CHAPTER – VII
ADDITIONAL STUDIES

7.0 RISK ASSESSMENT

7.1 INTRODUCTION

Risk analysis deals with the identification and quantification of risks, the plant equivalent and personnel are exposed to, due to accidents resulting from the hazards present in the factory.

Hazard analysis involves the identification and quantification of the various hazards (unsafe conditions) Involved in the factory. Both hazard and risk analysis very extensive studies, and require a very detailed design and engineering information.

The various hazard analysis techniques that may be applied are Hazard and Operability (HAZOP) studies, Fault – Tree Analysis (FTA), event –tree analysis and failure and effects mode analysis.

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

K.P.R. Fertilizers Limited is an existing industry operating Single Super Phosphate, NPK mixtures, DCP and Sulphuric acid units at Halvarthi Village, Koppal Taluka, Koppal District, Karnataka. Now the company has proposed to

- Enhance the production capacity of single super phosphate (powdered / granulated)
- Enhance the production capacity of Di-calcium phosphate
- Enhance the production capacity of NPK mixtures
- Manufacture Sulphuric acid and Oleum
- Manufacture Di methyl sulphate (DMS)
- Manufacture Linear Alkyl Benzene Sulphonic Acid
- Generation of Electricity of 1 MW

7.1.2 HAZARDOUS MATERIALS STORAGE AT THE PLANT

Hazardous chemicals are classified as:

⇒ Flammable
⇒ Reactive/ explosive
⇒ Toxic or corrosive

As per Manufacture, storage and Import of Hazardous Chemicals rules 1989 and amendment subsequently, there will be only few hazardous chemicals which have potential for creating risk to life and property in an unlikely event of leakage or spillage followed by fire. The bulk quantities of hazardous chemicals will be stored at the plant in tank farm area with adequate dyke. Other chemicals will be stored in cylindrical tanks, barrels and carboys.

The following are the types of chemicals / substances handled in the proposed project

Toxic: HCl
Corrosive: HCl, Sulphur Trioxide, H₂SO₄, LABSA,
Flammable: Furnace oil, Coal, Methanol, DMS

Above chemicals will be stored at the K.P.R Fertilizers Limited as listed in Table 7.1. These materials will be stored at above ground tanks except Methanol which will be stored in underground tank with MS, CS, MSRL as material of construction with necessary mitigation measures.

### TABLE 7.1

<table>
<thead>
<tr>
<th>S. NO</th>
<th>NAME OF RAW MATERIALS</th>
<th>STORAGE CAPACITY</th>
<th>Flammable : F</th>
<th>Corrosive: C</th>
<th>Toxic : T</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sulphuric acid</td>
<td>5000 MT</td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>2.</td>
<td>Furnace oil</td>
<td>35 MT &amp; 45 MT</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Coal</td>
<td>300 MT</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Methanol</td>
<td>250 m³</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Linear Alkyl Benzene</td>
<td>2 x 100 m³</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Hydrochloric acid</td>
<td>2 x 100 MT</td>
<td>C, T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Di-methyl Sulphate</td>
<td>3 x 50 MT</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>LABSA storage tanks</td>
<td>4 x 50 m³</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Sulphur</td>
<td>8000 MT</td>
<td>C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For the above chemicals / substances, Risk assessment study has been done to determine probable accident scenario.
### LIST OF HAZARDOUS CHEMICALS HANDLING, STORAGE AND TRANSPORTATION (TOR # 35)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Raw materials</th>
<th>Storage</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Methanol</td>
<td>Material will be stored in underground horizontal cylindrical MS Storage tanks as per SMPV Rules at room temperature &amp; atmospheric pressure. Tanks will be grounded by proper earthing.</td>
<td>Tankers</td>
</tr>
<tr>
<td>2.</td>
<td>Linear Alkyl Benzene</td>
<td>Material will be stored in horizontal cylindrical MS Storage tanks at room temperature &amp; atmospheric pressure. Tanks will be grounded by proper earthing.</td>
<td>Tankers</td>
</tr>
<tr>
<td>3.</td>
<td>Sulphuric acid</td>
<td>Material will be stored in Vertical cylindrical MS Storage tanks at room temperature &amp; atmospheric pressure. Tanks will be grounded by proper earthing.</td>
<td>Pipe Line</td>
</tr>
<tr>
<td>4.</td>
<td>Hydrochloric acid</td>
<td>Material will be stored in Vertical cylindrical MS Rubber Lined Storage tanks at room temperature &amp; atmospheric pressure. Tanks will be grounded by proper earthing.</td>
<td>MSRL Tankers</td>
</tr>
<tr>
<td>5.</td>
<td>Di-methyl Sulphate</td>
<td>Material will be stored in Horizontal cylindrical MS Storage tanks at room temperature &amp; atmospheric pressure. Tanks will be grounded by proper earthing.</td>
<td>Tankers</td>
</tr>
<tr>
<td>6.</td>
<td>LABSA storage tanks</td>
<td>Material will be stored in Vertical cylindrical MS Storage tanks at room temperature &amp; atmospheric pressure. Tanks will be grounded by proper earthing.</td>
<td>Tankers</td>
</tr>
<tr>
<td>7.</td>
<td>Furnace oil</td>
<td>Material will be stored in MS Storage tanks at room temperature &amp; atmospheric pressure. Tanks will be grounded by proper earthing.</td>
<td>Through tankers</td>
</tr>
<tr>
<td>8.</td>
<td>Coal</td>
<td>stored in separate stock piles, with proper drains around to collect washouts during the monsoon</td>
<td>Through trucks</td>
</tr>
<tr>
<td>9.</td>
<td>Sulphur</td>
<td>Stored in separate closed shed</td>
<td>Through trucks</td>
</tr>
<tr>
<td>10.</td>
<td>Oleum</td>
<td>Material will be stored in Vertical cylindrical MS Storage tanks at room temperature &amp; atmospheric pressure. Tanks will be grounded by proper earthing.</td>
<td>Through tankers</td>
</tr>
</tbody>
</table>
7.1.2.2 LIST OF HAZARDOUS CHEMICALS WITH THEIR TOXICITY LEVEL

<table>
<thead>
<tr>
<th>Materials</th>
<th>Boiling point Deg C</th>
<th>Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TLV</td>
</tr>
<tr>
<td>Methanol</td>
<td>64.7</td>
<td>260 mg/m³</td>
</tr>
<tr>
<td>Linear Alkyl Benzene</td>
<td>275 to 314</td>
<td>---</td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>290</td>
<td>0.2 mg/m³</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>-85.06</td>
<td>7 mg/m³</td>
</tr>
<tr>
<td>Di-methyl Sulphate</td>
<td>188.8</td>
<td>0.1 ppm TWA</td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>290</td>
<td>0.2 mg/m³</td>
</tr>
<tr>
<td>Furnace oil</td>
<td>151 to 371</td>
<td>100 mg/m³ TWA</td>
</tr>
<tr>
<td>Oleum</td>
<td>315 to 338</td>
<td>0.2 mg/m³</td>
</tr>
</tbody>
</table>

7.1.3 OBJECTIVE OF RISK ASSESSMENT STUDY

M/s K.P.R Fertilizers Limited will engage in handling and storage of hazardous materials which can possess risk to life and properties in an unlikely event of emergency. Therefore, the risk assessment studies have been conducted for identification of hazards, to calculate damage distances, evaluate safety at the plant and to spell out risk mitigation measures to enhance safety at the plant.

7.1.4 SCOPE OF STUDY

The scope of work is to carry out risk analysis for the proposed plant covering all the hazardous chemicals to be handled and stored at the plant. The risk assessment study will cover following aspects:

- Selection of credible scenarios
- Consequences Analysis of selected accidents scenarios
- Review of Safety at the plant
- Risk Mitigation Measures

7.1.5 METHODOLOGY OF STUDY

The risk assessment study broadly comprises of the following steps:
• Identification of hazards
• Selection of Credible Accident Scenarios
• Effect & Consequence Analysis
• Review of Safety at the Plant
• Risk Mitigation Measures

7.1.5.1 IDENTIFICATION OF HAZARDS

Hazards associated at the plant will be identified. Summary of relevant accident cases will be reviewed.

7.1.5.2 SELECTION OF CREDIBLE ACCIDENT SCENARIOS

The release sources and potential accidents scenarios in the plant will be listed. For each selected release source several scenarios may be developed depending upon the failure mode causing loss of containment.

7.1.5.3 EFFECT & CONSEQUENCE ANALYSIS

Effects & consequence distance estimation will be done to determine the potential for damage or injury from the selected scenarios. The incident outcomes will be analyzed using release rate, dispersion, combustion, heat radiation and explosion models from fires. The software “ALOHA” which was developed jointly by National Oceanic and Atmospheric Administration (NOAA) and Environmental Protection Agency (EPA) was employed for analyzing consequences due to hazards identified.

7.1.5.4 SAFETY MEASURES

All the required safety measures will be taken up during handling, storage and disposal which will be as per the norms. All the chemicals / materials will be stored as per the guideline of MSDS of each chemical / material is enclosed as Annexure - XIII

7.1.5.5 RISK MITIGATION MEASURES

Based on hazard identification, consequence analysis, risk reduction measures will be suggested to reduce risk and enhance safety at the plant.

7.1.6 HAZARD IDENTIFICATION

Hazard is defined as a chemical or physical conditions those have the potential for causing damage to people, property or the environment. Hazard identification is the first step in the risk analysis and entails the process of collecting information on:
- The types and quantities of hazardous substances stored and handled at the plant,
- The location of storage tanks & other facilities,
- Potential hazards associated with the spillage and release of hazardous chemicals.

7.1.6.1 HAZARDS DUE TO CHEMICALS

Properties of the hazardous materials proposed to be stored, its possible hazards and mitigation measures are furnished in the Material safety data Sheets issued by CPCB. MSDS sheets are enclosed as Annexure - XIII

Thermal Effects

Thermal radiation effects on stationery objects like piping, equipment or vegetation also need to be evaluated to assess their impacts. Table 7.3 presents the damage effects due to thermal radiation intensities.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Incident Radiation (Kw/m²)</th>
<th>Type of Damage intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>62.0</td>
<td>Spontaneous ignition of wood</td>
</tr>
<tr>
<td>2.</td>
<td>37.5</td>
<td>Sufficient to cause damage to process equipment</td>
</tr>
<tr>
<td>3.</td>
<td>32.0</td>
<td>Maximum thermal radiation intensity allowed on thermally protected adjoining equipment</td>
</tr>
<tr>
<td>4.</td>
<td>25.0</td>
<td>Minimum energy required to ignite wood at infinitely long exposure (non-piloted)</td>
</tr>
<tr>
<td>5.</td>
<td>12.5</td>
<td>Minimum energy required for piloted ignition of wood, melting of plastic</td>
</tr>
<tr>
<td>6.</td>
<td>8.0</td>
<td>Maximum thermal radiation intensity allowed on thermally unprotected adjoining equipment</td>
</tr>
<tr>
<td>7.</td>
<td>4.5</td>
<td>Sufficient to cause pain to personnel if unable to reach cover within 20 seconds, however blistering of skin (1st degree burns).</td>
</tr>
<tr>
<td>8.</td>
<td>1.6</td>
<td>Causes no discomfort on long exposures</td>
</tr>
<tr>
<td>9.</td>
<td>0.7</td>
<td>Equivalent to solar radiation</td>
</tr>
</tbody>
</table>

For continuous presence of persons, the following thermal radiation intensity levels are usually adopted.
1.6 Kw/m² for outside population
4.5 Kw/m² for Plant operators
7.1.6.2 HAZARDOUS SUBSTANCES TO BE HANDLED

The plant will be engaged in handling and storage of various flammable and toxic hazardous materials. The list of flammable and corrosive chemicals are furnished in table No. 7.2

7.1.6.3 HAZARDS DUE TO LOSS OF CONTAINMENT

Most of the flammable chemicals handled and stored at the plant are materials like DMS, Methanol, furnace oil and coal.

In the event of leakage or accidental release of these chemicals, it will create localized effects within the short distances inside the plant in the form of vapour cloud or explosion or thermal radiation. Adequate safety measures including firefighting facilities will be provided as per norms to attend any emergency due to handling and storage of these hazardous chemicals. In the bulk storage of hazardous chemicals adequate size of dykes will be provided for full containment for an unlikely event of leak or spillage. In unlikely event of release, vapour cloud may be formed and move on site or even off site of the plant. Detailed release and consequence computations have been done for potential hazardous chemicals to be handled and stored at the site.

7.1.6.4 RELEASE OF FLAMMABLE MATERIALS

Flammable materials will be stored in tanks of various sizes at the plant to meet the process requirements. Suitable dyke will be provided for containment. At the time of leakage, pool will be formed in dyke and in an unlikely event of fire thermal radiation may cause damage to life and property.

7.1.6.5 EFFECT & CONSEQUENCE ANALYSIS

As a part of risk assessment study, maximum credible accident analysis (MCA) is carried out to determine the maximum loss scenario from this analysis. It is an eventuality which is possible and will have maximum consequential distances for the particular hazardous chemicals under evaluation.

The selection of the accident scenarios is based on the engineering and professional judgment, accident descriptions of the past in similar type of plants & the expertise in risk analysis studies.
7.1.7 MAXIMUM CREDIBLE ACCIDENT SCENARIOS

M/s K.P.R Fertilizers Ltd. will deal with many hazardous substances. Most of hazardous chemicals are not solvents and will not create major threat to life and property in the event of spillage as dykes will be provided for full containment. Subsequently, then consequence will be confined within short distances. For the selection of maximum credible accident scenarios following methodology have been adopted.

7.1.7.1 METHODOLOGY FOR SELECTION OF ACCIDENT SCENARIOS

In this study the following steps were followed for scenario selection for risk analysis study:
Operating and storage conditions of handling and storage of hazardous materials were studied. An assessment was made of what inventories can get released accidentally. From the meteorological data collected, average wind velocity is 1.8 m/s. For risk assessment wind velocity of 2 m/s has been assumed.

7.1.7.2 POSSIBLE HAZARD SCENARIOS

The following hazards have been identified and their consequences are analyzed by employing mathematical models named “ALOHA” which was developed jointly by National Oceanic and Atmospheric Administration (NOAA) and Environmental Protection Agency (EPA).

Probable locations of hazards

1. Failure of 50 MT of DMS storage tank
2. Failure of 50 m³ of Methanol storage tank
3. Leakage of 50 MT of DMS storage tank
4. Leakage of 50 m³ of Methanol storage tank
5. Leakage of 45 MT of Furnace oil tank
6. Failure of 45 MT of Furnace oil tank
### 7.1.7.3 CONSEQUENCE ANALYSIS

Results of Consequence Analysis are furnished below

**Consequence analysis for Vapour Cloud Explosion**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Scenario</th>
<th>Weather</th>
<th>Damage distance (m) for various heat loads</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distance in m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 psi</td>
</tr>
<tr>
<td>1.</td>
<td>Failure of 50 m³ of Methanol storage tank</td>
<td>2F</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3D</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5D</td>
<td>--</td>
</tr>
</tbody>
</table>

**Consequence analysis for Thermal radiation from Pool fire**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Scenario</th>
<th>Weather</th>
<th>Thermal radiation Distance in m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>37.5 Kw/sq.m</td>
</tr>
<tr>
<td>1.</td>
<td>Leakage of 50 MT of Furnace oil tank</td>
<td>2F</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3D</td>
<td>&lt; 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5D</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>2.</td>
<td>Failure of 50 m³ of Methanol storage tank</td>
<td>2F</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3D</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5D</td>
<td>100</td>
</tr>
</tbody>
</table>

**Consequence analysis for Flammable Area of Vapour Cloud**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Scenario</th>
<th>Weather</th>
<th>Lower Explosive Limit Distance in m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>1.</td>
<td>Failure of 50 MT of DMS storage tank</td>
<td>2F</td>
<td>381</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3D</td>
<td>438</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5D</td>
<td>332</td>
</tr>
<tr>
<td>2.</td>
<td>Failure of 50 m³ of Methanol storage tank</td>
<td>2F</td>
<td>297</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3D</td>
<td>293</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5D</td>
<td>235</td>
</tr>
</tbody>
</table>
### 3. Failure of 45 MT of Furnace oil tank

<table>
<thead>
<tr>
<th></th>
<th>2F</th>
<th>220</th>
<th>290</th>
<th>722</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3D</td>
<td>101</td>
<td>134</td>
<td>366</td>
</tr>
<tr>
<td></td>
<td>5D</td>
<td>75</td>
<td>103</td>
<td>306</td>
</tr>
</tbody>
</table>

### Consequence analysis for Toxic area of vapour cloud

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Scenario</th>
<th>Weather</th>
<th>IDLH</th>
<th>Distance in Km.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Failure of 50 MT of DMS storage tank (IDLH – 7 ppm)</td>
<td>2F</td>
<td>&gt; 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3D</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5D</td>
<td>&gt; 10</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Leakage of 50 MT of DMS tank (IDLH – 7 ppm)</td>
<td>2F</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3D</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5D</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Failure of 50 m³ of Methanol storage tank (IDLH – 6000 ppm)</td>
<td>2F</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3D</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5D</td>
<td>1.4</td>
<td></td>
</tr>
</tbody>
</table>

In all the above scenarios the hazard distances are within the plant premises and also out of the Plant premises. The nearest village in the down wind direction is about 3.3 Kms. from the Plant site. All required precautions as specified in the MSDS will be taken in the plant premises to take care of any eventuality.

Material Safety Data Sheets are enclosed as Annexure – XIII.

### 7.1.8 SAFETY MEASURES AT THE PLANT

The following safety measures will be taken to mitigate the potential leaks of Furnace oil tank, Methanol & DMS:

- Level gauges will be provided.
- Scrubber system for the neutralization of vent gases will be provided.
- Required PPEs will be provided to all employees.
- Double drain valve will be provided to sulphuric Acid storage tank.
- Full body protection will be provided to operator.
- Caution note and emergency first aid will be displayed and train for the Safety shower and eye wash will be provided in storage tank area and plant area.
- Total close process will be adopted for Sulphuric acid handling.
- Dyke wall will be provided to storage tank.
Flame proof plant, pumping transfer, close process, etc. will be provided
- Double Static earthing
- Jumper clips on flanges
- Hydrant system
- Fire extinguishers
- Fencing and Smoking will be prohibited area.
- Tanker unloading procedure.
- Flame arrestor will be provided in the venting of off gases.

### 7.1.9 OCCUPATIONAL HEALTH, ENVIRONMENT AND SAFETY POLICY

In large scale industries where multifarious activities are involved during construction, erection, testing, commissioning, operation and maintenance, the men, materials and machines are the basic inputs. Along with the booms, the industrialization generally brings several problems like occupational health and safety. Occupational health needs attention both during construction and operation phases. However the problem varies both in magnitude and variety in the above phases.

The company will prepare Occupational Health, Environment and Safety Policy. The Occupational Health, Environment and Safety Policy will be displayed at prominent locations within the plant premises and will be known to all employees.

#### 7.1.9.1 CONSTRUCTION & ERECTION

The occupational health problems envisaged at this stage will be mainly due to constructional accident and noise.

To overcome these hazards, to reduce it within TLV’S, personnel protective equipments will be supplied to workers.

#### 7.1.9.2 OPERATION & MAINTENANCE

The working personnel will be given the following appropriate personnel protective equipments.

- Industrial Safety helmets
- Crash helmets
- Face shield with replacement acrylic vision
- Zero power plain goggles with cut type filters on both ends
- Zero power goggles with cut type filters on both sides and blue colour glasses
- Welders equipment for eye and face protection
- Cylindrical type earplug
- Ear plugs
- Canister gas masks
- Self contained breathing apparatus
- Leather apron
- Boiler suit
- Safety belt / line man's safety belt
- Leather hand gloves
- Asbestos hand gloves
- Canvas cum leather hand gloves with leather palm
- Industrial safety shoes with steel toe
- Electrical safety shoes without steel toe and gum boots

7.1.9.3 ENVIRONMENT, HEALTH & SAFETY ORGANIZATION

A dedicated Environment, Health & Safety Department will be set up within the plant. The Environment, Health & Safety Department will be empowered to stop the unsafe operating conditions and unsafe acts at the plant.

7.1.9.4 ACCIDENT REPORTING, INVESTIGATION AND ANALYSIS

The accident data will be maintained for reportable and non-reportable accidents. Records for near-miss, incidents and accidents will also be maintained and analyzed to take precautionary measures. The accident statistics and data will be maintained by Environment, Health & Safety Department. Accident statistics and data will be reviewed regularly by senior management.

7.1.9.5 SAFETY INSPECTIONS AND INTERNAL AUDIT

General safety inspections will be carried out regularly. However, there will be system of internal inspection. As per OSHAS requirement, internal safety audit will be conducted once in three months. However, system needs to be initiated for checklist based safety inspection and internal audit.

7.1.9.6 SAFETY EDUCATION AND TRAINING

(a) Training
There will be provision at the plant for induction training for new workers. The selection of trainees and assessment of the training will be done to ensure the effectiveness of training.
(b) Periodic Training / Reporting

The workers are trained as per the needs of training. The training calendar will be prepared for entire year.

(c) Safety Communication / Motivation / Promotion

- There will be a system for safety suggestion schemes at the plant.
- There will be a provision at the plant for the safety contests for motivation of safety.
- The plant will celebrate safety week (4th to 10th of March) to motivate the workers to enhance safety and awareness about health and safety.

FIRST AID

- First aid boxes will be available at plant, one at main gate & others with various departments.

The first-aid room will be available and trained compounders will be employed in each shift at the plant.

7.1.9.7 OCCUPATIONAL HEALTH SURVEILLANCE(TOR # 42 & 43)

Occupational Health Surveillance (OHS) shall be undertaken as regular exercise for all the employees specifically for those engaged in handling hazardous substances. Occupational health centre for medical examination of employees with all the basic facilities will be established within the plant.

- Medical officer will visit the plant at regular intervals.
- All the first aid facilities shall be provided in the Occupational Health Centre.
- The medical records of each employee shall be maintained separately.
- Emergency vehicle (Ambulance) will be available round the clock to take care of the emergencies.
- Required number of oxygen cylinders will be made available at the Occupational Health Centre.
- All required personal protection equipments will be provided to keep the chemicals exposure within PEL / TLV.
- Liver function tests will be carried out during pre-placement & periodical examination

FIRE PROTECTION

- Adequate fire fighting facilities will be made available at the plant, including, dry chemical powder type, water CO₂ type, mechanical foam type, CO₂ type
and sand buckets.

- The fire fighting system and equipment will be tested and maintained as per relevant standards.
- The fire drills will be conducted once in six months.

GENERAL WORKING CONDITIONS

(a) House Keeping

- Good housekeeping practices will be maintained.
- Sufficient disposable bins will be clearly marked and these are suitably located in the plant.
- Walkways will be free from obstructions.
- Roads within the plant will be maintained neat and clean.

(b) Noise

- Noise generating source like Turbo Generator, Boiler and Compressors will be identified as high noise generating sources.
- Following engineering and administrative will be implemented to reduce noise exposure below the permissible limits:
  - Noise generating sources will be located at isolated place.
  - Ear plug and ear muff will be provided to personnel engaged in high noise area
- There will be a system of subjecting all those workers to periodic audiometric test, who work in high-level noise areas.
- Personal protective equipment (PPEs) along with ear muffs/plugs are provided and mostly used by workers.

(c) Illumination

Adequate illumination will be provided in the plant.

7.1.9.8 HAZARDOUS IDENTIFICATION AND CONTROL

- All the hazardous areas will be identified in the plant.
- Adequate risk mitigation measures will be taken to mitigate these hazards.
- Safety inter-locks, alarms and trip system will be provided in process area.
- For any modification, approval of the concerned competent authority will be taken.
7.1.9.9 SAFE OPERATING PROCEDURES

Safe operating procedures will be made available for all operations. No contractor worker will be allowed to process and operation activities without proper training.

7.1.10 RISK REDUCTION MEASURES
7.1.10.1 GENERAL RISK MITIGATION/REDUCTION MEASURES

For risk mitigation/reduction, attempts will be made to either reduce inventories that could get released in the event of loss of containment or failure likelihood’s or both as feasible. Risk analysis identifies the major risk contributors, which enables prioritization of the plant that deserve special attention in terms of inspection and maintenance in particular and over all safety management as a whole.

For the risk reduction at the plant, the following salient suggestions and recommendations are made:

- Personnel especially contractor workers at the plant should be made aware about the hazardous substance stored at the plant and risk associated with them.
- A written process safety information document may be compiled for general use.
- The document compilation should include an assessment of the hazards presented including (i) toxicity information (ii) permissible exposure limits. (iii) Physical data (iv) thermal and chemical stability data (v) reactivity data (vi) corrosion data (vii) information on process and mechanical design.
- The process design information in the process safety information compilation must include P & IDs/PFDs; process chemistry; maximum intended inventory; acceptable upper and lower limits, pressures, flows and compositions and process design and energy balances.
- The adequate numbers of heat, smoke, chlorine gas detectors (near chlorine storage area) may be provided at strategic locations in the plant and indication of detectors/sensors should be provided in main control room.
- Predictive and preventive maintenance schedule should be prepared for equipment, piping, pumps, etc. and thickness survey should be done periodically as per standard practices.
- Safe work practices should be developed to provide for the control of hazards during operation and maintenance.
- Personnel engaged in handling of hazardous chemicals should be trained to
respond in an unlikely event of emergencies.

- The plant should check and ensure that all instruments provided in the plant are in good condition and documented.
- Safety measures in the form of DO and Don't Do should be displayed at strategic locations especially in Telugu and English languages.

7.1.10.2 HANDLING OF HAZARDS

- Personal protective equipment used by the workers during handling of hazardous chemicals, should be replaced after certain time.
- If any spillage of hazardous chemicals, it should be cleaned and disposed as per standard practices.
- Empty drums of hazardous chemicals should be neutralized immediately.
- Workers engaged in handling of hazardous chemicals should be made aware of properties of hazardous chemicals.

7.1.10.3 GENERAL WORKING CONDITIONS

(a) House Keeping

- All the passages, floors and stairways should be maintained in good conditions.
- The system should be available to deal with any spillage of dry or liquid chemical at the plant.
- Walkways should be always kept free from obstructions.
- In the plant, precautions and instructions should be displayed at strategic locations in Telugu and English Languages.
- All pits, sumps should be properly covered or securely fenced.

(b) Ventilation

- Adequate ventilation should be provided in the work floor environment.
- The work environment should be assessed and monitored regularly as local ventilation is most effective method for controlling dust and gaseous emissions at work floor.

7.1.10.4 SAFE OPERATING PROCEDURES

- Safe operating procedures should be available for all the process operations and equipment.
- The workers should be informed of consequences of failure to observe the safe operating procedures.
• Safe operating procedures should be formulated and updated, specific to process & equipment and distributed to concerned plant personnel.
• Safety procedure near Cylinders should be prepared and displayed meticulously in Telugu and English languages.

7.1.10.5 WORK PERMIT SYSTEM
Work permit system should be followed at the plant during maintenance periods.

7.1.10.6 FIRE PROTECTION
The fire fighting system and equipment should be tested and maintained as per relevant standards.

7.1.10.7 STATIC ELECTRICITY
• All equipment and storage tanks/containers of flammable chemicals should be bounded and earthed properly.
• Electrical pits should be maintained clean and covered.
• Electrical continuity for earthling circuits should be maintained.
• Periodic inspections should be done for earth pits and record should be maintained.

7.1.10.8 MATERIAL HANDLING
• The workers should be made aware about the hazards associated with manual material handling.
• The workers should be made aware and trained about the use of personal protective equipment (PPE) while handling hazardous chemicals.

7.1.10.9 COMMUNICATION SYSTEM
Communication facilities should be checked periodically for its proper functioning.

7.1.10.10 SAFETY INSPECTIONS
The system should be initiated for checklist based routine safety inspection and internal audit of the plant. Safety inspection team should be formed from various disciplines and departments.

7.1.11 PREDICTIVE AND PREVENTIVE MAINTENANCE
Predictive and preventive maintenance schedule will be followed in religious manner.
7.1.11.1 INSPECTION FOR HOUSE KEEPING

Weekly plant inspection schedule may be prepared comprising 2-3 members team. Observations of inspection should be recorded and compliance report should be forwarded to higher management.

7.1.11.2 ELECTRICAL SAFETY

- Proper ventilation should be provided in MCC room.
- Insulation pad at HT panels should be replaced at regular interval.
- Proper housekeeping in MCC room should be maintained for safe working conditions.

7.1.11.3 COLOUR CODING SYSTEM

Colour coding for piping and utility lines should be followed in accordance with IS: 2379:1990.

7.1.11.4 SAFETY AT PLANT GATE

At Security gate, system for safety briefing to visitors may be introduced, while they are entering in the plant. A system of frisking of truck drivers and truck cabins may be introduced to ensure they are not carrying mobile, match box, etc. in the plant.

7.2 DISASTER MANAGEMENT PLAN

7.2.1 INTRODUCTION

An emergency is said to have arisen when operators in the plant are not able to cope with a potential hazardous situation i.e. loss of control of an incident causes the plant to go beyond its normal operating conditions, thus creating danger. When such an emergency evolves, chain of events which affect the normal working within the factory area and/or which may cause injuries, loss of life, substantial damage to property and environment both inside and around the factory take place and a DISASTER is said to have occurred.

K.P.R Fertilizers Ltd has proposed to enhance the production capacity of Single Super Phosphate, Di-calcium Phosphate and NPK mixtures and manufacture Di methyl sulphate (DMS) Linear Alkyl Benzene Sulphonic Acid in the existing plant premises.

As described previously the risk assessment studies have been conducted for
identification of hazards, to calculate damage distances and to spell out risk mitigation measures. Despite of our best efforts in the way of managing an emergency situation lies in the prevention of any risk hazards from the manufacturing process or material handling, things can go wrong. Therefore, it is essential to plan and develop the support system, which will be required in case an emergency arises.

7.2.2 OBJECTIVES OF THE PLAN

Following are the Objectives of the disaster management plan:

1. To define and assess emergencies, including risk and environment impact assessment.
2. To reduce possibilities of accident.
3. To safeguard employees, visitors and other people in the vicinity.
4. To minimize damage to property and/or the environment.
5. To inform employees, general public and the authorities about the hazards/risk assessed, safeguard provided, residual risk if any and the role to be played by them in the event of emergency.
6. To be ready for the mutual aid if need rises to help the neighbouring unit.

Normal jurisdiction of an On-site Emergency Plan is the own premises only, but looking to the time factor in the arriving the external help of off-site plan agency, the jurisdiction must be extended outside to the extent possible in case of emergency occurring outside.

7. To inform authorities and mutual aid centres to come for help.
8. To affect rescue and treatment of casualties to the injured.
9. To identify and list any causalities.
10. To inform and help relatives.
11. To secure the safe rehabilitation of affected area and to restore normalcy.
12. To provide authoritative information to the news media.
13. To preserve records, equipment, etc., and to organize investigation into the cause of the emergency and preventive measure to stop its recurrence.
14. To insure safety of the works before personal re-enter and resume work.
15. To work out a plan with all provisions to handle emergencies and to provide for emergency preparedness and the periodical rehearsal of the plan.

The structure of the plan may vary depending on number of employees, materials and processes, availability of resources, location of site, size and complexity of work. The plan should not be complicated. Instructions should not overlap or create any confusion. Responsibilities should be clearly assigned and should be workable
smoothly. For clear understanding and quick action, the action (Role) by each individual (his emergency duty) should be prepared in a booklet or card size and given to him.

7.2.3 IDENTIFICATION OF MAJOR HAZARDS

The major hazardous fields where disaster management plant is required are as under,

- Bursting of high-pressure steam pipe, vessels, etc. due to abnormal pressure rise
- Fire hazard due to ignition of fuel
- Inhalation of any hazardous chemical

7.2.4 SCOPE OF PLAN

- The plan will set into action immediately after a fire or other hazard occurs in and around the plant
- Fuel storage facility is situated away from the manufacturing plant and fulfilling all rules and regulations
- All the electrical fittings are of explosion proof fittings
- All necessary fire-fighting arrangements have been provided near the storage area

7.2.5 THE AVAILABILITY, ORGANIZATION AND UTILIZATION OF RESOURCES AND FACILITIES FOR EMERGENCIES

In order to maintain an emergency response capability, certain facilities must be kept in a state of readiness and sufficient supplies and equipment must be available. In some cases, it may be impossible to maintain all of the equipment necessary for all possible emergencies. In these cases, agreements will be made with neighbouring facilities to provide additional support as and when necessary.

Where the local police or private agencies may be called upon, such as volunteer fire companies and ambulance associations, agreements will be developed ahead of time.

Emergency hardware can be classified according to its use during the response operations.

Typical examples are:

- Emergency operation centres
- Communication equipment
- Alarm system
- Personal protection equipment
- Fire fighting facilities, equipment and supplies
- Spill and vapour release control equipment and supplies
- Medical facilities, equipment and supplies
- Monitoring systems
- A media Centre
- Transportation system
- Security and access control equipment

Some of these resources will also be available in the local municipalities. It is the responsibility of the plant management to ensure that the appropriate equipments and materials are available to respond to their very hazard-specific emergencies at the facilities, independently from external resources. These resources can be extremely valuable, but should be used mainly in support of the main response actions that the facility personnel will have to implement in case of a serious emergency.

In any case, the availability of resources within the community must be determined beforehand, so that these resources can be mobilized, if the time comes to do so.

7.2.5.1 RESPONSE ORGANIZATION STRUCTURE

To set up a response organization structure necessary for chain of commands during emergency situation, which may arise in the premises is one of the most important objectives of emergency plan, which is briefly described hereunder.

7.2.5.2 FUNCTIONS AND RESPONSIBILITIES

The main key person of the emergency plan is Chief Emergency Co-coordinator (Factory Manager / Plant Head). He shall be assisted by,

- Emergency Plant Coordinator, Chief (Production)
- Material Management Coordinator, Chief (Commercial)
- Special Job Coordinator, Chief (Administration)

Chief Emergency Coordinator

He shall be responsible for

- Essential communications
- Public relations
- Transportation
- Investigation and reports
- Alert the hospital authorities
7.2.5.3 EMERGENCY PLANT COORDINATOR (CHIEF – PRODUCTION)

Rush to the site of emergency on receipt of information. Direct plant operation/shut-down operations as needed to control situation. Guide the Shift Production Officer and members of the Emergency Squad in fire fighting/rescue operations. Arrange for any additional fire fighting/safety equipment, which may be required at the site.

Keep in constant touch with the Chief Emergency Coordinator and pass on all relevant and necessary information to him so as to enable him to keep in touch with concerned authorities. Keep in touch with the other coordinators for requirement of any services like external help, communication, transportation, etc. Arrange for replacement/refilling of used up fire fighting equipment’s or gas masks/canisters so as to make these available at the site at the earliest. Carry out investigation of the accident and assist in filling of statutory reports as required. Carry out preliminary investigation into the accident with the help of concerned personnel. Preserve records/evidence that may be required for investigation.

7.2.5.4 MATERIAL MANAGEMENT COORDINATOR (CHIEF-COMMERCIAL)

Rush to the site of emergency. Keep the stores open for emergency issue of any items that may be required for control of emergency. In case some material is not available, arrange for its emergency purchase. Keep contact with other coordinators to assess any requirements in terms of material. Arrange for any trucks/trolleys, which may be required for transportation of materials.

Keep in constant touch with the Chief Emergency Coordinator. Assess the situation in consultation with the Chief Emergency Coordinator and other coordinators. Arrange to get maintenance mechanics along with their toolboxes to provide help in any isolation/repair work as may be required. Arrange for requisite number of contractor workmen in case any additional help is required. Arrange for the Shift Electrician and get power supply to the affected area which will be isolated, if required. Make arrangements for temporary lighting/emergency lighting at the affected area, as required. In case of a power failure, ensure the running of the DG sets and uninterrupted power supply to emergency facilities.

7.2.5.5 SPECIAL JOB COORDINATOR (CHIEF – ADMINISTRATION)

Rush to the site of emergency. Assess the situation in consultation with Emergency Plant Coordinator to provide help as may be required. Keep in constant touch with the Chief Emergency Coordinator. Assess the situation in consultation with Chief Emergency Coordinator. Attend to all emergencies related communications at the
Security gate. Arrange for all Security Guards at their respective post and in case of the availability of some spare Security Guards, they may be sent to site of emergency to assist emergency Squad in fire fighting/rescue operations. Monitor closely all movements at the gate keeping passage clearance for movement of emergency vehicles. No visitors should be allowed to come inside the premises during the period of emergency.

Assess the law and order situation inside/outside the premises and take necessary action accordingly. Proper vigilance to be maintained to avoid any attempts from inside/outside saboteurs. Arrange to keep the emergency vehicles and ambulance ready with their drivers for any movement of personnel/material. Arrange for canteen services for the personnel on duty and in the affected area. In case of any injuries, provide necessary first aid and arrange for shifting of the injured personnel to the nearby hospitals as the case may be. Attend to any external calls/telephones relating to information about emergency. In case of need from other emergency coordinators at site, arrange to inform external agencies like fire Brigade, Police station Ambulance and other Medical Services. Arrange for filling of statutory report that may be required.

7.2.5.6 EMERGENCY RESPONSE CENTRE

The place identified As Emergency Response Center will be considered as the Security Gate Office.

The location of Emergency Response Center may change in future as per convenience. The facilities available at the Emergency Response Center shall include:

- Internal Telephone
- External Telephone
- Manual Fire/Emergency Siren
- Siren Actuation Switch
- Important Addresses and Telephone Numbers
- Emergency Vehicles
- Confined Space Entry Procedure
- List of antidote/actions to be taken in case of exposure to hazardous Chemicals/ materials.
- Material Safety Data Sheets of chemicals
- A copy of On-Site Disaster Management Plan

All communications after General Shift working hours and on Sundays / Holidays are to be routed through the Security Gate Office.
7.2.5.7 GENERAL RULES

1. Follow sense of discipline and do not panic.
2. Do not rush and endanger your personal safety.
3. Use personnel protective equipment according to the situation.
4. Do not block any passages which may hinder the movement of emergency Vehicles.
5. In case you have to shut down your plant operations, do it in an orderly Manner as per standard operating procedures.
6. In situation when you have to leave your work and evacuate to identify places out of operating areas, do it in an orderly manner.
7. Follow instructions of the Emergency Coordinators.
8. Understand the disaster management plan well and take interest in practice drills.

7.2.5.8 EMERGENCY SQUAD

There is a group of personnel (5-10 in number) who will be identified to handle any emergency situation. These personnel includes officers from various operating areas and will be imparted extensive training in fire fighting, material safety data for hazardous chemicals, rescue operations, decontamination procedures, confined space entry procedures, first aid and other related functions. The members will be so chosen that at any given time at least 2–3 members of Emergency Squad will be available in the premises.

7.2.5.9 COMMUNICATION SYSTEM

Intercom telephone points shall be provided at all critical areas of operations. An Emergency Telephone shall be available at the Emergency Response Center. In addition, telephone connections shall be provided at the residence of all critical personnel to ensure immediate contact.

7.2.6 POST EMERGENCY – RECOVERY

When an emergency is over, it is desirable to carry out a detailed analysis of the causes of accidents to evaluate the influence of various factors involved and to propose methods to eliminate or minimize them in future. Simultaneously, the adequacy of the disaster preparedness plan will be evaluated and any shortcomings will be rectified.
### 7.2.6.1 ACCIDENT INVESTIGATION

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<tbody>
<tr>
<td>A</td>
<td>As soon as possible, after the emergency is over and plant operation has become normal, the investigation will be carried out to determine the cause of the event.</td>
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<td>B</td>
<td>Representatives from various disciplines will be members of the investigating team.</td>
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<tr>
<td>C</td>
<td>The area of the event will be sealed off so that tampering or alteration of the physical evidence will not occur.</td>
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<tr>
<td>D</td>
<td>Key components will be photographed and logged with time, place, direction, etc.</td>
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<tr>
<td>E</td>
<td>Statements will be taken from those who were involved with the operation or who witnessed the event.</td>
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### 7.2.6.2 DAMAGE ASSESSMENT

This phase of recovery establishes the quantum of replacement machinery considered necessary for bringing back the plant to normal operation, property and personnel losses, and culminates in a list of necessary repair, replacement and reconstruction work. Insurance companies will be informed of the damage and requested to pay the compensation as per claim.

### 7.2.6.3 CLEANUP AND RESTORATION

This phase will only begin after the investigation is complete. Reporting documentation will be prepared and forwarded to appropriate authorities. Repairs, restoration and cleanup will begin. Insurance claims will be prepared and submitted.

### 7.3 SOCIAL IMPACT ASSESSMENT

The local areas will be benefited by way of generation of employment opportunities, increased demand for local products and services. There will be an overall improvement in the income level of the local people.

The project creates employment to about 50 persons once the plant is commissioned and for 400 persons during construction stage. Priority will be given to locals for Semi-Skilled and Unskilled workers. With the development of this Plant there will be lot of scope for more industrial investments which in turn will benefit the nation.

The project proponent intends to provide welfare activities recreational facilities in the surrounding villages once the plant commences production. The project proponent
intends to conduct regular health checkups in the surrounding villages. Therefore there will be a certain enhancement of educational and medical standards of people in the study area. There will be generally positive and beneficial impacts by way of economic improvements, transportation, aesthetic environment and business generation. There will be an overall upliftment of socio-economic status of people in the area.

7.4 R & R ACTION PLAN

There is no habitation in the proposed plant site. Hence no Rehabilitation & Resettlement Action Plan has been envisaged in the proposed expansion project.