# Risk Assessment and Disaster Management Plan

**Proposed Expansion of Viscose Filament Yarn (1650 to 2400 MTPM), Sodium Sulphate ($Na_2SO_4$) Plant (2050 to 2350 MTPM), CPP (34.5 to 54.5 MW) along with Installation of Sodium Sulphite ($Na_2SO_3$) Plant (3000 MTPM) & Liquid Sulphur Dioxide ($SO_2$) Plant (1500 MTPM)**
**At Veraval, District: Gir-Somnath (Gujarat)**

**M/s. Indian Rayon**

***A Unit of Aditya Birla Nuvo Limited***

## 1.0 RISK ASSESSMENT

Accidental risk involves the occurrence or potential occurrence of some accident consisting of an event or sequence of events resulting into fire, explosion or toxic hazards to human health and environment.

MCA stands for Maximum Credible Accident or in other words, an accident with maximum damage distance, which is believed to be probable. MCA analysis does not include quantification of the probability of occurrence of an accident. In practice, the selection of accident scenarios for MCA analysis is carried out on the basis of engineering judgement and expertise in the field of risk analysis especially in accident analysis.

A disastrous situation is the outcome of fire, explosion or toxic hazards in addition to other natural causes that eventually lead to loss of life, property and ecological imbalances.

### 1.1 Methodology of MCA Analysis

The MCA analysis involves ordering and ranking of various sections in terms of potential vulnerability. The data requirements for MCA analysis are:

- Operating manual
- Flow diagram and P&I diagrams
- Detailed design parameters
- Physical and chemical properties of all the chemicals
- Detailed plant layout
- Detailed area layout
- Past accident data

Following steps are involved in the MCA analysis:

- Identification of potential hazardous sections and representative failure cases
- Visualization of release scenarios considering type and the quantity of the hazardous material
- Damage distance computations for the released cases at different wind velocities and atmospheric stability classes for heat radiations and pressure waves.

### 1.2 Hazard Identification

Identification of hazards is an important step in Risk Assessment as it leads to the generation of accidental scenarios. The merits of including the hazard for further investigation are subsequently determined by its significance, normally using a cut-off or threshold quantity.

- Fire
- Explosion
- Accidental Spillage or Leak of Hazardous(Flammable, Toxic) Chemicals & Gases
- Contact with Flammable Toxic Chemicals and Gases
- Loading/ Unloading /Packaging Operations failures
- Electrocution/ Electrical Hazards

**TABLE - 1.1**

**Possible Hazardous Locations Onsite**

| S. No. | Hazardous Area | Likely Accident |
|---|---|---|
| 1. | $CS_2$ storage area | Toxic & Flammable |
| 2. | Caustic Storage Area | Toxic |
| 3. | Sulfuric Acid Storage area | Toxic /Reactive |
| 4. | Hydrochloric Acid storage area | Toxic |
| 5. | Sodium Hypochlorite storage area | Toxic |
| 6. | Coal/ fuel storage area | Fire and spillage |
| 7. | Boiler Area | Explosion |
| 8. | Electrical rooms | Fire and electrocution |
| 9. | Turbine room | Explosion |
| 10. | Transformer area | Fire and electrocution |
| 11. | Cable tunnel | Fire and electrocution |
| 12. | Storage yard | Sliding/fall of material |
| 13. | Crushing and grinding unit of Coal | Fatal accident |
| 14. | Chimney/Stacks | Air pollution |

### 1.2.1 Fire and Explosion Index (FEI)

Fire and Explosion Index (FEI) is useful in identification of areas in which the potential risk reaches a certain level. It estimates the global risk associated with a process unit and classifies the units according to their general level of risk. FEI covers aspects related to the intrinsic hazard of materials, the quantities handled and operating conditions. This factor gives index value for the area which could be affected by an accident, the damage to property within the area and the working days lost due to accidents.

Fire and explosion index is then calculated as the product of Material Factor (MF) and Unit Hazard Factor. Degree of hazards based on FEI and TI is given in the following Tables 7.2 and 7.3respectively.

Preventive and protective control measures are recommended based on degree of hazard. Therefore, FEI indicates the efforts to be taken to reduce risks for a particular unit. FEI and TI computed for various process equipments are presented in Table 1.2.

**TABLE - 1.2**

**Degree of Hazards Based On FEI**

| FEI Range | Degree of Hazard |
|---|---|
| 0 – 60 | Light |
| 61-96 | Moderate |
| 97 - 127 | Intermediate |
| 128 - 158 | Heavy |
| 159 and Above | Severe |

**Source:** Dow's Fire and Explosion Index Hazard Classification Guide, Seventh Edition, AIChE Technical Manual (1994)

**TABLE - 1.3**
**Degree of Hazards Based On TI**

| TI Range | Degree of Hazard |
|---|---|
| 0 - 5 | Light |
| 5 - 10 | Moderate |
| Above 10 | High |

**TABLE - 1.4**
**Fire and Explosion Index and Toxicity Index for Process Units**

| S. No. | Unit Name | FEI | Category |
|---|---|---|---|
| **Fire and Explosion Index** | | | |
| 1 | Hydrogen Cylinder Bank (CAS No. 7647-01-0) | 97.12 | Intermediate |
| 2 | Hydrogen Compressor | 97.12 | Intermediate |
| 3 | Furnace Oil Day Storage Tank | 12.5 | Light |
| 4 | Furnace Oil Storage Tank (Caustic) | 14.3 | Light |
| 5 | Fuel Oil Pump (Caustic) | 15.1 | Light |
| 6 | Furnace Oil Storage Tank (Diesel Power House) | 18 | Light |
| 7 | Carbon Disulphide Storage Tank (CAS No. 75-15-0 ) | 53.13 | Light |
| **Toxicity index** | | | |
| 1 | Chlorine Tonner (CAS No. 7782-50-5) | 19.35 | High |
| 2 | Chlorine Liquefier | 20.7 | High |
| 3 | Carbon Disulphide Storage Tank | 14.72 | High |
| 4 | Sulphuric Acid storage | 13.25 | high |

## 1.3 Results & Conclusion from MCA Analysis

Results & Conclusion from MCA Analysis of Environmental Impact & Risk Assessment (EIRA) study carried out by National Environmental Engineering Research Institute(NEERI), Nagpur are given below.

Risk has been quantified in terms of individual and societal risk contours for process equipment and storage tanks for partial and full rupture scenarios. The maximum individual risk generated in the plant site is of $10^{-6}$ level. Risk acceptance criteria provided by UK Guidelines are used. The risk is acceptable according to the international standards.

The societal risk has been given as F/N curve where F is the failure probability and N is the number of fatalities. The curve has been presented by considering the population, population density and ignition sources around the plant. The F/N curve for Chlorine Liquefier, Chlorine Bullet Storage, Hydrogen Compressor and FO (Diesel PH) Storage are in the "As Low as Reasonably Practicable" (ALARP) region where risk can be reduced with the precautionary measures. The necessary risk mitigation measures for these equipments have been recommended in following sections. The societal risk from other process equipment and storage tanks is within the acceptable region.

As in case of FO (caustic) Pump there is no risk generated because the handling capacity of the pump is less and F/ N curve fall in broadly acceptable region.

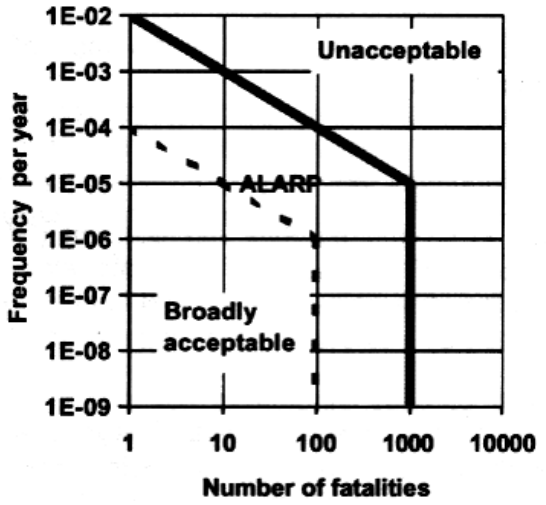



**Figure 1.1: United Kingdom Societal Risk Guidelines (risk to workforce and public)**

## 1.4 Risk Mitigation Measures

Environmental Impact & Risk Assessment study has been carried out by National Environmental Engineering Research Institute, Nagpur for proposed facilities of Indian Rayon a unit of Aditya Birla NUVO Limited, Veraval. The Fire & Explosion and Toxicity Indices were computed for the identification of vulnerable sections. Maximum Credible Accident (MCA) analysis for the visualized release scenarios of hazardous chemicals was also carried out. Risk mitigation measures have been recommended based on computation of indices and MCA analysis. General as well as specific recommendations are presented in the subsequent sections.

### 1.4.1 Existing "safe practice" followed for handling, storage, transportation andunloading of Chemicals

Indian Rayon has adopted 12 DuPont Safety standards for Implementation of efficient Safety Practices onsite

- PPE
- Permit to Work
- Work at height
- Material Handling
- LOTO (Lock Out Tag Out)
- Scaffolding
- Excavation
- Incident Investigation
- Control Safety Management

- Job Safety Analysis
- Confined Space
- Hot Work
- Precautions are taken during storage and transportation of hazardous chemicals. Safe Loading & Unloading Procedures are followed.
- Use of TREM Card is mandate in the industry. HAZCHEM Code is displayed on transport vehicles during Transportation
- PUC certified vehicles are used for Hazardous chemical transportation
- Manifest copies are issued as per Manufacture, Storage, Import of Hazardous Chemicals rules, amended 2008.
- Chlorine Transportation Emergency Network Gujarat Chapter started Interlinking Disaster Control Centers of all Chlor Alkali Industries in Gujarat for Handling Chlorine Transportation Emergencies.

### 1.4.2 Existing Chemical Specific Implementation of safe Practice onsite

List of Storage of chemicals (inflammable/explosive/hazardous/toxic substances) Onsite is given below in **Table - 1.5**.

**TABLE - 1.5**

**List of Storage of Chemicals Onsite**

| S. No. | Name of the Chemical | MSDS No. | Quantity that Can stored | Stored(including in process & handling) | Place of Storage | State of Pressure & Temperatures | Types of possible hazards(Fire, explosion,toxic) | Control Measures |
|---|---|---|---|---|---|---|---|---|
| 1 | Sulphur | 1 | 1000 Ton | 600 Ton | Open Yard at Rayon Plant | Normal | F & T | Hydrant Line Provided near storage |
| 2 | Caustic 48% | 2 | 870 Ton | 227 Ton | Caustic Plant | Normal | Corrosive/Irritant | Hydrant line, SCBA sets,PVC suits |
| 3 | Caustic 32% | 2 | 250 Ton | 41 Ton | Caustic Plant | Normal | Corrosive/Irritant | Hydrant line, SCBA sets,PVC suits |
| 4 | Chlorine | 3 | 320 Ton | 215 Ton | Caustic Plant | 2.5 Kg/cm2 & -3 C | Toxic release | Emergency Chlorine Kit, SCBA sets,Airline repirators,Shower Curtain,Neutralization Pit,Fire Hydrants,etc. |
| 5 | Carbon-disulfide | 4 | 500 Ton | 153 Ton | CS2 Plant | Normal | F,E & T | Kept under water,Fire Hydrant |
| 6 | Sulfuric Acid | 5 | 1200 Ton | 592 Ton | Sulfuric Acid plant | Normal | Corrosive/Irritant | Bund walls provided,lime provided for neutralization |

***Following are some preventive measures for specific chemicals that are handled in the plant.***

**Carbon Disulphide**

- $CS_2$ is kept under water due to explosive nature of carbon disulfide & $CS_2$ tanks are kept under water in the dyke. Transferring of $CS_2$ is with the help of water pressure.
- Three numbers of $CS_2$& Five numbers of $H_2S$ detectors are installed.
- Lightening arrestor installed at the top of the plant.
- Entire plant is well protected by closed earthing network.
- Regular safety training, practical demonstrations are imparted to the employees.
- Mock drill is carried out to test emergency preparedness.
- Material Safety Data Sheet for all the Chemicals are being used/will be used. CAS No. /RTECS No./DOT/UN etc are mentioned at handling area.
- Cleaning of sulphur seal is always under nitrogen purging to avoid fire incident.
- There is total prohibition on smoking, carrying matches, fire or naked light or other means of producing spark inside the plant. Safety cautionary notice is also displayed in the plant.
- The sufficient number of fire monitors, hydrants and portable fire extinguishers are provided around the installation. Extinguish fire with dry chemical or carbon dioxide as water and foam may be ineffective on fire.
- Enough number of air line respirator & SCBA are provided for emergency purpose.
- Two number of wind socks are installed in the plant to know wind direction from any corner of the plant.
- Water spray system is provided for $CS_2$ tanker filling station.

**Chlorine**

- There are five chlorine storage vessels so called bullets (Capacity 64 M3 water capacity each). The total operation of chlorine storage vessels i.e. starting, filling, isolation and transfer is auto-sequential controls by DCS with necessary safety interlocks.
- Inventory of 70 tons bullet for Chlorine gas storage is eliminated by resorting to store directly in 900 kg cylinders using liquid chlorine pump. This reduces the risk of accidental release of $Cl_2$ to 900 kgs only.
- Company has started Liquid Chlorine filling through Liquid Chlorine Pump by which is almost nullified Chlorine inventory in Liquid chlorine Storage tanks (Bullets)
- Chlorine Transportation Emergency Network Gujarat Chapter started Interlinking Disaster Control Centers of all Chlor Alkali Industries in Gujarat for Handling Chlorine Transportation Emergencies.
- All important in/out ON / OFF valves are provided with limit switches to physically verify the opening / closing of ON / OFF valves. All these valves are bellow sealed type and are remote operated. If valve remains open for more than 10 minutes, then plant will trip.

- Each storage vessel is provided with double safety valves, set at 12.5 kg/cm2 (gauge) having common isolation valve and individual rupture disc at the upstream of safety valve. The safety valves are tested once in a year.
- As an additional safety feature, there is a pressure switch mounted between rupture disc and safety valve which gives an alarm in case of rupture disc failure.
- Material Safety Data Sheet for all the Chemicals are being used/will be used.
- Water curtain system is provided around chlorine bullets.
- There is one level and one weight measurement device on each storage vessels. One is level transmitter connected with DCS which gives continuous level and high level alarm. The second device works on load cell and gives hold-up of chlorine in vessel in metric tons in DCS. Also, high weight interlock closes the Liquid chlorine inlet valve.
- The safety valve outlets are connected to waste air unit where chlorine is absorbed in lean caustic solution.
- Each vessel is mounted with pressure gauge and pressure transmitter. The pressure transmitter gives indication and high pressure alarm in DCS.
- Emergency remote switches are provided in field to isolate all the five chlorine bullets and all chlorine filling points.
- Hard wired emergency switches are provided in control room for closing on / off valves mounted on vessels, one switch for each vessel. This can be operated in emergency for complete isolation of vessel.
- During Liquid Cl2 filling, if tonner temperature rises above 40 ºC, audio visual alarm display in field.
- The total storage area is isolated and entry is restricted by wire link maintaining required safety distances.
- All vessels are insulated with cold insulation and kept under approved shed by CCE, Govt. of India, Nagpur. There are 3 gates and one set of SCBA provided at each gate.
- Final absorption tower and sump capacity from 0.6 M3 to 12 M3 are increased.
- Company has separate routine and Emergency chlorine gases absorption in different streams.
- On chlorine storage tank, Chlorine Equalizer and sniff chlorine to hypo was controlled by single ON/OFF valve. Now companyhas separated ON/OFF valves on all chlorine storage tanks.
- HCl & Hypo Stack Monitoring done on regular basis once in 15 days and results are recorded. One chlorine detector provided in Hypo stack with Audio Video Alarm at DCS.
- Chlorine in ambient air is monitored once in 15 days and results are recorded.
- One pocket chlorine monitor is available in Lab to detect the chlorine concentration in the area.

- One bullet is always kept under reserve for emergency dumping. This is also taken care of in operation sequence by DCS.
- Expansion vessel with pressure switch provided in chlorine bottling line (In between chlorine storage and filling area through Liquid chlorine trap.
- Thirty chlorine sensors mounted in various areas where there is chlorine leakage possibility.
  - 6 No. Sensors in chlorine bullet area.
  - 6 No. Sensors in chlorine filling area.
  - 2 No. Sensors near Liquid Chlorine Pump
  - 11 No. Sensors in other sections of Plant
  - 5 No. Sensor at different gates of Plant & colony gives local AUDIO Visual alarm & rest 24 gives alarm in DCS
  - These detectors detect (0-10 ppm) chlorine level.

**Hydrogen**

- 2 No's Online hydrogen monitoring is with DCS installed onsite at hydrogen handling area of caustic soda plant.
- Flame arrestors are provided at various places in the system.
- Maintenance and replacement of defective lines are done regularly.
- Fire extinguishers are posted around the area covered by pipelines carrying hydrogen gas.
- Proper care of process parameters are taken to avoid explosives range of hydrogen and chlorine mixture.
- Vapour may explode if ignited in an enclosed area. Evacuate surrounding area. Stop flow of gas if possible. Cool exposed containers and protect men effecting shutoff with water.
- Natural or explosion-proof ventilation is provided to ensure hydrogen does not reach its lower explosive limit of 4%.
- Check valve or other protective apparatus in any line or piping from the cylinder to prevent reverse flow is provided.
- Cylinder storage locations are well protected, well-ventilated, dry, and separated from combustible materials.

**Hydrogen Chloride**

- Bubble cap tray followed by packed bed scrubber with DM water as scrubber media is installed to control HCl emissions.
- Stack of 34 m is constructed at HCl plant to reduce emissions.
- Normally stable but can become unstable at elevated temperatures and pressures
- Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture is maintained onsite.

- Storage in a metallic or coated fibreboard drum using a strong polyethylene inner package is done onsite.
- Proper care for the product istaken presently to maintain at a concentration level below TLV.
- Visual displays are provided to create awareness in the working area.
- Sign Boards are provided.

**Furnace Oil**

- All storage tanks have been provided with water spray cooling system and foam pourer system.
- Gas and hydrocarbon detector are provided in plant area to detect leakage.
- The fire proofing material/coating resistant to weather effects such as chalking and erosion having adequate adhesion, strength and durability is applied.
- Storage areas are found to be adequately separated from buildings, process areas and flammable materials.
- The separation /space in the storage areas are according to the OISD guidelines and sufficient to escape from fire.

**Hydrogen Sulphide**

- All work operations are monitored in such a way that emergency personnel can be immediately contacted in the event of a release.
- Water spray is used to cool fire-exposed containers, structures, and equipment.
- Appropriate extinguishing media used are dry chemical, foam, and carbon dioxide.
- All piped systems and associated equipment are grounded.
- Visual displays are provided to be aware of any signs of dizziness or fatigue, exposures to fatal concentrations of Hydrogen Sulphide could occur without any significant warning or symptoms.

**Sulphuric Acid**

- Dyke walls are provided around the storage tank so that the contents of the tank are collected in dyke in case of accidental release.
- One of the storage tanks is kept empty so that in case of emergency the liquid of the damaged tank can be transferred to the empty stand by storage tank.
- Safety eyewear complying with an approved standard is used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.
- Sign Boards are provided for accidental release if occurs, then immediately contact emergency personnel and Keep unnecessary personnel away.
- Personnel protective equipment for the body are selected based on the task being performed and the risks involved and is approved by a specialist before handling this product.

**Coal handling yard**

**Flammable and will be easily ignited by heat, sparks or flames:**

- Coal handling facility is stored 500 meters away from the ecological sensitive area and forests area.
- Coal handling facility is ensured for adequate water supply through pipe/water sprinklers to avoid fugitive dust emission.
- Coal handling facility is ensured for stacking of coal in heaps does not get higher than the compound wall of premises.
- During loading/unloading, fixed pipe network with sufficient water storage and pump are installed. Coal handling facility is /will ensure maximum sprinkling of water at each and every stage of transportation to avoid generation of coal dust or other dust.
- The ignition sources, which are traceable to routine operations or worker habits such as smoking, open flames, open light (bulbs), welding, cutting, and grinding, are eliminated by sufficient staff training and enforcement of discipline.
- Coal handling facility is ensured that all transportation vehicles before leaving the storage yard are covered with tarpaulin and also that they are not over loaded as well as there is no spillage during transportation.
- Coal handling facility is ensured of regular sweeping of coal from internal and main road and also ensures that there is adequate space for free movement of vehicles at the surrounded area.
- Coal handling facility is storing coal in such a way that coal heap is not higher than 15 feet and clear distance between two adjoining heap at G.L. is 5 meters ,so that in case of fire ,approach is available.
- Coal handling facility is taking measures to control the air pollution while loading/handling coal. Specific measures are under-taken to avoid fugitive emission at the time of loading/unloading of coal by coal yard unit.
- Coal handling facility is providedwith adequate fire fighting measure to avoid any fire and is ensured that there is no explosive or chemical reaction in storage yard.

### 1.4.3 Preventive Measures for Electrical Hazard

- All electrical equipments are provided with proper earthing. Earthed electrode are calibrated, periodically tested and maintained.
- Emergency lighting are available at all critical locations including the operator's room to carry out safe shut down of the plant, ready identification of fire fighting facilities such as fire water pumps and fire alarm stations.
- All electrical equipments are free from carbon dust, oil deposits, and grease.
- Use of approved insulated tools, rubber mats, shockproof gloves and boots, tester, fuse tongs, discharge rod, safety belt, hand lamp, wooden or insulated ladder and not wearing metal ring and chain is insured.

- Flame and shock detectors and central fire annunciation system for fire safety are provided.
- Temperature sensitive alarm and protective relays to make alert and disconnect equipment before overheating are provided.
- Danger from excess current due to overload or short circuit are prevented by providing fuses, circuit breakers, thermal protection.
- Carbon dioxide or dry chemical fire extinguishers are for electrical fires.

### 1.4.4 Fire Protection Systems

The typical fire fighting system for the various facilities described under this project is outlined in this section. Fire protection system are designed in accordance with the requirements of OISD, Tariff Advisory Committee (TAC) of India, NFPA standards, design requirements and safe engineering practices and will have full capability for early detection and suppression of fire. The system will primarily consist of:

- Hydrant system
- Deluge sprinkler system
- Portable fire extinguisher
- Fire detection and alarm system

### 1.4.5 Personnel Protective Equipment (PPE)

Personnel Protective Equipment (PPE) provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems.

PPE is considered to be a last resort that is above and beyond the other facility controls and provides the worker with an extra level of Personnel protection. Table 1.6 presents general examples of occupational hazards and types of PPE available for different purposes. Recommended measures for use of PPE in the workplace include:

- Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE is a part of the recurrent training programs for Employees.
- Selection of PPE is based on the hazard and risk ranking described earlier in this section, and selected according to criteria on performance and testing established.

**TABLE - 1.6**

**Summary of Personnel Protective Equipment According To Hazard**

| Objective | Workplace Hazards | PPE |
|---|---|---|
| Eye and face protection | Flying particles, molten metal, liquid chemicals, gases or vapours, light radiation | Safety glasses with side-shields, protective shades, etc. |
| Head protection | Falling objects, inadequate height clearance, and overhead power cords | Plastic helmets with top and side impact protection |
| Hearing protection | Noise, ultra-sound | Hearing protectors (ear plugs or ear muffs) |

| | | |
|---|---|---|
| Foot protection | Failing or rolling objects, points objects. Corrosive or hot liquids | Safety shoes and boots for protection against moving and failing objects, liquids and chemicals |
| Hand protection | Hazardous materials, cuts or lacerations, vibrations, extreme temperatures | Gloves made of rubber or synthetic material (Neoprene), leather, steel, insulation materials, etc. |
| Respiratory protection | Dust, fogs, fumes, mists, gases, smokes, vapours | Facemasks with appropriate filters for dust removal and air purification (chemical, mists, vapours and gases). Single or multi-gas personal monitors, if available |
| | Oxygen deficiency | Portable or supplied air (fixed lines).<br>Onsite rescue equipment |
| Body / leg protection | Extreme temperatures, hazardous materials, biological agents, cutting and laceration | Insulating clothing, body suits, aprons etc. of appropriate materials |

**1.4.6 Measures for Occupational Health Hazards**

- To detect the possible onset of an occupational disease regular monitoring of health status is done/will be done.
- To Check the effectiveness of preventive and control measures are done on regular basis.
- Adequate supplies of potable drinking water is provided from a fountain with an upward jet or with a sanitary means of collecting the water for the purposes of drinking.
- Pre-Employment Medical Examination is being carried out for all new employees and Contract labours.
- Periodic medical hearing checks are performed on workers exposed to high noise levels
- OHS orientation training is provided to all new employees to ensure they are appraised of the basic site rules of work at / on the site and of Personnel protection and preventing injury to fellow employees
- Contractors that have the technical capability to manage the occupational health and safety issues of their employees are hired, extending the application of the hazard management activities through formal procurement agreements.
- Two nos ambulance and fully fledged First aid treatment facilities is provided with OHC.

## 2.0 Need for Disaster Management Plan

Extreme care is essential in handling such chemicals in any form and at all stages of manufacture, processing, treatment, package, storage, transportation, use, collection, destruction, conversion or sale.

Several agencies of the Government, both at the Central and State levels, such as the Directorate of Explosives, the Inspectorate of Factories and Port and Transport Authorities are entrusted with the responsibility of ensuring safe handling and management of hazardous chemicals under acts and rules made for the purpose. In spite of these measures, the possibility of accidents cannot be

ruled out. Human errors and mechanical, electrical, instrumental or system failures have, on occasions, led to severe disasters. Occurrence of fatal accidents makes it essential that the Central and State Governments as well as the local authorities are fully prepared to mitigate the sufferings and meet the eventualities resulting from any unfortunate occurrence of chemical accidents in our country.

Following are the general types of Emergency /Disaster which lead to preparation of disaster management plan:

- Fire in tank area
- Large oil spillage which may escape outside the boundary.
- Major fire / explosion in unit area
- Toxic gas release

## 2.1 Objectives of Disaster Management Plan

"Disaster Management Plan" means a well-coordinated, comprehensive response plan to contain loss of life, property, environment and provide speedy and effective recovery by making the most effective use of available resources in case of a disaster. The purpose of DMP is to give an approach to detail organizational responsibilities, actions, reporting requirements and support resources available to ensure effective and timely management of emergencies associated to production and operations in the site.

*Onsite and offsite emergency plans have been defined, documented and implemented in the industry. Indian Rayon has approved onsite Emergency plan and Offsite Emergency plan and its validity period is one year and it is duly approved by Deputy –Director (Industrial Safety and Health) Government of Gujarat* .They follow these emergency preparedness plans and carryout periodic mock-drills and onsite mock drill every three months & off site Mock drills every year. They have adopted DuPont safety system for safety cultural Transformation .

The overall objectives of DMP are to:

- Ensure safety of people, protect the environment and safeguard commercial considerations.
- Immediate response to emergency scene with effective communication network and organized procedures.
- Obtain early warning of emergency conditions so as to prevent impact on personnel, assets and environment.
- Safeguard personnel to prevent injuries or loss of life by protecting personnel from the hazard and evacuating personnel from an installation when necessary
- Minimize the impact of the event on the installation and the environment, by:
  - Minimizing the hazard as far as possible
  - Minimizing the potential for escalation
  - Containing any release

**2.2 Key Elements**

Following are the key elements of Disaster Management Plan:

- Basis of the plan
- Pre-Emergency Planning
- Accident/emergency response planning procedures
- On-site Disaster Management Plan
- Off-site Disaster Management Plan

**2.3 Basis of the Plan**

Identification and assessment of hazards is crucial for on-site emergency planning and it is therefore necessary to identify what emergencies could arise in production of various products and their storage. Hazard analysis or consequence analysis gives the following results.

- Hazards from spread of fire or release of flammable and toxic chemicals from storage and production units.
- Hazards due to formation of pressure waves due to vapour cloud explosion of flammable gases and oil spill hazards.

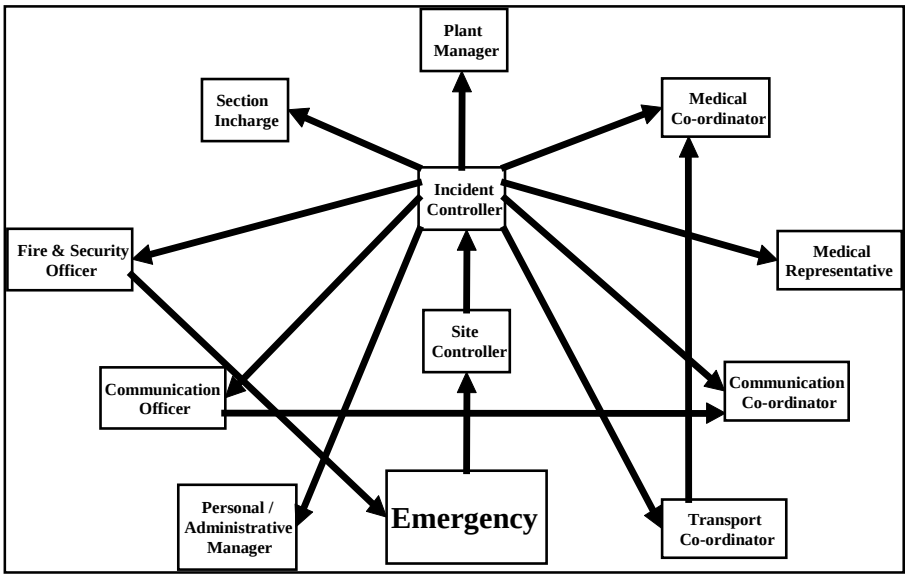
**2.4 Emergency Planning and Response Procedures**

Emergency rarely occur, therefore activities during emergencies require coordination of higher order than for planned activities carried out according to fixed time schedule or on a routine day-to-day basis. To effectively coordinate emergency response activities, an organizational approach to planning is required. The emergency planning includes anticipatory action for emergency, maintenance and streamlining of emergency preparedness and ability for sudden mobilization of all forces to meet any calamity.

**3.0 Onsite Disaster Management Plan**

Onsite Emergency/disaster is an unpleasant event of such magnitude which may cause extensive damage to life and property due to plant emergencies resulting from deficiencies in Operation, Maintenance, Design and Human error, Natural Calamities like Flood, Cyclone and Earthquake; and deliberate and other acts of man like Sabotage, Riot and War etc. An Onsite Disaster may occur all of a sudden or proceeded by a Major Fire.

In order to handle disaster / emergency situations, an organizational chart entrusting responsibility to various personnel of Indian Rayon showing their specific roles are available as shown below.




**Onsite DMP - Disaster Control / Management System**

Following fire protection facilities are available to combat the emergencies and depending upon the type of emergencies any one or combination of the facilities are applied.

- Fire Water System
- Carbon Dioxide System
- Foam System
- First Aid Fire Fighting Equipment
- Mobile Fire Fighting Equipment
- Gas / Fire Detection and Alarm System

### 3.1 Emergency Organization Structure& their Roles and Responsibilities

Following are the key personnel and the units in the plant which are responsible to take appropriate actions during emergencies.

- Overall objectives of an emergency control organization are:
  - To promptly control problems as they develop at the scene.
  - To prevent or limit the impact on other areas and off-site.
  - To provide emergency personnel, selecting them for duties compatible with their normal work functions wherever feasible. The duties and functions assigned to various people, including full use of existing organizations and service groups such as fire, safety, occupational health, medical, transportation, personnel, maintenance, and security.
  - Employees must assume additional responsibilities as per laid down procedure of DMP whenever an emergency alarm sounds.

**Chief Incident Controller (CIC)**

The Chief Incident Controller (CIC) is having overall responsibility to protect personnel, site facilities, and the public before, during, and after an emergency or disaster. The CIC is present at the main emergency control centre for counsel and overall guidance. Responsibilities of the Chief Incident Controller are including the following:

- Preparation, review and updated DMP as per Check List
- Assessment of situation and declaration of emergency
- Mobilisation of main coordinators and key personnel
- Activation Emergency Control Centre
- Taking decision on seeking assistance from mutual aid members and external agencies like Police, Fire Brigade, Hospitals etc.
- Continuous review of situation and decide on appropriate response strategy
- Taking stock of casualties and ensure timely medical attention
- Ensuring correct accounting and position of personnel after the emergency
- Ordering evacuation of personnel as and when necessary
- Taking decision in consultation with District Authorities when an Off-site emergency to be declared

**Site Incident Controller (SIC)**

The Site Incident Controller is identified by the Chief Incident Controller and will report directly to him. SIC is nominated by the entity in each shift 24 hrs. Responsibilities of the Chief Incident Controller include the following

- The SIC maintain a workable emergency control plan, establish emergency control centres, organize and equip the organization with DMP and train the personnel.
- The SIC are capable of making quick decisions and taking full charge.
- The SIC communicate to the Emergency Control Centre where it can coordinated among groups.
- The SIC is responsible for ensuring that appropriate local and national government authorities are notified, preparation of media statements, obtaining approval from the CIC and releasing such statements once approval received.
- The SIC ensure the response to the incidents or the emergencies, as the case may be, is in line with entity procedures, coordinating business continuity or recovery plan from the incident. He must ensure next of kin are notified in a timely manner.
- The SIC co-ordinates if any specialist support is required for the above purpose.
- The SIC decide on seeking assistance of mutual aid members and external agencies like police, fire brigade, hospital etc.

**Fire Safety Coordinator and Fire Team**

Responsibilities of the Fire and Safety Coordinator include the following:

- To activate emergency sirens as per the practiced codes.
- To take charge of all fire fighting and rescue operations and safety matters.
- To ensure that key personnel are called in and to release crew of fire fighting operations as per emergency procedure.
- Assess functioning of his team and communicate with the CIC and or administrative controller for any replenishment or, replacement of manpower or fire fighting equipment.
- Direct the fire brigade personnel and mutual aid members to their desired roles as also proper positioning of the manpower and equipment.
- To decide the requirement of mutual aid and instruct fire station, who, in turn will contact mutual aid members.
- To coordinate with outside fire brigades for properly coordinated fire fighting operation.
- To ensure that casualties are promptly sent to first aid centre / hospital.
- To arrange requirement of additional fire fighting resources including help from mutual aid partners.

**Workers, Contract Labours**

The India Rayon employees, contractors, employees, visitors, etc., (other than emergency response personnel) present at the incident site those are not required to be present at the incident site during the emergency at the site. In the event of declaration of an emergency in the plant/area, these persons quickly assemble at the safe assembly point of the plant/area and respond as instructed by the Site Incident Controller.

**HSE Co-ordinator**

- He will report at the Emergency Control Centre (Primary Command Post) immediately after receiving information about the emergency. He will assist the Chief Incident Controller for taking critical decisions and provide necessary advice and information.
- He will co-ordinate with Key Person (Fire & Safety) and will assist the CIC for providing decision support and resources support to the Key Persons (F&S), as may be necessary.
- He will arrange for mobilizing off-duty fire personnel from their residence; and call other members of the staff for assistance.
- He will co-ordinate with the materials/stores co-ordinator and mobilize additional resources, viz., spillage containment equipment/fire fighting equipment/material, Personnel protective equipment, spare breathing air cylinders, etc., as may be required at the incident site for control measures.
- He will liaise with Factory Inspectorate / Pollution Control authorities in consultation with the Chief Main Controller and provide necessary information. He will also ask for the help, if

necessary to evacuate neighbouring area outside the complex as advised by the Site Main Controller.

- He will organize relieving groups for fire fighting.
- He will also initiate necessary actions to minimise impact on environment.

**Medical Co-ordinator**

The Chief Medical Officer (or the next in command available at site) will be the Medical Co-ordinator and perform the following duties:

- He will contact the Chief Main Controller immediately after receiving the information about the emergency
- He will report immediately at the Emergency Control Centre (Primary Command Post) or OHC as instructed by the Chief Main Controller and contact the Key personnel (Medical) and take stock of the situation
- He will assist and advise the Chief Main Controller in all critical decisions in the area of health/medical services to the affected persons and keep constant liaisons with him
- Organize rescue and first aid arrangements for the affected persons at the site in the "Cold Zone", as may be necessary with essential staff/equipment and post additional ambulance for transporting seriously injured persons
- Ensure that adequate paramedical staff, equipment and medicines are available at the OHC. He will mobilize additional resources from neighbouring industries, if necessary
- To liaise with the Local Medical Authorities and City Hospitals, if the causalities are more and situation demands treatment at additional medical centres.
- To co-ordinate with the Transport Co-ordinator for transporting victims to various hospitals.
- To arrange for additional ambulances from other hospitals /Veraval Municipal Corporation.

**Security Co-ordinator**

The Chief of Security or the next in command available at site &the Security Co-ordinator will have the following duties / responsibilities:

- He will instruct and deploy plant security personnel to ensure that the law and order is maintained; and unnecessary gathering of the personnel at the scene of emergency is prevented and ensure control of traffic movement in and out of the factory areas.
- He will instruct the security personnel / Security Gates to direct and guide external emergency vehicles (Fire tenders/ambulances etc.) called for assistance/help from neighbouring industries/Local administration, to the scene of incident.
- He will instruct security personnel who could be spared to assist Site Incident Controller /Key Personnel (fire and Safety) in fire fighting and evacuation of personnel, at the Incident Site.

- He will take action to regulate traffic movement and prevention of traffic jams inside the works as well as outside the factory gates for proper and speedy movement of the emergency vehicles, ambulances, other vehicles carrying outside resources, etc.
- He will mobilize additional security force for help, as necessary.

**Engineering Co-ordinator**

- He will report to the Chief Main Controller at the Emergency Control Centre (Primary Command Post) immediately after receiving information about On-site emergency.
- He will take stock of the situation and assist/advise the Chief Main Controller in deciding control strategies.
- He will mobilize the team from the Maintenance Dept. to assist the Site Incident Controller in control operation at the Field Command Post.
- Arrange isolation of electrical lines from distribution point/substations as required by the Site Incident Controller by calling the Electrical Engineer / Electricians.
- Provide all other engineering support, as may be required.
- Liaise with Key Personnel (Eng./Maintenance) and co-ordinate with other groups.

**Communication Co-ordinator**

Communication Co-ordinator plays very important part at the time of an emergency particularly when extensive disruption of services takes place. He has the following duties and responsibilities:

- To ensure all available communications links remain functional.
- To quickly establish communication links between the Field command Post and (if this happens to be in remote off site area) and the Primary Command Post.
- To arrange for announcement on the public address system and maintain contacts with congregation points like canteen, main gate, control rooms etc.
- To ensure that previously agreed inventory of various types of communication equipment is maintained in working condition and frequent checks are carried out and records maintained.
- To maintain voice record of significant communications with timings received/passed from the Primary Command Post.

**Transport Co-ordinator**

The Transport Co-ordinator performs the following duties

- Mobilize all available company's vehicles for emergency use along with the drivers.
- Arrange for transport of victims to hospitals/dispensaries.
- Arrange for duty rotation of the drivers to meet the emergency situation.
- To direct refuelling of the vehicles.
- To co-ordinate with the neighbouring industries for additional vehicles / ambulances as may be required.

- To mobilize buses of the RECCS, if necessary.
- To arrange for vehicles from outside local transport agencies, if required.
- To keep in contact with the Chief Main Controller for evacuation of personnel and transportation of victims.

**Media Co-ordinator**

The Media Co-ordinator will co-ordinate the following under the direction of the Chief Main Controller (The Chief Co-ordinator):

- He will liaise with various media and release written statements to the press through prior concurrence of the Chief Co-ordinator.
- He will handle media interview with various media groups make arrangements for televising the information about the incident, the number of casualties, etc.
- He will inform State and Central Government and the statutory bodies of the nature and magnitude of the incident, the number of casualties, etc.
- He will locate himself such that media persons/ third parties do not need to go past the complex security gates and that adequate communication links exists.
- Media personnel often insist on visiting incident scene. He will escort media team(s) If such visits are approved by the Chief Co-ordinator.
- He will be in constant contact with the Medical Co-ordinator, and other co-ordinators to be aware of latest development and closely liaise with the Chief Co-ordinator.

**Materials Co-ordinator**

The Materials Co-ordinator will ensure:

- Availability of the materials required by the Site Incident Controller.
- Arrange issues of materials from the General Stores round-the-clock during an emergency.
- Arrange emergency procurements form local dealers / vendors or from neighbouring industries.
- Arrange transportation of materials from General Store to the Incident Site in co-ordination with the Transport Co-ordinator.

## 3.2 Emergency Control Centre (ECC)

In the event of an emergency, SSM Office will be designated as the Emergency Control Centre, which will be known as the Primary command Post. If, the SSM office is likely to be affected due to unfavourable wind direction or any other reasons, the Emergency Control Centre will be shifted to the Construction Conference Room which will be having necessary facilities to connect communication links as provided in the SSM Office.

### 3.3 Assembly Points

- Two alternate locations for safe assembly points have been earmarked at all the operating plants. These locations are designated for assembling non-essential workers, visitors, and other persons who are not required in the plant site at the time of emergency but they are to be moved to safe places. These locations have been provided with sign boards displaying "Assembly Points" for easy identification.
- The persons required to be assembled at the assembly point is chosen for safer assembly point out of the two, considering the wind direction at that time. The plant control room will also announce the same on the plant PA system, if possible.
- The person assembled at the assembly point to follow the instruction for evacuation of the plant area and move to safe locations as directed. They move in the cross wind direction or up-wind direction, whichever is safer.

## 4.0 Offsite Disaster Management Plan

Emergency is a sudden unexpected event, which can cause serious damage to personnel life, property and environment outside the boundary wall of the refinery as a whole, which necessitate evolving Off-site Emergency Plan to combat any such eventuality. In Offsite disaster management plan, many agencies like Revenue, Public Health, Fire Services, Police, Civil Defence, Home Guards, Medical Services and other Voluntary organization are involved. Thus, handling of such emergencies requires an organized multidisciplinary approach.

Evacuation of people, if required, can be done in orderly way. The different agencies involved in evacuation of people are Civil Administration (both state and central), non Govt. organizations, factory Inspectorate and Police authorities.

Various organizations involved during emergencies are shown below.

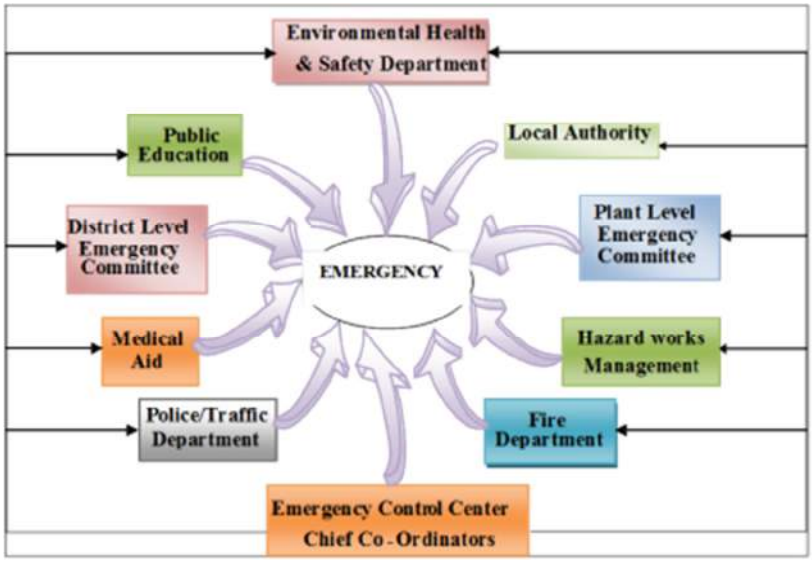



**Figure 1.2: Various Organizations Involved During Emergency**

**4.1 Mock Drills**

As per the Industrial Major Accident Hazard Rules, the occupier has to ensure that a mock drill of the on-site emergency plan is conducted every six months. A detail report of the mock drill conducted under sub-rule (4) is made immediately available to the concerned authority.

Accordingly, Onsite Disaster Mock Drills are conducted once in six months. Also, Major Fire and Minor Fire mock drills are conducted once in three months and one month respectively.

**4.2 All Clear / Re-entry Procedures**

Chief Emergency Controller (CEC) will declare "All Clear" after control of the Incident and arrange measures required for post Disaster control period and ask Fire Station to Blow 2 minutes straight run siren.

After incident normalization, CEC would ask Unit in-charge to visit and check the incident site along with representatives of Inspection and F&S and also Maintenance (Electrical / Mechanical / Civil/ Instrumentation/ Rotary) as needed. Standard Checks particular to a unit will be provided by respective Area Managers.

Based on feedback of the team, CEC would allow re-entry / resumption of operations at the incident site.

**4.3 Evacuation Plan**

To establish method of systematic, safe and orderly evacuation of all the occupants in case of fire or any emergency, in the least possible time, to a safe assembly point through nearest safe means of escape. Additionally to use available fire appliances provided for controlling or extinguishing fire and safeguarding of human life.

**1.7.4 Training**

On job training to the engineers on various facets of risk analysis would go a long way in improving their horizon which in turn is expected to reflect in the operation of plant, especially from the safety stand point. In order to combat with emergency situations arising out of accident release of hazardous chemicals, it is necessary for industries to prepare an exhaustive offsite and onsite emergency preparedness plan. The fire crew belonging to the fire fighting department is given intensive training for the use of all equipment and in various fire fighting methods for handling different types of fires.

**4.5 Voluntary Organizations**

Details of Voluntary organizations, telephone numbers nearby of hospitals, Emergency helpline, resources etc are to be available with chief authorities.

**4.6 Non-governmental Organizations (NGO)**

NGO's could provide a valuable source of expertise and information to support emergency response efforts. Members of NGOs could assist response personnel by performing specified tasks, as planned during the emergency planning process.

- Evacuation of personnel from the affected area.
- Arrangements at rallying posts and parking yards.
- Rehabilitation of evacuated persons.

**4.7 Chemical information**

Details of the hazardous substances (MSDS information) and a summary of the risks associated with them are made available at respective site.

**4.8 Meteorological information**

There are arrangements for obtaining details of weather conditions prevailing at before the time of accident and weather forecasts updates.

**4.9 Humanitarian Arrangements**

Transport, evacuation centres, emergency feeding, treatment of injured, first aid, ambulances, temporary mortuaries are made available at plant site.

**4.10 Public Information**

It includes dealing with the media-press office&Informing relatives, etc.

**4.11 Assessment**

- Collecting information on the causes of the emergency.
- Reviewing the efficiency and effectiveness of all aspects of the emergency plan.

**4.12 Role of local authority**

Local Authorities like Panchayat, Sabha, Samity, Municipalities can help in combating emergency situation after assessing the impact scenario in rescue phase.

**4.13 Role of police**

- The police will assist in controlling of the accident site, organizing evacuation and removing of any seriously injured people to hospitals.
- Co-ordination with the transport authorities, civil defence and home guards.
- Co-ordination with army, navy, air force and state fire services.
- Arrange for post mortem of dead bodies.
- Establish communication centre with easy contact with ECC.

**4.14 Role of Fire Brigade**

The fire brigade is to be organized to put out fires and provide assistance as required during emergency.

**4.15 Role of Media**

The media is to have ready and continuous access to designated officials with relevant information, as well as to other sources in order to provide essential and accurate information to public throughout the emergency and to avoid commotion and confusion.

Efforts are made to check the clarity and reliability of information as it becomes available, and before it is communicated to public.

Public health authorities are consulted when issuing statements to the media concerning health aspects of chemical accidents.

Members of the media are to facilitate response efforts by providing means for informing the public with credible information about accidents involving hazardous substances.

**4.16 Role of health care authorities**

- Hospitals and doctors must be ready to treat all type of injuries to causalities during emergency.
- Co-ordinate the activities of Primary Health Centres and Municipal Dispensaries to ensure required quantities of drugs and equipments.
- Securing assistance of medical and paramedical personnel from nearby hospitals/institutions.
- Temporary mortuary and identification of dead bodies.

**5.0 CONCLUSION**

As discussed in above sections, adequate risk mitigation measures for process are considered for to say that the Existing project is not likely to cause any significant risk to onsite, offsite & environment. In the event of disaster onsite, offsite and all the emergency planning procedures are to be followed so as to minimise the impact on working personnel, plant surrounding and environment. Company has the Risk Management Matrix developed on each aspect covering the Safety, Environment, Health & Business Continuity Aspects and Report on monthly / Quarterly basis to Business Review Council. Du Pont safety system is implemented for plant safety.

**Figure 1.3: Defensive Driving Session for school Students**

**Figure 1.4: Safety Massage by "NUKKAD"**

**Figure 1.5: Training of Standard to Staff, Employee & Contractor with Demonstrations**

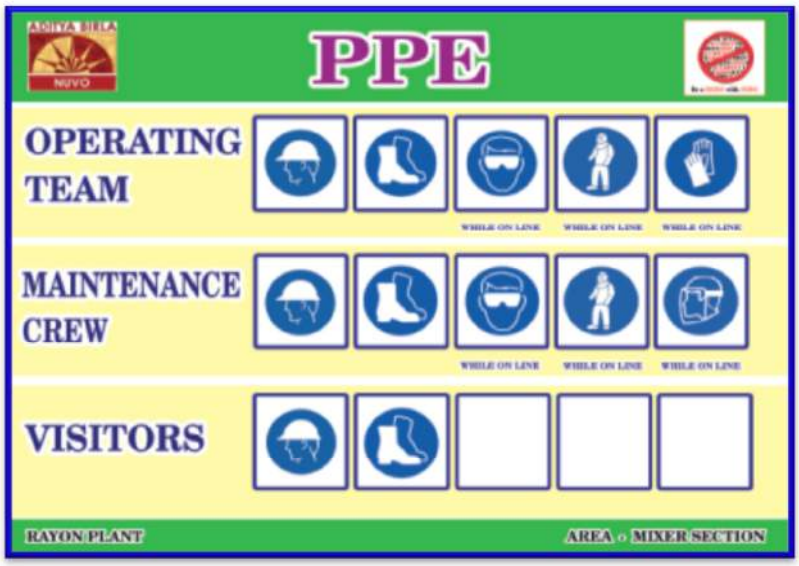



**Figure 1.6: Display area wise PPE Matrix**