RISK ASSESSMENT & DISASTER MANAGEMENT PLAN FOR PROPOSED SSP PLANT AT KHARAGPUR

M/s. ISIKA FERTILIZER LIMITED
MR. GOPAL KUMAR SANEI
DIRECTOR
PODDAR POINT, 1ST FLOOR, BLOCK-A, 113,
PARK STREET, KOLKATA,
WEST BENGAL

MANTEC CONSULTANTS PVT LTD
Environment Division,
D-36, Sector-6, Noida-201 301, (U. P)
Ph: 0120-4215000, Fax: 0120-4215809,
# Table of Contents

1. RISK ANALYSIS
   1.1 Introduction
   1.2 Scope of Study
   1.3 Objective
   1.4 Philosophy
   1.5 Methodology
   1.6 Introduction of the Unit
   1.7 Hazard Identification
   1.8 Hazardous Materials to be Stored at the Plant
   1.9 Consequence Analysis
   1.10 RISK REDUCTION MEASURES
   1.10.1 Design
   1.10.2 Safety Devices
   1.10.3 Storage Tanks
   1.10.4 Pumps
   1.10.5 Pipelines
   1.10.6 Operation and Maintenance
   1.11 Recommendations
   1.12 Occupational Exposure Mitigation Planning
   1.13 Other Recommended Measures for Safe Operation of the Plant
   1.14 Personal Protective Equipment
   1.15 Handling of Hazards
   1.15.1 General Working Conditions at the Proposed Plant
   1.15.2 House Keeping
   1.15.3 Ventilation

---

RA/DMP REPORT OF PROPOSED SINGLE SUPER PHOSPHATE PROJECT M/s ISHIKA FERTILIZERS LIMITED'S
1.15.4 Safe Operating Procedures ........................................................................... 21
1.15.5 Work Permit System ................................................................................... 21
1.15.6 Fire Protection ............................................................................................ 21
1.15.7 Static Electricity ......................................................................................... 21
1.15.8 Material Handling ...................................................................................... 22
1.15.9 Communication System ............................................................................ 22
1.15.10 Safety Inspections ................................................................................... 22
1.15.11 Safe Operating Procedures ...................................................................... 22
1.15.12 Predictive and Preventive Maintenance .................................................. 22
1.15.13 Electrical Safety ....................................................................................... 22
1.15.14 Colour Coding System ............................................................................. 23

2 DISASTER MANAGEMENT PLAN ...................................................................... 24
2.1 Disaster Management Plan ............................................................................. 24
2.2 Onsite Emergency Plan ................................................................................ 24
  2.2.1 Objectives of Onsite Emergency Plan ....................................................... 24
  2.2.2 During an Emergency ............................................................................... 24
  2.2.3 During Normal Time ............................................................................... 24
  2.2.4 Scope of OSEP ....................................................................................... 25
2.3 Elements of Onsite Emergency Plan ............................................................. 25
2.4 Methodology .................................................................................................. 25
2.5 Emergencies Identified ................................................................................ 26
2.6 Others ............................................................................................................ 26
2.7 Emergency Organisation ............................................................................... 26
2.8 Emergency Facilities ..................................................................................... 26
  2.8.1 Emergency Control Centre (ECC) ............................................................. 26
  2.8.2 Facilities Proposed To Be Maintained At Emergency Control Centre (ECC) ......................................................................................... 26
  2.8.3 Fire Fighting Facilities .............................................................................. 27
  2.8.4 Fire Protection Systems .......................................................................... 27
  2.8.5 Hydrant System ....................................................................................... 28
2.9 Emergency Escapes ....................................................................................... 28
2.10 Assembly Point ............................................................................................ 29
2.11 Wind Sock .................................................................................................... 29
List of Tables
Table 1: Coordinates of Project site  .................................................................................. 3
Table 2: Operational detail .................................................................................................. 3
Table 3: Properties of Hazardous material ......................................................................... 5
Table 4: Safety measure of the tank .................................................................................... 6
Table 5: Fire Explosion and toxicity Indices of H$_2$SO$_4$ .................................................... 7
Table 6: Acute Exposure Guideline levels of Sulfuric Acid ................................................... 8
Table 7: Action required in case of Exposure ..................................................................... 9
Table 7: Emergency contact Number .................................................................................. 29

List of Figures
Figure 1: Risk assessment Methodology ........................................................................... 2
Figure 2: Spill pool evaporation through sulphuric acid storage Tank No.1 catastrophic Rupture .. 13
Figure 3: Spill pool evaporation through sulphuric acid storage Tank No.2 catastrophic rupture.... 14
EXECUTIVE SUMMARY

Ishika Fertilizers Limited was incorporated on 26th September, 2011 as a Public Limited Company under the companies Act 1956. The Company is promoted by Sanei group of companies. The group has a manufacturing unit of NPK mixture fertilizers in the name & style as G. S. Fertilisers Ltd. in Burdwan district of W. Bengal. The group has business interest in dealing with Maruti Car through its subsidiary Sanei Motors Pvt. Ltd. The company is managed by its directors for day to day operations.

Ishika Fertilizers Limited propose to establish and operate facilities for manufacturing granulated single super phosphate (SSP) in a plot of land located at Mantageria, Chakturia and Sanmaninathpur Villages in Paschim Medinipur District of W. Bengal near NH-60, at a distance of approximately 9 kms from Kharagpur. The project proposal pertains to establish facilities for manufacturing 400 TPD (1,20,000 TPA) Granulated Single Super Phosphate and 200 TPD (60,000 TPA) Sulphuric acid. The main raw materials for manufacture of SSP are Sulphuric acid and rock phosphate. The project will utilize imported/indigenous rock phosphate, whereas sulphuric acid will be manufactured internally from elemental sulphur. Approximately 40,000 TPA of the acid will be consumed for manufacture of SSP, and the balance will be sold out in market. The heat generated during various reactions involved in manuafacturing sulphuric acid from elemental sulphur will be utilised for steam generation and steam will be utilised for power generation (approx. 1.5 MW).

Recommendations

From the Risk Analysis studies conducted, it would be observed that by and large, the risks are confined within the factory boundary walls in case of acid tank rupture. To minimize the consequential effects of the risk scenarios, following steps are recommended.

- The plants will meet provisions of the The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2009, & the factories Act, 1948.
- Air line respirator provision to be made in sulfuric acid storage tank farm area.
- Dyke wall and collection pit with drain valve needs to be provided in acid storage area.
- Periodic on-Site Emergency Mock Drills and occasional Off-Site Emergency Mock Drills to be conducted, to train the staffs and to maintain a state of preparedness to tackle any emergency.
• Emergency handling facilities to be maintained in ready-to-use condition at all time.
• Safe operating procedure to be prepared for hazardous and material handling processes.
• Safety devices and control instruments to be calibrated once in a year.
• Proper colour work as per IS 2379 to plant pipeline and tank, equipments to be done once in a six month to protect from corrosion.
• Permit to work system to be implemented 100% for hazardous work in the plant.
• Safety manual as per Rule-68 K & P and Public awareness manual as per 41 B & C, be prepared and distributed to all employees and nearby public.
• As per Scenario for Leakage from sulphuric acid storage tanks, it has been observed that AEGL-1 (0.2 mg/m³) distance extends up to 140m from the tank farm, which lies within the factory premises. Hence, evacuation plans up to 150m needs to be prepared for employees in downwind direction in case of extreme accident scenario.
• Manual call points for fire location identification to be installed in plant premises.
• For proposed plant Fire & Safety organization setup to be established and maintained for better plant process safety.
• Induction safety course to be prepared and trained all new employees before starting duties in plant.

Double drain valve will be provided to sulphuric acid storage tank.
Full body protection will be provided to operators.
Caution note and emergency first aid will be displayed.
All employees will be trained for use of emergency first aid.
Safety shower and eye wash will be provided in storage tank area and plant premises.
Total close process will be adopted for Sulphuric acid handling.
Dyke wall will be provided to storage tank. Acid resistant tiling in dyke flooring and inside dyke walls and acid resistant painting on tank foundation will be provided.
Tanker unloading procedure will be prepared.
SOP (Standard Operating Procedure) will be adopted for sulphuric acid handling.
Training programme will be conducted for safe handling and emergency handling of Sulphuric Acid to all concerned personnel including tanker drivers and security.
In Storage Tank Area, caution board with safety message for ‘acid on reaction with water generates fumes and avoid such practice’ should be displayed.
Suitable extinguishing media-Extinguish with dry powder / sand. Do not use water.
Fire and explosion hazards-Not flammable. May evolve toxic fumes in fire (sulphur oxides).
Personal protective equipment- Emergency Responders must use fresh-air supplied breathing apparatus, eye protection, acid resistant hand gloves, helmet and chemical protection suit.
Use acid neutralizing Diphoterine for personnel exposed to acid to protect against burns.
Spillage protection: Do not let this chemical enter the environment. Collect the acid from dyke in tank.
Evacuate danger area, do not absorb in saw-dust or other combustible absorbents.
Use lime for neutralizing the acid spillages/ leakages.
1.1 Introduction

Ishika Fertilizers Limited was incorporated on 26th September, 2011 as a Public Limited Company under the companies Act 1956. The Company is promoted by Sanei group of companies. The group has a manufacturing unit of NPK mixture fertilizers in the name & style as G. S. Fertilisers Ltd. in Burdwan district of W. Bengal. The group has business interest in dealing with Maruti Car through its subsidiary Sanei Motors Pvt. Ltd. The company is managed by its directors for day to day operations.

Ishika Fertilizers Limited propose to establish and operate facilities for manufacturing 400 TPD granulated single super phosphate (SSP) in a plot of land located at Mantageria Chakturia and Sanmaninathpur Villages in Paschim Medinipur District of W. Bengal near NH-60, at a distance of approximately 9 kms from Kharagpur. The project proposal also includes a 200 TPD Sulphuric acid plant (raw material for SSP), 1.5 MW captive power generations based on waste heat recovery boilers and a 500 KVA DG Set for emergency power.

1.2 Scope of Study

Mantec Consultants Pvt. Ltd, D-36, Sector-6, NOIDA (U.P.) is appointed for carrying out the Risk Assessment study. The objective of the Risk Assessment study is to identify vulnerable zones, major risk contributing events, understand the nature of risk posed to nearby areas and in addition, the Risk Assessment study is also necessary to ensure compliance to statutory rules and regulations.

1.3 Objective

The main objectives of the Risk Assessment (RA) study is to determine damage due to major hazards having damage potential to life & property and provide a scientific basis to assess safety level of the facility.

The principle objective of this study was to identify major risks in the manufacture of chemicals and storage of hazardous chemical at site and to evaluate on-site & off-site consequences of identified hazard scenarios. Pointers are then given for effective mitigation of hazards in terms of suggestions for effective disaster management, suggesting minimum preventive and protective measures & change of practices to ensure safety.

1.4 Philosophy
This report is limited to the following:

- Hazard identification taking recourse to hazard indices, inventory analysis, natural hazard probability etc.
- Maximum Credible Accident (MCA) analysis is to identify potential hazardous scenarios.
- Consequence analysis of failure and accidents resulting in fire, explosion, hazardous release etc.
- Assessment of risk on the basis of the above evaluation.

1.5 Methodology

The procedure used for carrying out the Risk Assessment Study is outlined below:

Identify Credible Loss Scenarios for the facility under the study by discussion with Isika Fertilizer. Simulate loss Scenarios to determine the vulnerable zones for toxic dispersion, Suggest mitigating measures to reduce the damage, considering all aspects of the facilities. The flowchart of the methodology for the present study is shown in Figure-1:

![Figure 1: Risk assessment Methodology](image-url)
1.6 Introduction of the Unit

M/s. Ishika Fertilizer Ltd. is operating and manufacturing unit of Single Super Phosphate. The project pertains to establishment of facilities for manufacturing of 400 TPD or 120,000 TPA of granulated single super phosphate. For smooth operation of the project, a 200 TPD (60,000 TPA) sulphuric acid (H₂SO₄) plant is also proposed.

As significant heat is generated during conversion of sulphur to SO₂ and also SO₂ to SO₃, captive power generation to the tune of approx. 1.5 MW, based on waste heat recovery boilers, is also proposed.

Ishika Fertilizer’s Surrounding area is located adjacent to NH-60, approximately 9 kms away from Kharagpur. Elevation of the plot varies from 28 m above MSL.

Ishika Fertilizer unit having Geo-code is follows as in Table -1

<table>
<thead>
<tr>
<th>Direction</th>
<th>NE</th>
<th>NW</th>
<th>SW</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude (N)</td>
<td>22°16’22.70”</td>
<td>22°16’23.82”</td>
<td>22°16’15.19”</td>
<td>22°16’16.66”</td>
</tr>
<tr>
<td>Longitude (E)</td>
<td>87°23’37.92”</td>
<td>87°23’23.47”</td>
<td>87°23’25.62”</td>
<td>87°23’37.85”</td>
</tr>
</tbody>
</table>

1.6.1 Detail of Operation

This project will consist of following plants given in Table-2.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Plant Detail</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sulphuric acid plant</td>
<td>200 TPD or 60,000 TPA</td>
</tr>
<tr>
<td>2.</td>
<td>Single superphosphate plant</td>
<td>400 TPD or 120,000 TPA</td>
</tr>
<tr>
<td>3.</td>
<td>SSP granulation plant</td>
<td>400 TPD or 120,000 TPA</td>
</tr>
<tr>
<td>4.</td>
<td>Electric power from WHR boilers</td>
<td>1.5 MW</td>
</tr>
</tbody>
</table>

The Sulphuric acid plant will be provided with waste heat recovery boilers and the generated steam will be utilized for power generation (approx 1.5 MW) to meet the electric requirement of the plant and facilities. Surplus Sulphuric acid, to the tune of approximately 52 TPD will be sold to other user industries in the area.

The SSP and granulation plants will have rated capacities to produce 20 TPH or 400 TPD of product (running 20 hours per day and 300 days per year). Thus, the plant will produce 120,000 TPA granulated SSP.
1.6.2 Population Detail

Unit: Ishika Fertilizer
Skilled Employee – 61 People / Shift
Semi-Skilled and Un-Skilled Employee – 12 People / Shift
Semi-Skilled and Un-Skilled Employee (Contract Basis) – 37 People / Shift (Approx.)
Total Required people in project site – 110 People / Shift

Additionally, approx. 200 semi-skilled and un-skilled persons from the local population will be engaged in loading, unloading, transportation and service sector. The proposed project will provide employment opportunities to approx 300 persons from the neighbouring population.

1.7 Hazard Identification

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

1.8 Hazardous Materials to be Stored at the Plant

Only major hazardous chemical to be stored at the project site is spent sulphuric acid with specific gravity 1.84.
The acid plant’s total capacity of 200 TPD or 60,000 TPA.

1.8.1 Characteristics of Hazardous Materials

Important characteristics of the hazardous material (i.e. sulphuric acid) has been presented below-

1.8.2 Associated Hazards

Hazards associated with the use and storage of sulphuric acid has been presented in the following Table-3.
### Table 3: Properties of Hazardous material

<table>
<thead>
<tr>
<th>SR. No</th>
<th>NAME OF CHEMICAL</th>
<th>HAZARD</th>
<th>FLASH POINT 0°C</th>
<th>BP 0°C</th>
<th>LEL %</th>
<th>UEL %</th>
<th>SP.GR. 20 0°C</th>
<th>VD</th>
<th>SOLUBILITY WITH WATER at 20 0°C</th>
<th>NFPH</th>
<th>FR</th>
<th>HAZARDOUS COMBUSTION PRODUCT</th>
<th>TLV PPM</th>
<th>TWA</th>
<th>IDL H PPM</th>
<th>LC50 mg/m³</th>
<th>CARCINOGENIC CHARACTERISTI C</th>
<th>ANTIDOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sulfuric Acid</td>
<td>C</td>
<td>--</td>
<td>340</td>
<td>--</td>
<td>--</td>
<td>1.84</td>
<td>--</td>
<td>Water reactive</td>
<td>3 0 2</td>
<td></td>
<td>Non combustible</td>
<td>1 mg/m³</td>
<td>15</td>
<td>mg/m³</td>
<td>510 mg/m³</td>
<td>No</td>
<td>Sodium Hydro-Carbonate (4% Conc.), Milk, Lime Juice, Milk of Magnesia.</td>
</tr>
</tbody>
</table>

F = FIRE, T = TOXIC, E = Explosive, C=Corrosive,  R = REACTIVE, BP = BOILING POINT, LEL = LOWER EXPLOSIVE LIMIT, UEL = UPPER EXPLOSIVE LIMIT, SP.GR = SPECIFIC GRAVITY, VD = VAPOUR DENSITY, ER = EVAPORATION RATE, H = HEALTH HAZARD, CLASS F = FIRE HAZARD, CLASS R = REACTIVE HAZARD, BR = BURNING RATE, TLV = THRESHOLD LIMIT VALUE, PPM = PARTS PER MILLION, STEL = SHORT TERM EXPOSURE LIMIT, NFPA = NATIONAL FIRE PROTECTION ASSOCIATION-USA
Table 4: Safety measure of the tank

<table>
<thead>
<tr>
<th>NAME OF HAZARDOUS SUBSTANCE</th>
<th>MAX. STORAGE CAP.[Qty.]</th>
<th>PLACE OF IT’S STORAGE</th>
<th>OPERATING PRESSURE AND TEMP.</th>
<th>TYPE OF HAZARD</th>
<th>CONTROL MEASURE PROVIDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphuric Acid</td>
<td>820 MT X 2 Nos. tank</td>
<td>MS A/G Tank</td>
<td>Atmospheric Ambient</td>
<td>Corrosive</td>
<td> Level gauge provided.&lt;br&gt; Scrubber provided.&lt;br&gt; Required PPEs provided to all employees.&lt;br&gt; Double drain valve will be provided to sulfuric Acid storage tank.&lt;br&gt; Full body protection will be provided to operator.&lt;br&gt; Caution note and emergency first aid will be displayed and train for the same to all employees.&lt;br&gt; Safety shower and eye wash will be provided in storage tank area and plant area.&lt;br&gt; Total close process will be adopted for Sulfuric acid handling.&lt;br&gt; Dyke wall will be provided to storage tank.</td>
</tr>
</tbody>
</table>
Table 5: Fire Explosion and toxicity Indices of H₂SO₄

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Material Stored</th>
<th>Storage Qty.</th>
<th>Nh</th>
<th>Nf</th>
<th>Nr</th>
<th>MF</th>
<th>GPH</th>
<th>SPH</th>
<th>FEI</th>
<th>Degree of hazard</th>
<th>Radius of expo. (ft.)</th>
<th>Th</th>
<th>Ts</th>
<th>TI</th>
<th>Degree of Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sulfuric acid</td>
<td>820 MT x 2 Tanks</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>2.9</td>
<td>3.3</td>
<td>9.57</td>
<td>Low hazard for fire</td>
<td>8</td>
<td>250</td>
<td>125</td>
<td>27.00</td>
<td>Severe</td>
</tr>
</tbody>
</table>

FEI = MF x GPH x SPH  
TI = Th/100 + Ts x (1 + GPH tot + SPH tot)  
Nh = NFPA Health rating GPH = General Process Hazard  
Nf = NFPA Fire rating SPH = Special Process Hazard  
Nr = NFPA Reactive rating FEI = Fire Explosion Index  
MF = Material Factor Th = Penalty Factor  
Ts = Penalty for Toxicity TI = Toxicity Index
### Table 6: Acute Exposure Guideline levels of Sulfuric Acid

<table>
<thead>
<tr>
<th>Sulfuric acid</th>
<th>7664-93-9 (Interim)</th>
<th>(mg/m³) 11/30/06</th>
<th>10 min</th>
<th>30 min</th>
<th>60 min</th>
<th>4 hr</th>
<th>8 hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEGL 1</td>
<td>0.20 mg/m³</td>
<td>0.20 mg/m³</td>
<td>0.20 mg/m³</td>
<td>0.20 mg/m³</td>
<td>0.20 mg/m³</td>
<td>0.20 mg/m³</td>
<td></td>
</tr>
<tr>
<td>AEGL 2</td>
<td>8.7 mg/m³</td>
<td>8.7 mg/m³</td>
<td>8.7 mg/m³</td>
<td>8.7 mg/m³</td>
<td>8.7 mg/m³</td>
<td>8.7 mg/m³</td>
<td></td>
</tr>
<tr>
<td>AEGL 3</td>
<td>270 mg/m³</td>
<td>200 mg/m³</td>
<td>160 mg/m³</td>
<td>110 mg/m³</td>
<td>93 mg/m³</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: US EPA

<table>
<thead>
<tr>
<th>Types of Hazard / Exposure</th>
<th>Acute Hazards / Symptoms</th>
<th>Prevention</th>
<th>First Aid / Fire Fighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>Not combustible. Many reactions may cause fire or explosion. Gives off irritating or toxic fumes (or gases) in a fire.</td>
<td>No contact with flammable substances. No contact with combustibles.</td>
<td>No water. In case of fire in the surroundings: powder, foam, carbon dioxide</td>
</tr>
<tr>
<td>Explosion</td>
<td>Risk of fire and explosion on contact with base(s), combustible substances, oxidants, reducing agents or water.</td>
<td></td>
<td>In case of fire: keep drums, etc., cool by spraying with water but No direct contact with water.</td>
</tr>
</tbody>
</table>
### Table 7: Action required in case of Exposure

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Effect</th>
<th>Prevent generation of mists! Avoid all contact!</th>
<th>In all cases consult a doctor!</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhalation</strong></td>
<td>Corrosive. Burning sensation. Sore throat. Cough. Laboured breathing. Shortness of breath. Symptoms may be delayed (see Notes).</td>
<td>Ventilation, local exhaust, or breathing protection.</td>
<td>Fresh air, rest. Half-upright position. Artificial respiration may be needed. Refer for medical attention.</td>
</tr>
<tr>
<td><strong>Eyes</strong></td>
<td>Corrosive. Redness. Pain. Severe deep burns.</td>
<td>Face shield or eye protection in combination with breathing protection.</td>
<td>First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.</td>
</tr>
<tr>
<td><strong>Ingestion</strong></td>
<td>Corrosive. Abdominal pain. Burning sensation. Shock or collapse.</td>
<td>Do not eat, drink, or smoke during work.</td>
<td>Rinse mouth. Do not induce vomiting. Refer for medical attention.</td>
</tr>
</tbody>
</table>
## 1.9 Consequence Analysis

### Damage risk criteria for SO$_3$/acid mist vapour

<table>
<thead>
<tr>
<th>Risk category</th>
<th>Associated risks for 60 minute exposure</th>
<th>Concentration, mg/m$^3$</th>
<th>Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AEGL-1</strong></td>
<td>Airborne concentration, expressed as parts per million or milligrams per cubic meter (ppm or mg/m$^3$) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.</td>
<td>0.2</td>
<td>140</td>
</tr>
<tr>
<td><strong>AEGL-2</strong></td>
<td>Airborne concentration (expressed as ppm or mg/m$^3$) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.</td>
<td>8.7</td>
<td>17</td>
</tr>
<tr>
<td><strong>AEGL-3</strong></td>
<td>Airborne concentration (expressed as ppm or mg/m$^3$) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.</td>
<td>160</td>
<td>&lt;10</td>
</tr>
</tbody>
</table>

### SITE DATA:

Location: KHARAGPUR, INDIA,

Building Air Exchanges per Hour: 0.65 (unsheltered single storied)

### CHEMICAL DATA:

Warning: OLEUM can react with water and/or water vapor. This can affect the evaporation rate and downwind dispersion. ALOHA cannot accurately predict the air hazard if this substance comes in contact with water.

Chemical Name: OLEUM

Solution Strength: 4% (by weight)
Ambient Boiling Point: 218.9° C
Partial Pressure at Ambient Temperature: 5.93e-004 atm
Ambient Saturation Concentration: 595 ppm or 0.060%
Hazardous Component: SULFUR TRIOXIDE
Molecular Weight: 80.06 g/mol
AEGL-1 (60 min): 0.2 mg/(cu m)
AEGL-2 (60 min): 8.7 mg/(cu m)
AEGL-3 (60 min): 160 mg/(cu m)

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 2.5 m/s from SW at 3 meters
Ground Roughness: open country
Cloud Cover: 5 tenths
Air Temperature: 35° C
Stability Class: D
Relative Humidity: 60%

SOURCE STRENGTH:
Evaporating Puddle
Puddle Area: 25 square meters
Puddle Mass: 300 kilograms
Ground Type: Concrete
Ground Temperature: 35° C
Initial Puddle Temperature: Ground temperature
Release Duration: ALOHA limited the duration to 1 hour
Max Average Sustained Release Rate: 16.1 grams/min (averaged over a minute or more)
Total Amount Hazardous Component Released: 953 grams
THREAT ZONE:

Model Run: Gaussian

Red: less than 10 meters (10.9 yards) --- (160 mg/(cu m) = AEGL-3 (60 min))
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.
Orange: 17 meters --- (8.7 mg/(cu m) = AEGL-2 (60 min))
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.
Yellow: 140 meters --- (0.2 mg/(cu m) = AEGL-1 (60 min))
Scenario: Spill pool evaporation through sulphuric acid storage Tank No. 1 Leakage.

Figure 2: Spill pool evaporation through sulphuric acid storage Tank No. 1 Leakage
- **Scenario:** Spill pool evaporation through sulphuric acid storage Tank No.2 Leakage

**Figure 3:** Spill pool evaporation through sulphuric acid storage Tank No.2 catastrophic rupture
1.10 RISK REDUCTION MEASURES

Some of the safeties and risk reduction measures adopted and recommended for the safety of the plant are as follows:-

1.10.1 Design

- During the design stage itself adequate care has been taken for design, selection, fabrication, erection and commissioning of Flammable and toxic liquid / gas handling facilities and other equipment, piping, pipe fittings, electrical equipment etc. relevant and prevalent international and Indian standards has been followed for design, fabrication, inspection of the storage tanks and other equipment.

- Civil foundations are suitably designed to take care of earthquakes, cyclones, landslides, flooding, collapse of structures etc.

- Plant operator and staffs are selected well experience and qualified for chemical plant operation.

- All key personals are trained for emergency handling procedures and regular Mock- Drills has been conducted on various scenarios.

1.10.2 Safety Devices

Following safety devices are provided to protect from any malfunctioning of plant equipments.

1.10.3 Storage Tanks

- Level gauges on storage tanks.
- Static bonding of pipeline flanges.
- Dyke wall provided surround above ground storage tanks.
- All pipeline and tanks painted as per IS colour code.
- Caution note and Material identification, capacity displayed on all storage tanks.
- Matur curtain sprinkler will be provided for Acid storage tanks leakage spillage.
- Moisture absorbent (Silica gel provision will be made on sulfuric storage tanks).
1.10.4 Pumps

Required outlet valve on pump outlet.

1.10.5 Pipelines

- Jumper connections on flanges to prevent build up of static electricity charge.
- Proper supports and clamping are provided
- Double earthing provided to all electrical motors.
- Colour code as per IS maintained.

1.10.6 Operation and Maintenance

Operations and maintenance of the plant is being in accordance with the well-established safe practices. Some of the guidelines are as follows:-

- Periodic testing of hoses for leakages and continuity.
- Annual testing of all safety relief valves.
- Planned preventive maintenance of different equipment for their safety and reliable operations.
- Inspection of the storage tanks as per prefixed inspection schedule for thickness measurement, joint and weld efficiency etc.
- Comprehensive color code scheme to identify different medium pipes.
- Strict compliance of safety work permit system.
- Proper maintenance of earth pits.
- Strict compliance of security procedures like issue of identify badges for outsiders, gate pass system for vehicles, checking of spark arrestors fitted to the tank lorries etc.
- Strict enforcement of no smoking regime.
- Periodic training and refresher courses to train the staff in safety, fire fighting and first aid.

1.11 Recommendations

From the Risk Analysis studies conducted, it would be observed that by and large, the risks are confined within the factory boundary walls in case of acid tank rupture. To minimize the consequential effects of the risk scenarios, following steps are recommended.

- Plant should meet provisions of the Manufacture, storage & Import of Hazardous Chemicals Rules, 1986 & the factories Act, 1948.
• Sprinkler opening valve location needs to be relocating away from the EO storage tanks.
• Air line respirator provision to be made in sulfuric acid storage tank farm area.
• React with water and generate toxic fumes while contact with water caution note to be displayed in Acid tank farm area.
• Dyke wall and collection pit with drain valve needs to be provided in acid storage area.
• Periodic on-Site Emergency Mock Drills and occasional Off-Site Emergency Mock Drills to be conducted, so those staffs are trained and are in a state of preparedness to tackle any emergency.
• Emergency handling facilities to be maintained in tip top condition at all time.
• Safe operating procedure to be prepared for hazardous process and material handling process.
• Safety devices and control instruments to be calibrated once in a year.
• Proper colour work as per IS 2379 to plant pipeline and tank, equipments to be done once in a six month to protect from corrosion.
• Permit to work system to be implemented 100 % for hazardous work in the plant.
• Safety manual as per Rule-68 K & P and Public awareness manual as per 41 B & C, be prepared and distributed to all employees and nearby public.
• As per Scenario for Catastrophic Failure of storage tanks, it has been observed that AEGL distance cover surrounding 1.7 kilometers distance. But the concentration is very low i.e. 0.2 mg/m³ Hence, population evacuation plan up to 100 m. needs to be prepared for nearby factories in upwind direction in case of extreme accident scenario i.e. 8.7 mg/m³.
• Manual call points for fire location identification to be installed in plant premises.
• For proposed plant Fire & Safety organization setup to be replanted for better plant process safety.
• All Acid vents to be connected with scrubber system.
• Induction safety course to be prepared and trained all new employees before starting duties in plant.

Based on the outcome of the risk assessment, following recommendation has been made to avoid any risk associated with the storage and use of sulphuric acid in the plant:

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.

All employees will be trained for use of emergency first aid.

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. Acid resistant tiling in dyke flooring and inside dyke walls and acid resistant painting on tank foundation will be provided.
Tanker unloading procedure will be prepared.
SOP will be prepared for sulphuric acid handling.
Training programme will be conducted for safe handling and emergency handling of sulphuric acid to all concerned personnel including tanker drivers and security.
In Storage Tank Area, caution board with safety message for ‘acid on reaction with water generates fumes and avoid such practice’ should be displayed.
Suitable extinguishing media: Extinguish with dry powder / sand. Do not use water.
Fire and explosion hazards: Not flammable. May evolve toxic fumes in fire (sulphur oxides).
Personal protective equipment: Emergency Responders must use fresh-air supplied breathing apparatus, eye protection, acid resistant hand gloves, helmet and chemical protection suit.
Use acid neutralizing Diphoterine for personnel exposed to acid to protect against burns.
Spillage protection: Do not let this chemical enter the environment. Collect the acid from dyke in tank.
Evacuate danger area, do not absorb in saw-dust or other combustible absorbents.
Use lime for neutralizing the acid spillages/ leakages.

1.12 Occupational Exposure Mitigation Planning

To control any occupational health and safety impact a detailed planning for mitigation measures has been done in the design stage of the project. Apart from the occupational exposure mitigation plans for various activities and work areas of hazards, following administrative control measures will be followed:
All the employees will be trained for EHS policies.
Health check-up for Contractor personnel – Yearly
Health check-up for Employees-
All the Emergency Responders have been trained for Basic life support, first aid, Basic fire safety and emergency preparedness.
Ambient air quality monitoring in every month at 3 locations.
Monthly monitoring of environmental parameters such as stack emissions and domestic treated waste water.
Safety display boards provided throughout the plant.
Monthly fire extinguisher inspection.
Work permit system.
PPE adherence.
Waste management and hazardous waste handling.
Safe lifting operation.
Industrial hygiene.

1.13 Other Recommended Measures for Safe Operation of the Plant

In addition to the specific recommendations made in the above section for storage and handling of sulphuric acid within the plant premises, for safe operation of the plant and risk reduction, following 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) corrosivity 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, detectors 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 Hindi and English language.
The present DO’s and DON’T's followed in their other units/ factories is given as Annexure-II as checklist in the form of do's and don'ts of preventive maintenance, strengthening of HSE, manufacturing utility staff for safety related measures.

1.14 Personal Protective Equipment

Personal protective equipments (PPEs) are devices that are fitted and issued to each worker personally for his or her exclusive use. They are intended for temporary use and emergency response action only. If a worker must enter a confined space / contaminated area, he must wear adequate protective equipment. Employees should be taught when and how to use respiratory apparatus (SCBA) provided, and how to recognize defects in the equipment. Without SCBA entry into the confined space / contaminated area should not be attempted.

Keep personal protective equipment where it can be accessed quickly, outside the hazardous material storage area and away from areas of likely contamination.

Each employee should maintain his personal protective equipment in clean, working condition at all times.

All equipment should be used and maintained in accordance with the manufacturer's instructions.

Equipment installed for body and eye wash should be checked properly for round the clock operation.

1.15 Handling of Hazards

Some of the measures employed in handling of hazards:

Personal protective equipment used by the workers during handling of hazardous chemicals, should be replaced after getting defective.

If any spillage of hazardous chemicals, it should be cleaned and disposed as per standard practiced.

Empty drums of hazardous chemicals should neutralize immediate.

Workers engaged in handling of hazardous chemicals should be made aware of properties of hazardous chemicals.

1.15.1 General Working Conditions at the Proposed Plant

1.15.2 House Keeping

The House Keeping practices employed would be:

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, precaution and instructions should be displayed at strategic locations in Hindi and English Languages. All pits, sumps should be properly covered or securely fenced.

1.15.3 Ventilation

The Ventilation measures that would be employed:
Adequate ventilation would be provided in the work floor environment.
The work environment would be assessed and monitored regularly as local ventilation is most effective method for controlling dust and gaseous emissions at work floor.

1.15.4 Safe Operating Procedures

Other operation procedures followed would be:
Safe operating procedures will be available for mostly all materials, operations and equipment.
The workers will be informed of consequences of failure and strongly emphasized to observe the safe operating procedures.

1.15.5 Work Permit System

Work permit system will be followed at the plant during maintenance.

1.15.6 Fire Protection

For fire protection the measures taken are:
The fire fighting system and equipment will be tested and maintained as per relevant standards.
Smoke detectors will be provided at the plant and shall be calibrated and maintained properly.
Smoking and carry ignitable material, match boxes are not allowed inside factory premises.

1.15.7 Static Electricity

The general instructions for working with static electric are:
All equipment and storage tanks/containers of flammable chemicals shall be bounded and earthed properly.
Electrical pits shall be maintained clean and covered.
Electrical continuity for earthing circuits shall be maintained.
Periodic inspections shall be done for earth pits and record shall be maintained.

1.15.8 Material Handling

For material handling the regulatory measures that are taken for workers handling various materials would include:
The workers shall be made aware about the hazards associated with manual material handling.
The workers shall be made aware and trained about the use of personal protective equipment (PPE) while handling hazardous chemicals.

1.15.9 Communication System

Communication facilities such as PA system, landlines extension and emergency numbers and walkie-talkie shall be checked periodically for its proper functioning.

1.15.10 Safety Inspections

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

1.15.11 Safe Operating Procedures

Safe operating procedures should be formulated and updated, specific to process & equipment and distributed to concerned plant personnel.

1.15.12 Predictive and Preventive Maintenance

Predictive and preventive maintenance schedule shall be followed in religious manner.

1.15.13 Electrical Safety

For electric safety provisions to be taken care of are:
Insulation pad at HT panels shall be replaced at regular interval.
Housekeeping in MCC room shall be kept proper for safe working conditions.
First Aid training and First Aid charts will be provided at all electrical control centres.
1.15.14  Colour Coding System

Colour coding for piping and utility lines shall be followed in accordance with IS: 2379:1990.
2 DISASTER MANAGEMENT PLAN

2.1 Disaster Management Plan

An onsite emergency in the industries involving hazardous processes or in hazardous installations is one situation that has potential to cause serious injury or loss of life. It may cause extensive damage to property and serious disruption in the work area and usually, the effects are confined to factory or in several departments of factory, premise. An emergency begins when operator at the plant or in charge of storage cannot cope up with a potentially hazardous incident, which may turn into an emergency.

2.2 Onsite Emergency Plan

2.2.1 Objectives of Onsite Emergency Plan

A quick and effective response at during an emergency can have tremendous significance on whether the situation is controlled with little loss or it turns into a major emergency. Therefore, purpose an emergency plan is to provide basic guidance to the personnel for effectively combating such situations to minimize loss of life, damage to property and loss of property. An objective of Emergency Planning is to maximize the resource utilization and combined efforts towards emergency operations are as follows.

2.2.2 During an Emergency.

- To increase thinking accuracy and to reduce thinking time.
- To localize the emergency and if possible eliminates it.
- To minimize the effects of accident on people and property.
- To take correct remedial measures in the quickest time possible to contain the incident and control it with minimum damage.
- To prevent spreading of the damage in the other sections.
- To mobilize the internal resources and utilize them in the most effective way
- To arrange rescue and treatment of causalities.

2.2.3 During Normal Time.

- To keep the required emergency equipment in stock at right places and ensure the working condition.
- To keep the concerned personnel fully trained in the use of emergency equipment.
- To give immediate warning to the surrounding localities in case of an emergency situation arising.
- To mobilize transport and medical treatment of the injured.
- To get help from the local community and government officials to supplement manpower and resources.
- To provide information to media & Government agencies, Preserving records, evidence of situation for subsequent emergency etc.

2.2.4 Scope of OSEP

This OSEP is prepared for industrial emergencies like fires, explosions, toxic releases, and asphyxia and does not cover natural calamities and societal disturbances related emergencies (like strikes, bomb threats, civil commission’s etc.)

2.3 Elements of Onsite Emergency Plan

- The important elements to be considered in plan are
- Emergency organization
- Emergency Facilities.
- Roles and Responsibilities of Key Personnel and Essential Employee.
- Communications during Emergency
- Emergency Shutdown of Plant & Control of situation.
- Rescue Transport & Rehabilitation.
- Developing Important Information.

2.4 Methodology.

The consideration in preparing Emergency Plan will be included the following steps:

- Identification and assessment of hazards and risks.
- Identifying, appointment of personnel & Assignment of Responsibilities.
- Identification and equipping Emergency Control Centre.
- Identifying Assembly, Rescue points Medical Facilities.
- Formulation of plan and of emergency sources.
- Training, Rehearsal & Evaluation.
- Action on Site.
2.5 Emergencies Identified

Emergencies that may be likely at bulk fuel storage area, process plant, cylinder storage area, and drum storage shed, and autoclave reactor area. There are chances of fire and explosive only.

2.6 Others

Other risks are earthquake, lightning, sabotage, bombing etc., which are usually, not in the purview of management control.

2.7 Emergency Organisation.

Emergency Organization is constituted towards achieving objectives of this emergency plan. Plant Manager is designated as Overall in Charge and is the Site Controller. The following are designated as Incident Controllers for respective areas under their control. Shift in charge Engineer (Plant Operations) is designated at Incident Controller for all areas of plant.

- Factory Manager
- Production Manager
- Maintenance Manager
- Shift Chemists
- Operators

2.8 Emergency Facilities

2.8.1 Emergency Control Centre (ECC)

It is a location, where all key personnel like Site Controller; Incident Controller etc. can assemble in the event of onset of emergency and carry on various duties assigned to them. Plant Manager’s Office is designated as Emergency Control Centre. It has P&T telephone as well as internal telephones, ECC is accessible from plant located considerably away from process plant, Storage’s and on evaluation of other locations, Plant Manager’s Room find merit from the distance point of view, communication etc.

2.8.2 Facilities Proposed To Be Maintained At Emergency Control Centre (ECC)

The following facilities and information would be made available at the ECC Latest copy of Onsite Emergency Plan and off sites Emergency Plan (as provided by District Emergency Authority).
- Intercom Telephone.
- P&T Telephone.
- Telephone directories (Internal, P&T)
- Factory Layout, Site Plan
- Plans indicating locations of hazardous inventories, sources of safety equipment, hydrant layout, location of pump house, road plan, assembly points, vulnerable zones, escape routes.
- Hazard chart.
- Emergency shut-down procedures.
- Nominal roll of employees.
- List and address of key personnel
- List and address of Emergency coordinators.
- List and address of first aides,
- List and address of first aid fire fighting employees,
- List and address of qualified Trained persons.

2.8.3 Fire Fighting Facilities.

- Internal hydrant system
- Portable extinguishers

2.8.4 Fire Protection Systems

- These systems are proposed to protect the plant by means of different fire protection facilities and consist of
- Hydrant system for exterior as well as internal protection of various buildings/areas of the plant.
- Portable extinguishers and hand appliances for extinguishing small fires in different areas of the plant.
- Water cum foam monitor to be provided in bulk fuel storage area.
- Fire water pumps.
- Two (2) independent motor driven pumps each of sufficient capacity and head are proposed for the hydrant systems which is capable to extinguish Fire or cooling purpose.
**Fire Order:**

- Any person who notices an outbreak of fire or abnormal release of flammable toxic/corrosive material will:
  - Immediately inform the fire station on phone/ walkie-talkie or break the glass of nearest manual call point.
  - Give exact location of fire and if possible inform nature of fire i.e material involved or call for ambulance if there are possibilities of injury/causality.
  - In case you are trained in fire fighting, try to control the fire using nearby fire extinguishing appliances (Extinguisher).
  - Removal of flammable/combustible material surrounding the fire area to prevent the propagation of fire.
  - Inform the HOD/Incharge of the area and all concerned persons.
  - No one shall switch on/off power in the vicinity of flammable vapour area.
  - Barricade the affected area to prevent crowding of unauthorized persons.
  - Evacuate the area if it is a big fire and assemble at nearest assembly point through safe routes(check wind direction with help of wind socks)
  - Keep the road clear for emergency vehicle movement.
  - Arrange for required first-aid and assist in shifting the injured to medical centre.
  - Do not keep back the used fire extinguisher to its fixed location, hand over it FSE department for refilling.
  - Report all cases of fire no matter how small it may be.
  - Follow safety rules and cooperate with the FSE Department.

### 2.8.5 Hydrant System.

Adequate number of fire hydrants and monitors will be provided at various locations in and around the buildings and other plant areas. The hydrants will be provided on a network of hydrant mains drawing water from the hydrant pump, which starts automatically due to drop of pressure in the event of operating the hydrant valves. We are suggesting you to go for TAC approved hydrant system for foolproof safety and benefit from fire policy premium.

### 2.9 Emergency Escapes

The objective of the emergency escape is to escape from the hazardous locations, to the nearest assembly point or the other safe zone, for rescue and evacuation.
2.10 Assembly Point.

Assembly point is location, where, persons unconnected with emergency operations would proceed and await for rescue operation.

<table>
<thead>
<tr>
<th>ASSEMBLY POINT</th>
<th>ASSEMBLY POINT AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer Plant</td>
<td>Material gate and Entrance gate</td>
</tr>
</tbody>
</table>

2.11 Wind Sock.

Wind socks for knowing wind direction indication would be provided at a suitable location to visible from many locations. It is proposed to install windsocks at E.O storage area and Administration Building so as to be visible from different locations in the plant.

2.12 Emergency Transport.

Emergency Ambulance would be stationed at the Administration Office and round the clock-driver would be made available for emergency transportation of injured etc. However, the other vehicles of the company also would be available for emergency services.

2.13 EMERGENCY COMMUNICATION.

There are two kinds of communication system provided.

(a) Regular P&T phones with intercom facility.
(b) Mobile phone

Table 8: Emergency contact Number

<table>
<thead>
<tr>
<th>Emergency Control Center</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Manager</td>
<td>+918334866688</td>
</tr>
<tr>
<td>Fire station (Kharagpur)</td>
<td>101, 0322-2255709</td>
</tr>
<tr>
<td>Medinipur Medical College &amp; Hospital</td>
<td>0322-275503</td>
</tr>
<tr>
<td>Police station (Kharagpur)</td>
<td>100, 0322-255797</td>
</tr>
<tr>
<td>Ambulance</td>
<td>102</td>
</tr>
</tbody>
</table>
2.14 WARNING/ALARM/COMMUNICATION OF EMERGENCY

The emergency would be communicated by operating electrical siren for continuously for five minutes with high and low pitch mode.

2.15 EMERGENCY RESPONSIBILITIES:

- Priority of Emergency Protection.
- Life safety
- Preservation of property
- Restoration of the normalcy

2.16 MUTUAL AID

While necessary facilities are available and are updated from time to time, sometimes, it may be necessary to seek external assistance; it may be from the neighboring factories or from the State Government as the case may be.

2.17 MOCK DRILL

In spite of detailed training, it may be necessary to try out whether, the OSEP works out and will there be any difficulties in execution of such plan. In order to evaluate the plan and see whether the plan meets the objectives of the OSEP, occasional mock drills are contemplated. Before undertaking the drill, it would be very much necessary to give adequate training to all staff members and also information about possible mock drill. After few pre-informed mock drills, few UN-informed mock drills would be taken. All this is to familiarize the employees with the concept and procedures and to see their response. These scheduled and unscheduled mock drills would be conducted during shift change, public holidays, in night shift etc. To improve preparedness once in 6 months and performance is evaluated and Site Controller maintains the record. Incident Controller (IC)coordinates this activity.