static discharge.

During spill recovery and disposal, exposure to emergency responders is likely. Care needs to be taken in this regard.

QRA FOR AMMONIA LEAKAGE:

Quantitative Risk analysis was carried out for following conditions:

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)

Wind: 4 meters/second from NW at 3 meters	
Ground Roughness: open country	Cloud Cover: 0 tenths
Air Temperature: 35° C	Stability Class: D
No Inversion Height	Relative Humidity: 5%

For following three Scenarios:

1. **Scenario 1** Worst case Scenario: Failure of Pressure reducing Control and Gas flow rate through pipe to the tank with water for 1 hr. without absorption.
2. **Scenario 2:** Same as above predicting distance covered till IDLH value
3. **Scenario 3:** MCS Leakage through 5 mm hole in piping with 6 atm ammonia pressure for a minute

TABLE

Scenario No	**Amount of NH3 released**	(300 ppm = IDLH)	1100 ppm = AEGL-3 (60 min)	(160 ppm AEGL-2 (60 min))	(30 ppm AEGL-1 (60 min)
Scenario 1		**----**	**79 M**	**208 M**	**523 M**
Scenario 2	**876 kgs for 1 hr**	**149 M**		**208 M**	**523 M**
Scenario 3	**3.01 Gms in 1 min**	**Less than 10 m**		**Less than 10 m**	**Less than 10 m**

10 DETAILS OF SAFETY SYSTEMS

10.1 Warning Alarm:

Factory shall be provided with an Emergency Siren to alert people in and around the factory and also to indicate to all such employees who are not assigned any job in the Emergency Control Plan, together at the assembly point.

siren shall be installed in the factory premises as mentioned in the site plan. Switch is to be kept in the security cabin. Security will blow the siren only in case of emergency that too permitted / instructed by Authority mentioned in below table.

Emergency Siren:

Siren will be blown in the following style to give wailing sound so that everybody present in and around the factory will come to know that something has happened inside the factory:

15 sec High 5 Sec Low for 2 Minutes

All Clear Signal:

All clear signal will be given by blowing siren continuously for **1 Minute**.

Testing of Emergency Siren will be carried out during Mock Drills and on any other suitable days.

Sr.	SIRENS	INDICATES	AUTHORITY
1.	15 sec High 5 Sec Low for 2 Minutes	On Site Emergency (Alert)	Incident Controller
2.	1 Minute Continuous	Emergency Controlled (**All Clear**)	Site Controller

Testing of emergency siren shall be performed every week on any fixed day. Mock Drills shall be conducted at least once in six months which is also a statutory requirement. Till all employees get familiar with the On Site Emergency Plan, it is advised to conduct Mock Drills once in three months.

10.2 Assembly Point:

The management has identified Main Gate as Assembly point, location of which will be beyond the distances predicted in the results given above. In case of an EMERGENCY the employees should evacuate from emergency exits and assemble on the Assembly Points. Visitors are required to be directed by their host.

All personnel on site will assemble in case of an emergency and the headcount will be conducted by the security supervisor at the main gate.

Assembly point –In front of Main Gate

10.3 Reliable Measuring Instrument, Control Units & Servicing Of Such Equipment

Details regarding 10.3 have already been covered in earlier part of the report.

10.4 Rehearsal / Mock Drill:

In disaster management, time is very important factor. Initial few minutes are very critical and timely action only can contain the emergency.

For persons to perform their assigned roles quickly, it is essential that each individual should be made aware of emergency procedures and their roles through proper training.

The success of any plan depends on planned & unplanned Mock Drills. It is necessary to test through rehearsals, which will impart necessary expertise to every individual to act quickly in case of a real emergency situation. Rehearsals also help in identifying the deficiencies in the procedures / implementations and likely difficulties that may be encountered during implementations. Besides this it is also a statutory requirement to conduct Mock Drills of the On-Site Emergency Plan once in six months. Hence rehearsals of the On-Site Emergency Plan shall be undertaken periodically & **shall be documented. Documentation shall consist of observations Response Time & Recommendations.**

Mock Drill Procedure

- Inform all the employees about the mock Drill to be conducted.
- Depute the Performance Observers (Inside / Outside) who are not involved in exercise.
- Incident observer shall communicate to Emergency Control Centre (ECC) / Security by phone or verbally.
- Security will communicate to Site Main Controller (SMC) & Site Incident Controller (SIC)
- The Site Main Controller will communicate with various teams with existing communication system
- First Aid / Fire Fighting Team members will move to the incident location & get in action to control the situation.
- Site Main controller will take information from Site Incident controller. In case Type II Emergency SMC will instruct the Security to raise the alarm.
- After controlling the situation All Clear Signal will be raised
- The action, Co-ordinations of all teams & Response Time shall be observed & short comings are noted for updating the plan.

10.5 Continuous Surveillance Of Operations

Details regarding 10.5 have already been covered in earlier part of the report.

10.6 Maintenance & Repair Work According To The Generally Recognized Rules & Good Engineering Practices

Work permit system is implemented for doing HOT work , working at height , confined space entry etc.
Work order system is implemented for carrying out day to day maintenance work

10.7 Categories of Emergencies

Type I

The type of Emergencies which are restricted to one section of the only & which can be controlled by the manpower & facilities in the section.

Type II

The Type of Emergencies though originating from the section which cannot be controlled by the facilities available in section. These may require shutting down the plant & may require activation of On Site Emergency Plan and/ or total evacuation. However the magnitude is restricted to factory premises only.

Off Site Emergency

The Type of Emergency though originated from the factory but its effects felt outside the factory premises. The situation thus generated is called Off Site Emergency. This will need Coordination with local bodies.

10.8 Emergency Evacuation:

Various kinds of emergencies that can warrant limited or total plant area evacuation are:
Severe Fire, Threatening calls, Civil Unrest or Curfew Earthquake , Flood.
The Site Main Controller shall use his judgment and discretion to decide, and as far as reasonably practicable consult with the Management Leaderships, to effect a partial or total evacuation of personnel from the site. If the incident is likely to affect people working in the plant, the Site Controller will initiate evacuation. Evacuation of employees and contractors shall be initiated by alarm and then advising appropriately, specific evacuation information and instructions. Evacuation routine shall be cross-wind and up-wind relative to the gas cloud.

The following is a procedure for the evacuation:

- Non essential workmen will be evacuated to the Assembly Point.
- People (Employees and Contract Workers) from the affected site will be evacuated.

- The evacuation will be along the escape route leading to Assembly Point.
- **Ensure proper head count**

Maximum number of persons at any given time can be about **30.** So evacuation arrangement for the same number of people will be required in worst possible scenario.

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11 DETAILS OF FACILITY

11.1 COMMUNICATION FACILITIES:

IMPORTANT TELEPHONE NUMBERS:

ORGANISATION	CONTACT NO
FIRE BRIGADE:	
Paithan MIDC Fire Brigade	02431-233001
Paithan Nagar Panchayat Fire Brigade	101
POLICE:	
Police Station – Paithan	02431-232113
HOSPITALS / AMBULANCE SERVICES:	
Bhujbal Hospital MIDC	9096068554
Ganesh Hospital MIDC	02431-232444
Shraddha Hospital, Paithan	02431-224052
Civil Hospital	02431-223037
Ambulance	108
Dattaji Bhale Blood Bank, Aurangabad	0240-2352371
ELECTRIC SUPPLY:	
M.S.E.B. Paithan	02431-232039
M.I.D.C.:	
M.I.D.C. Office Paithan	02434-232080
GOVERNMENT AUTHORITIES:	
District Collector, Aurangabad	0240-2324800
Tahasildar Office Paithan	02431-223051
DISH Office, Aurangabad	
M.P.C.B. Office, Aurangabad	0240-2473461

LIST OF TELEPHONE NUMBERS (INTERNAL):

Sr. No.	Name	Contact No.
1	**Mr. G.D. Agrawal**	**+91 9422245677**
2	**Mr. A.V. Deshmukh**	**+91 9403697323**

DETAILS OF FIRE FIGHTING & OTHER FACILITIES:

Adequate fire protection facilities shall been provided in the plant.

FIRE EXTINGUISHERS

The following are the details of fire extinguishers with capacity and their locations:

SR. No.	Area	ABC TYPE	CO2 TYPE	Foam TYPE	Total
1	Security Cabin	1	**1**	1	3
2	Parking	1	-	1	2
3	Green Belt	-	-	-	0
4	Finished Good Stores	1	-	1	2
5	Office Building	2	1	-	3
6	Fire Hydrant Pump	1	-	-	1
7	Transformer	1	1	-	2
8	Electric House	1	1	-	2
9	Canteen	1	-	-	1
10	Toilet	-	-	-	0
11	Main Plant Building	4	-	2	6
12	Cooling Tower	-	-	-	0
13	Raw Material WH	1	-	1	2
14	Boiler House	2	-	-	2
15	E.T.P.	1	-	-	1
16	Solid fuel stores	1	-	-	1
17	Effluent Storage	-	-	-	0
18	UG solvent Tank	1	-	2	3
19	Solid Waste Stores	1	-	-	1
20	UG water tank	-	-	-	0

FIRE HYDRANT SYSTEM-

The Factory shall provide Hydrant System to provide fire protection to all plants storage tank farm area, stores, utilities, Laboratory &office block.

The details of the proposed Fire Fighting system are as follows-

1. Water Storage capacity - 2.5 lakh lit.

2. Emergency water capacity- 1.25 lakh lit.

3.1 Electrical operated Jockey pump - 10HP / Head 70mtr / flow rate 10.8 M3/hr.

3.2 Electrical operated Main pump - 40HP/ Head 70mtr/ flow rate 54.0 M3/hr.

3.3 Diesel Engine operated pump - 40HP/ Head 70mtr/ flow rate 54.0 M3/hr.

4. Power back up DG Set= 65 kVA

5. Number of Employees Trained for firefighting- 6 no's

6. D.G set - 125 KVA.

7. AFFF (Aqueous film forming unit)-200lit cap- 03 No

8. Fire Nozzles - 2 Nos

9. Foam Nozzles - 1 Nos

10. Fire Proximate Suit- 1 no's

11. Ammonia Mask

12 SCABA sets = 1 nos

Details of location shall be fixed during design

Training shall be imparted to employees for fire fighting and handling of chemical as well emergency handling**.**

Annexure VI: Health Management Plan

For Crystal Surfactants

Health Management plan for Methanol and Ammonia and ONCB

Following solvents and chemicals used can have effect on workers' health based upon NFPA values, MSDS and available literature. Chemicals which have Nh values more than or equal to 3 are considered as chemicals which can affect workers' health on long term exposure. The only solvent used is Methanol and is stored in over ground tank:

NFPA rating for these solvents

Sr. No.	Chemical	Max. qty required per Month	Maximum qty stored	Nf	Nh	Nr
2	Methanol	10 Cu. M	20 Cu. M	3	2	0

Information about toxic properties of Methanol

Boiling Point: 64.7 deg C @ 760.00mm Hg

TWA =250 ppm

TLV=200 ppm

Potential Health Effects

Eye:

Produces irritation, characterized by a burning sensation, redness, tearing, inflammation and possible corneal injury. May cause painful sensitization to light.

Skin:

Causes moderate skin irritation. May be absorbed through the skin in harmful amounts. Prolonged and/or repeated contact may cause defatting of the skin and dermatitis.

Ingestion:

May be fatal or cause blindness if swallowed. May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May cause systemic toxicity with acidosis. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure. May cause cardiopulmonary system effects.

Inhalation:

Harmful if inhaled. May cause adverse central nervous system effects including headache, convulsions, and possible death. May cause visual impairment and possible permanent blindness. Causes irritation of the mucous membrane.

According to this information available and other detailed medical information with Occupational Health certified medical fractioned, the periodic medical tests will be finalized to asses and control the adverse effects, in addition to all the engineering safety systems to be installed, like Hydrocarbon detectors, tank will be provided with overhead condensers with chilled water, transferring Methanol with mechanical seal pumps. And with BP of 64 deg C, it is not likely to contribute to any VOCs spite.

Chronic:

1. Prolonged or repeated skin contact may cause dermatitis.
2. Chronic exposure may cause reproductive disorders and teratogenic effects.
3. Prolonged exposure may cause liver, kidney, and heart damage.

Solvents are likely to be present in air as VOC. Chemicals which can contribute to VOC. The detailed measures which will be taken for keeping VOC from solvent storage have already been submitted.

Health Management Plan for Solvents:

Depending on their physical characteristics, certain chemicals have an affinity for specific target organs or body systems. Once deposited, they cause impaired functioning of the normal metabolic processes, which if permanent, ultimately results in disease.

Following are the steps to prevent adverse effect on workers' health.

1. **Environmental monitoring and control:** Measures the airborne concentration of the chemical in the workplace environment and control concentration less than Permissible levels. The plan has already been given
2. **Medical surveillance:** Aims to identify workers with early adverse health effects, which are likely to be reversible or do not progress to significant functional impairment when exposure conditions are improved. By carrying out regular medical examination of workers, specifically medical tests which are aimed for checking the effects of chemicals which affect target organs. These will be decided in consultation with qualified medical practitioner

3. Following table shows effects of solvent, of these solvents, toluene will only be used.
4. Detailed stepwise plan for ASSESSMENT AND MONITORING OF EXPOSURE TO CHEMICAL HAZARDS is given in **Annexure 1**.

Other Hazardous Chemicals Stored in Bulk:

Table

Sr. No.	Chemical	Maximum qty stored MT/Cu. M	Size of tank in Diameter and Height	Number Tanks	Clear Distance between each tank	NFPA rating
2	2, 4 DCNB	23000 Kg.	DIA =2.5 M Height= 4M	1	2 Meter	Nh=2 Nf=1
3	ONCB	23000 Kg.	DIA =2.5 M Height= 4M	1	2 Meter	Nh=3, Nh=1,Nr=1

Toxic properties of ONCB:

Acute toxicity, Oral - Category 4 - Acute Tox. 4

Hazardous: Toxic on skin contact. Repeated exposure and absorption through skin can cause significant harm.

Remove clothing, wash with plenty water soap and warm water. Call Doctor immediately.

Do not drink alcohol, smoke and eat while handling this product.

Proper PPES must be used.

M. P= 30-32 deg C

B. P. =246 deg C.

Since it is high boiling compound there will be no VOC increase due to this chemical

2,4-Dichloro-nitrobenzene

Boiling point 258 °C (496 °F)

NFPA Rating

Health Hazard: 2 Fire : 1 Reactivity Hazard : 0

Other raw materials handled are also solid and less toxic with Nh= < 2

Gases Handled:

Ammonia and Hydrogen

Out of these only Ammonia is irritant and toxic. Detailed Annexure is enclosed here with regarding handling precautions, toxic properties and medical consequences. This is enclosed as an **Annexure 2.**

It is clear that exposures as high as more than 2000 to 5000 ppm are of serious consequence. TLV limit is 35 ppm.

For Medical health management plan following is suggested:

Physical Examinations

Pre-placement Examinations

Most employees may be assigned to processes in which the use of anhydrous ammonia is carefully controlled. Under some circumstances the physician carrying out pre-placement examinations may wish to exclude from exposure people with the following disabilities:

a. Those with only one functioning eye;
b. Those with severe faulty vision; and
c. Those with chronic diseases of the nose, throat or lung.

Periodic Health Examination

Usually periodic health examinations will not be conducted solely by reason of the employee exposure to ammonia.

Three types of effects on the human body given in the table are:

1. Acute
2. Chronic
3. Allergic

- **Acute:**

The effect is exerted immediately or within a few hours of exposure (implies rapid accumulation at the target organ site; the severity of the reaction is directly proportional to the exposure dose rate) e.g. chemical asphyxiants (cyanide, carbon monoxide, hydrogen sulphide, nitrogen dioxide), irritants (chlorine, sulphur dioxide, ammonia) and corrosives (acids).

- **Chronic:**

The effect is exerted after months or years of exposure (implies gradual accumulation at the target organ site; severity is directly proportional to the exposure dose rate) e.g. heavy metallic

toxins such as lead. Certain substances demonstrate a delayed effect following a prolonged latency period (can occur with prolonged exposure or transient exposure) e.g. carcinogens such as asbestos.

- **Allergenic:**

The effect is exerted through the immune system (multiple initial doses result in sensitization with the accumulation of antibodies; subsequent low-level exposure triggers a response; pronounced individual susceptibility) e.g. respiratory and skin sensitizers (chrome, nickel, platinum salts).

Annexure 1

Assessment and Monitoring of Exposure to Chemical Hazards

Assessment and monitoring of exposure to hazardous chemical substances is an important aspect of initial and ongoing risk assessment and control. The primary prevention strategy should always be to prevent exposure to agents associated with toxic effects. When it is not possible to prevent such exposures, then the appropriate strategy is to limit exposure and minimise the possibility of adverse health effects. Exposure monitoring encompasses two basic techniques viz. **environmental air monitoring (occupational hygiene) and biological monitoring.** Environmental and biological monitoring are ways of investigating different problems and should be seen as complementary procedures. A practical approach in setting up an exposure monitoring programme for hazardous chemical substances is outlined in Table 3.

Table 3. A stepwise approach to developing an exposure monitoring programme for hazardous chemical substances	
Step 1	What is the nature of the job? - outline the various activities.
Step 2	Identify the hazardous chemicals associated with exposure to chemicals in the various activities.
Step 3	Identify the potential routes of exposure to the particular hazardous chemical substance.
Steps 1-3 are part of the risk assessment process. If a potential health risk is identified, proceed to Step 4.	
Step 4	If the exposure route is mainly airborne, proceed to environmental monitoring (EM).
Step 5	If the exposure route is mainly through non-inhalation routes (skin, ingestion) or if major reliance on personal protective equipment, proceed to biological monitoring

	(BM).
Step 6	Develop a sampling strategy for EM and/or BM based on exposure zone characterisation (groups of workers performing similar activities). For EM, it is preferable to do personal sampling. The timing of the sampling strategy for BM is based on the biological half-life of the substance in the sample medium (blood, urine) concerned. Conduct sampling in a standardised manner. Ensure that samples are appropriately stored after collection.
Step 7	Identify the appropriate analytical test that has a high degree of validity, and a quality-certified laboratory that will conduct the analysis of samples.
Step 8	Decide beforehand the criteria to be used to define an abnormal test result using the DOL/ ACGIH/NIOSH OELs for airborne substances or Department of Labour (DOL)/ACGIH BEIs for BM samples.
Step 9	Outline the process of referral to confirm abnormal result in the case of BM, removal of the person from exposure; determining the presence of adverse health effects through medical surveillance and/or diagnostic medical assessment; initiating treatment in instances of acute toxicity; and where appropriate submitting a workers' compensation claim (COIDA) should there be abnormal results.
Step 10	Outline the procedure for notification of employer, worker (ongoing worker notification procedures) and enforcement agency (notify incident to DOL) as to the outcome of the exposure assessment.
Step 11	Ensure input of the information obtained in this process into systems and procedures in assessing the efficacy and improvement of existing control measures such as engineering controls, work procedures, education and training.
Step 12	Ensure evaluation and audit of the programme on a regular basis.

Annexure 2

Measures for handling Ammonia

"Ammonia is a natural constituent of the atmosphere but exists in concentrations below the level which is hazardous to humans, animals, plants or materials.

High concentrations of ammonia gas are corrosive to mucous membranes; can cause damage to the eye, throat and upper respiratory tract; and can produce residual damage and even death to humans and animals.

High concentrations are also toxic to most plant life and have corrosive effects on materials."

Concentration in Air	Effect
20 µg/m (0.027 ppm)3	- Average atmospheric background concentration.
30 - 36,000 µg/m3 (.04 - 50 ppm)	- Odor threshold.
1.44 mg/m3 (2.0 ppm)	A limit of 0.50 ppm may be desirable if a surrounding buffer is not

Max one hour conc. limit	possible.
18 mg/m3 (25 ppm)	threshold limit value to which it is believed workers may be exposed continuously for 8 hours without adverse effects3
280 - 490 mg/m3 (390 - 680 ppm)	- concentration range where NH3 gas produces eye, nose and throat irritation and may injure respiratory mucous.
360 mg/m3 (500 ppm)	- suggested maximum short-term atmospheric concentration due to uncontrolled release of ammonia resulting from equipment failure, safety valves discharging or any other single release.

The flammable limits of ammonia are from 15% to 25% by volume in air; however, ammonia is difficult to ignite in spite of this. Gaseous ammonia will dissolve readily in water at a rate of approximately 700 volumes/volume of water.

Melting point: -77.4°C Boiling point: -33.4°C Density: 0.677 g per c.c.

* Due to the chilling effect of evaporation, ammonia vapor resulting from a large spill may move down-wind as a visible cloud some distance before dissipating or rising.

Vapour Concentration(ppm)	General Effect	Exposure Period
(1)	(2)	(3)
1-5	Odour detectable by most person	Prolonged repeated exposure produces no injury
25	No adverse effect for average worker	Maximum allowable concentration for 8 hour working exposure
35	No adverse effect for erage worker	Exposure should not be longer than 15 minutes and should not occur more than four times per day
400 to 700	Nose and throat irritation Eye irritation with tearing	Infrequent short (1/2 hour) exposure ordinarily produces no serious effect
2 000 to 3 000	Conculsive coughing Severe eye irritation	No permissible exposure. May be fatal after short exposure

Vapour Concentration(ppm)	General Effect	Exposure Period
(1)	(2)	(3)
5 000 to 10 000	Respirator spasm. Rapid asphyxia	No permissible exposure. Rapidly fatal

Liquid anhydrous ammonia produces skin burn on contact.

i. ACGIH Short Term Exposure Limit (STEL) – 35 ppm

NOTES

- ACGIH (TLV-TWA) – The TWA concentration for a conventional 8 h work day and 40 h work week, to which it is believed that nearly all workers may be repeatedly exposed, day after day for lifetime without adverse effect.
- ACGIH (TLV-STEL) indicates Short Term Exposure Limit. A 15 minutes TWA exposure that should not be exceeded at any time during a work day, even if the 8 h TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the TLV-STEL should be less than four times per day, and there should be at least 60 minutes between successive exposures in this range.'

LABELLING

Consignments or smaller containers shall carry an identifying label or stencil depicting the symbol given in Fig. 2 of IS 1260 (Part 1) and the following information shall also be given in the lower half of the label.

AMMONIA, ANHYDROUS

WARNING ! Hazardous liquid and gas under pressure

Liquid Causes Burns

Gas Extremely Irritating

Do not breathe gas.

Do not get in eyes, on skin, on clothing.

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. Call a physician at once in case of burns, especially to the eyes, nose and throat, or if the patient is unconscious.

Keep cylinders away from heat and sun. Do not store with flammable or explosive materials. Never drop cylinders.

Be sure connections are tight. Use no oil or lubricants on valves.

Never refill cylinders.

Keep the cylinders up-right (vertical) with its valve at the top and secure it properly.

PREVENTIVE MEASURES

Employee Education and Training

Safety in handling ammonia depends, to a great extent, upon the effectiveness of employee education, proper safety instructions, intelligent supervision and the use of safe equipment.

The education and training of employees to work safely and to use the personal protective equipment or other safeguards provided for them is the responsibility of supervision. Workers should be thoroughly informed of the hazards that may result from improper handling of ammonia. Each employees should be fully informed as to what to do in an emergency.

Employee education and training should include the following:

a. Instruction and periodic drill or quiz regarding the locations, purpose and use of respiratory protective devices and other personal protective equipment and action to be taken during emergency.
b. Instruction and periodic drill or quiz regarding the locations of safety showers, eye baths, bubbler drenching fountains, or the closest source of water for use in emergencies.
c. Instructions to avoid all unnecessary inhalation of vapours of ammonia and all direct contact with the liquid.
d. Instruction and periodic drill or quiz regarding the location, purpose and the use of emergency fire fighting equipment. Instruction to strictly prohibit smoking in storage area.
e. Instructions to report to the proper authority all equipment failures and any unusual odour of ammonia.

Personal Hygiene

Emergency showers and eye baths should be placed at convenient locations wherever anhydrous ammonia is used in quantity. Every employee should understand that direct contact with the chemical requires the instant application of large amounts of water to the affected area. These safety showers should be tested periodically for their proper functioning.

Skin, eye and respiratory protective equipment will often be necessary.

Physical Examinations

Pre-placement Examinations

Most employees may be assigned to processes in which the use of anhydrous ammonia is carefully controlled. Under some circumstances the physician carrying out preplacement examinations may wish to exclude from exposure people with the following disabilities:

a. Those with only one functioning eye;
b. Those with severe faulty vision; and
c. Those with chronic diseases of the nose, throat or lung.

Periodic Health Examination

Usually periodic health examinations will not be conducted solely by reason of the employee exposure to ammonia.

Personal Protective Equipment

Availability and Use

While personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation, and intelligent conduct on the part of employees working with ammonia, it is, in many instances, the only practical means of protecting the worker, particularly in emergency situations. One should keep firmly in mind that personal protective equipment protects only the worker wearing it, and other unprotected workers in the area may be exposed to danger.

The correct usage of personal protective equipment requires the education of the workers in proper employment of the equipment available to him. Under conditions which are sufficiently hazardous to require personal protective equipment, its use should be supervised and the type of protective equipment selected should be capable of control over any potential hazards.

Eye Protection

Gas-tight chemical goggles or full face mask should be worn when handling ammonia where leaks or spills may occur. Water wash or water sprays should be available in areas where ammonia leaks, spills or splashes may be encountered.

Respiratory Protection

Severe exposure to ammonia may occur in tanks during equipment cleaning and repairs, when decontaminating areas following spills, or in case of failure of piping or equipment. Employees

who may be subject to such exposures should be provide with proper respiratory protection and trained in its use and care. Available types are described below.

NOTE– Respiratory protective equipment shall be carefully maintained, inspected, cleaned and sterilized at regular intervals, and always before and after use by another person.

Self-contained breathing apparatus

It permits the wearer to carry a supply of oxygen or air compressed in the cylinder (the self-generating type produces oxygen chemically) and allows considerable mobility. The length of time a self-contained breathing apparatus provides protection varies according to the amount of air, oxygen or regenerating material carried.

Compressed oxygen should not be used where there is danger of contact with flammable liquids or vapours, especially in confined spaces such as tanks or pits. A special type of self-contained breathing apparatus may be used which is provided with a small cylinder of compressed air for escape but is supplied with air through an air line for normal work purposes.

Positive pressure hose masks

These are supplied by blowers and require no internal lubrication. The wearer shall be able to use the same route for exit as for entrance and shall take precautions to keep the hose line free of entanglement. The air blower shall be placed in an area free of contaminants.

Air-line masks

These are supplied with clean compressed air, are suitable for use only where conditions will permit safe escape in case of failure of the compressed air supply. These masks are usually supplied with air piped to the area from a compressor. It is extremely important that the air supply is taken from a safe source, and that is not contaminated by oil decomposition from inadequate cooling at the compressor. The safer method is to use a separate compressor of the type not requiring internal lubrication. Pressure reducing and relief valves as well as suitable traps and filters, shall be installed at all mask stations.

8.4.3.4 ***Chemical cartridge respirators***

These may be used to avoid inhaling disagreeable but relatively harmless concentrations of ammonia vapour. These respirators, however, are not recommended for protection where toxic quantities of ammonia may be encountered. While using cartridge care must be taken to check the oxygen content in the area. It should be more than 16.5 percent (*v/v*) and chemical cartridges whose life is over, must not be available for use

CAUTION : Filter type respirators do not offer protection against gases and are unsuitable for use when working with ammonia.

8.4.4 ***Head Protection***

Where there is no danger from falling objects, safety or 'hard' hats are considered unnecessary, soft, brimmed hat or caps should be worn to give protection against liquid leaks and splashes.

8.4.5 ***Foot Protection***

Rubber boots or safety-toed rubber booties should be used as required. Rubber boots should be thoroughly cleaned and ventilated after contamination.

8.4.6 ***Body, Skin and Hand Protection***

Rubber or other protective gloves should be worn where any danger of contact with ammonia may occur. Impermeable wears may also be used.

8.4.6.1

For the protection of the skin, cotton shirt, trousers and underwear should be worn (cotton resists alkalis better than wool).

8.4.6.2

In case of emergency, a rubber apron or rubber coat may provide sufficient protection, but in areas of high ammonia concentration a complete gas suit should be worn.

8.4.6.3

For optimum protection of the body, the collar should be kept buttoned, glove (gauntlets) should be tucked inside of sleeves, and trouser legs should be left outside of boots.

It is also suggested to have a valcro type tight fitting strap to have the legs and arm areas tight enough to avoid ammonia gas entry into the protective suit.

8.4.6.4

In area of high ammonia concentration, ammonia may be absorbed by perspiration on the body even though appropriate protective clothing is worn. Severe discomfort may be minimized or prevented by the application of protective oil to such body areas in addition to the wearing of protective clothing.

8.5 Spills and Leaks

8.5.1

Leaks of ammonia should be searched for, preferably with hydrochloric acid solution or with either chlorine gas or sulphur dioxide gas using a small cylinder of the compressed gas. A white

cloud is produced in the presence of ammonia. Because of the fire risk, sulphur candles should not be used.

8.5.2

If leaks or spills occur, only properly protected personnel should remain in the area. In cases where leaks cannot be valved off, use large volumes of water sprayed directly on the leak and maintain contact until the contents have been discharged and the tank is empty. Leaking cylinders should be removed to the outdoors or to an isolated, well-ventilated area and the contents transferred to other suitable containers. All spills should be flushed away promptly with water.

8.5.3

In handling or operating any type of ammonia system, always be sure that all valve connections and pipe lines are in proper order and condition before starting the operation. Keep compressors and motors clean and in good condition.

8.5.4

During cold weather keep all steam traps warm, whether or not tanks are in service.

8.5.5

Never, under any circumstances, close all valves on a full line of liquid ammonia unless protected by pressure relief or liquid expansion device.

9 FIRST-AID

9.1 ***General Principles***

After severe exposure to ammonia gas, it is important to move the patient from the contaminated area promptly. In case of contact of the liquid with the eyes or skin, immediate flushing with large quantities of running water is imperative. In all cases of serious injury, call a physician at once giving him a complete account of the accident.

9.2 Contact with Skin and Mucous Membranes

Speed in removing ammonia from contact with the patient and in moving the patient to an uncontaminated atmosphere is of primary importance.

If skin contact is extensive and emergency showers available, the employee should get under the shower immediately. Contaminated clothing and shoes should be removed under the shower. In other instances flushing with large amounts of running water should be continued for at least 15 minutes.

9.2.1: Under no condition should salves or ointments be applied to the skin or mucous membrane burns during the 24-hour period following the injury. Subsequent medical treatment is otherwise the same as for thermal burns.

9.3 ***Contact with the Eyes:*** If even small quantities of ammonia enter the eyes, they should be irrigated immediately and copiously with water for a minimum of 15 minutes. The eyelids should he held apart during the irrigation to ensure the contact of water-with the tissues of the eye surface and lids. A physician should be called at the earlier possible moment. After the first 15 minutes period of irrigation, if a physician is not available, the irrigation should continue for a second period of 15 minutes. It is then permissible as a first-aid measure to instill 2 or 3 drops of 0.5 percent pontocaine solution or an equally effective aqueous topical anesthetic. No oils or oily ointment should be instilled unless ordered by a physician. The employee should be sent to a physician, preferably an eye specialist, as soon as possible.

9.4 ***Ingestion:*** If liquid anhydrous ammonia has been swallowed, call a physician immediately. If the patient is conscious and able, he should drink large amounts of water to dilute the chemical. Do not induce vomiting if the patient is in shock extreme pain or is unconscious. If vomiting begins, place the patient face down with head lower than hips, this prevents vomitus from entering the lungs and causing further injury.

9.5 ***Inhalation***

Exposed persons should be removed at once to an uncontaminated area. If the exposure has been to minor concentrations for a limited time, usually no treatment will be required.

9.5.1: When there is severe exposure to higher concentrations, and if oxygen apparatus is available, oxygen may be administered but only by a person authorized for such duty by a physician. If the patient is not breathing, an effective means of artificial respiration should be initiated immediately. Call a physician.

9.5.2: The patient should be kept comfortably warm but not too hot and should be kept at rest.

9.5.3: Never attempt to give anything by mouth to an unconscious patient.

Annexure VII: EHS Policy

NSPL/SA/CSC/2017/323

Dt. 25-09-2017

OH &S POLICY OF THE COMPANY

Crystal Surfactants and Chemicals as company considers no phase of its operation more important than safety and health protection. Company Management will provide and maintain safe and healthy working conditions at all time and will establish and insist upon safe working methods and practices at all times during its production/operational activities.

Safety and health will be an integral part of all operations including planning, development, production, administration, sales, and transportation. Accidents have no place in our company. Our target is zero harm, zero incident and zero accident in our company premises.

We will continually work consistently to maintain safe and healthy working conditions to adhere to proper safe operating practices and procedures designed to prevent any harm, injury and illness and to observe Central, state, local and company safety and health regulations etc. pertaining to all statutory Indian rules/regulations/Acts.

Each level of management will reflect an interest in company safety and health objectives and is required to set a good example by always observing the rules as a part of the normal routine. Company Management interest will be vocal, visible, and continuous from top management to departmental supervisors/employees.

All company workers are expected to give their commitment to follow safe working practices, obey rules and regulations, and work in a way that maintains the high safety and health standards developed and sanctioned by the compan

We urge all our Associates to make our safety and health program an integral part of their daily operations. Then the total elimination of accidents and injuries will become not just an objective, but a safety will be way of life.

Date: 01.01.2017

Place: MIDC Paithan, Aurangabad.

Managing Partner