EMERGENCY PLAN
ON-SITE
OF
IFFCO KANDLA PLANT

INDIAN FARMERS FERTILISER COOPERATIVE LIMITED
Kandla Unit
P.O Kandla
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Diss. Kachchh, Gujarat
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DETAILS TO BE FURNISHED IN THE ON-SITE EMERGENCY PLAN

1. Name and address of the person furnishing the information.

Name of Person - Shri L. Murugappan
Designation - Senior Executive Director,
Name of Company - M/s INDIAN FARMERS FERTILISER COOPERATIVE LTD., Kandla Unit.
Address - Old Kandla – 370220 Gujarat
Phone no. : 02836 – 270640, 254201
Fax : 02836 - 27064227
E-mail : lmurgappan@iffco.in

2. Key personnel of the organization and responsibilities assigned to them in case of an emergency

At IFFCO Kandla Unit emergency has been categorized in three levels i.e.

LEVEL - 1 The level of emergency which is controllable within the plant / area.
Emergency may be due to:

a) Small spot of fire in the plant.
b) Toxic gas release for short duration.
c) Collapse of small equipments.

LEVEL – 2 The emergency which is confinable within the Factory premises.
Emergency may be due to:

a) Big fire in factory premises
b) Medium scale explosion
c) Heavy leakage of toxic gas for short duration.

LEVEL- 3 Likelihood of vapor cloud with formation of toxic / flammable gases drifting and affecting the general public (i.e. outside of plant premises). This type of emergency arises out of:

a) Explosion in high pressure vessel containing toxic / flammable material.
b) Heavy leakage of toxic material for a long duration from pipe line or storage tanks.
List of the key personnel of IFFCO Kandla Unit

<table>
<thead>
<tr>
<th>NAME &amp; DESIGNATION</th>
<th>OFFICE PHONE</th>
<th>RESIDENCE PHONE</th>
<th>MOBILE</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>INTERNAL</td>
<td>P&amp;T</td>
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<tr>
<td>L. Murugappan, Executive Director</td>
<td>4700</td>
<td>254201</td>
<td>5009</td>
</tr>
<tr>
<td>A.K. Singh, JGM (Maint.)</td>
<td>4550</td>
<td>254220</td>
<td>5003</td>
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<tr>
<td>A.E. Kadu, JGM (Technical)</td>
<td>4623</td>
<td>254213</td>
<td>5006</td>
</tr>
<tr>
<td>V.J. Mankodi, JGM (F &amp; A)</td>
<td>4583</td>
<td>254208</td>
<td>5004</td>
</tr>
<tr>
<td>K.D. Tekchandani, JGM (Materials)</td>
<td>4599</td>
<td>254210</td>
<td>5117</td>
</tr>
<tr>
<td>I.N. Rewari, JGM (Production)</td>
<td>4816</td>
<td>254205</td>
<td>5107</td>
</tr>
<tr>
<td>Dr. S.S. Senapati, JGM (Medical)</td>
<td>5971</td>
<td>230194</td>
<td>5108</td>
</tr>
<tr>
<td>R.A. Ambwani, DGM (P &amp; A)</td>
<td>4559</td>
<td>270709</td>
<td>--</td>
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<tr>
<td>R.K. Matai, CM (TPT)</td>
<td>4584</td>
<td>254221</td>
<td>5254</td>
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<tr>
<td>Maj. (Rtd.) A.K. Singh, Addl.C.S.O.</td>
<td>4851</td>
<td>254240</td>
<td>5226</td>
</tr>
<tr>
<td>N.C. Patel, M (F&amp;S)</td>
<td>4678</td>
<td>254231</td>
<td>5209</td>
</tr>
</tbody>
</table>

Responsibilities assigned to them in case of an emergency:

**First Hand Information:**
As per the emergency plan, any person at shop floor level who possesses the first information of leakage of toxic gas or Fire will communicate about the emergency as under:
- By informing to concerned control room / Shift Incharge immediately.
- In Fire Control Room Local telephone 4666 / 4555
- By shouting and informing to others working in near by area.
- If there is a Fire incident then try to extinguish immediately with available extinguisher in near by area.

**ROLE OF KEY PERSONNEL ON HEARING EMERGENCY SIREN:**

1. Unit Head will reach to Emergency Control Centre (ECC) or Alternate Emergency Control Centre depending upon wind direction & situation of emergency if ECC is affected.
2. HODs of Maintenance / Technical / Material / P & A / F & A / Non affected Plant will report to Chief Emergency Controller [ Unit Head ]
3. Sectional Heads of Maintenance / Work Shop / Civil / Instrument / Electrical / Non affected Plant will report to their normal work places if not demanded by Incident
Controller / Site Main Controller / Chief Emergency Controller; Accordingly instruct staff under their control to report to Incident place & or / plant to be present at their normal work place or to go to declared Assembly Point at the time of Emergency for further instruction & or if evacuation is needed.

4. All other Sectional Heads will report / remain at their normal work places with their staff and shall work as per the instruction of Chief Emergency Controller or role allotted in emergency action plan.

5. All the non essential employees will contact their Sectional Heads / Area Incharge for further instructions.

6. All Contractor’s Labour will follow safe route after seeing the wind direction and reach the assembly point for further instructions.

ROLE OF INCIDENT CONTROLLER: Shift Incharge of Affected Plant / Area (Production)

On receiving the information of emergency the shift Incharge concerned will direct his staff to control the situation by available gears. He will assess the scale of emergency likely to exist i.e. L1, L2, OR L3. Categorize the risk and

- inform Fire Control room -(4666 / 4555) if fire crew did not reach till that time.
- inform Plant Dispensary (4777 / 4574) if personnel injury is reported / observed.

1. Decide whether to stop or continue the process and take technical decision to control the incident and inform / instruct next person to inform Unit Head regarding incident and consult senior officers as per requirement. Inform Unit Head / Dept. Head / Sectional Head for declaration of emergency and activating emergency plan.

2. If emergency of L2 or L3 level, or L1 level is turning to L2 / L3 level and need arises to activate emergency action plan by giving information / intimation to Fire Control room Incharge (phone 4555 / 4606) for blowing emergency Siren for Gas / Fire code if Dept. Head / Sectional Head (Site Main Controller) does not reach to the site.

3. Instruct next person to inform Unit Head regarding incident. Also inform required key personnel

4. INCIDENT CONTROLLER HAS TO EXECUTE FOLLOWING RESPONSIBILITIES.
   a) Direct evacuation of plant and areas likely to be affected by the emergency.
   b) Ensure required key personnel are called in.
   c) Advice fire fighting, rescue team and provide additional manpower / material from non affected plant.
   d) Direct for search of causalities.
   e) Evacuate non-essential workers to assembly points.
   f) Preserve evidence for subsequent inquiry in to the cause of emergency.

5. He will hand over the charge to Site Main Controller when he reaches the scene of Incident.
ROLE OF SITE MAIN CONTROLLER: PRODUCTION (HOD / SHD of Affected Plant / Area)

After receiving information from Incident Controller, inform Unit Head about incident if not already informed by Incident Controller and reach to the scene of incident and assess the level of emergency.

Take charge of Site from Incident Controller.

Decide whether to stop or continue the process and take technical decision to control the incident. Consult Chief Emergency Controller (Unit Head) for declaration of emergency and activating emergency plan if need arises & if not declared by Incident Controller than,

Declaration of major emergency & inform to Fire Control room Incharge (phone 4555 / 4606) for blowing emergency Siren for Gas / Fire code

Direct Incident Controller in co-ordination with Chief Emergency Controller to control the Emergency and safe shut down of plant as situation demands.

Site Main Controller has to execute following responsibilities.

a) Direct evacuation of plant and areas likely to be affected by the emergency.
b) Ensure that the required key personnel are called in.
c) Advise fire fighting, rescue team and other emergency services.
d) Direct for search of causalities, if any.
e) Evacuate non-essential workers to assembly points.
f) Brief chief emergency controller on the developments.
g) Arrange for additional help for fire crew as per requirement of fire service Incharge.
h) Preserve evidence for subsequent inquiry in to the cause of incident / emergency.

After consulting the Fire & Safety Section Incharge, declare all clear at site & inform Chief Emergency Controller to declare all clear by blowing siren.

FIRE & SAFETY SERVICES

SHIFT INCHARGE (F&S):

- As soon as, notified about the location of Fire / Gas leak,
- Inform Lab Shift Incharge (Phone 4593) / Shift Lab. Chemist (In order of Priority) regarding Fire / Gas leak and inform to take charge of F& S Control Room.
- Put Fire Pumps on Auto mode.
- Ask for guards from Security Incharge.
- Proceed immediately to the scene of incident with fire tender & crew.
- Position the Fire tender depending on the wind direction.
- Decide the course of action in consultation with the Shift Incharge (Incident Controller) and take suitable measures to extinguish the fire / assist in controlling gas leak.
- Direct Rescue operation if needed
- Seek the help of trained employees from Incident Controller for controlling the Emergency Situation.
- Ensure that crew members are provided with proper safety equipments for tackling the emergency.
- Assess the severity of the incident, and inform Incident Controller to call for additional vehicles, equipments, extinguishing media or and help from mutual aid.
- Till the arrival of Sectional Head (F&S), guide the fire crew in fire fighting and rescue operation by giving clear instruction.

**SHIFT INCHARGE (Fire Control Room after Message of Emergency)**

[Laboratory Shift Incharge / Shift Lab. Chemist (In order of Priority)]

**On request of Fire & Safety Shift Incharge, Laboratory Shift Incharge / Shift Lab. Chemist (In order of Priority)**

will work as Shift Incharge of Fire Control Room till emergency exist / All clear siren blown:

Inform Sectional Head (F&S) about the incident.
Ensure that ambulance goes to the place of incidence.
Inform Security Shift Incharge.

After getting information from Incident Controller (Shift Incharge of Affected Plant / Site Main Controller - HOD / SHD of affected plant) blow the emergency Siren as per required code i.e. Fire / Gas Leak. Confirm the Name & Designation who is instructing for blowing the siren.

Ensure that the pressure in the fire hydrant system is maintained, if required put available pumps in auto system and still if pressure is not available in hydrant system request help of Maint. Service Staff for smooth running of Fire pumps.

Record all the messages received in a register and work as per the direction of Incident Controller till arrival of Chief Emergency Controller (Unit Head)

**ROLE OF SECTIONAL HEAD OF FIRE & SAFETY:**

- After receiving information from Fire Control Room Inform Unit Head / HOD about incident and reach to the scene of Incident.
- Direct the fire fighting, emergency operations with Fire Crew & other trained persons.
- Keep constant touch with Chief Emergency Controller for additional help if necessary till arrival of Site Main Controller.
- On arrival of Site Main Controller, inform him regarding additional help for incident control action who in turn will convey to Chief Emergency Controller.
- Ensure that all equipments & PPEs required are available at site and if required arrange for additional requirement.
- Direct Rescue operation and send the victims to First Aid Center for treatment.
- Inform Site Main Controller to get help from KPT, CRPL, KSEZ, G'dham Municipality Fire Brigades.
- Direct the Crew members at the scene of Emergency and reinforce, replenish equipments / extinguishing media & fire fighting crew.
- Consult the Site Main Controller and both will take decision for declaration of all clear.
- Direct Fire Crew & Mutual Aid members to wind up the equipments.
MAINTENANCE SERVICES

ROLE OF Sectional Heads of Mechanical / Workshop / Civil / Electrical / Instrument

Sectional Heads of Mechanical / Workshop / Civil / Electrical / Instrument are required to remain present at their normal work places and shall follow the decision made by Incident Controller / Site Main Controller / Chief Emergency Controller in the light of information received by them on the developing situation of emergency. Keep constant contact with Site Main Controller / Chief Emergency Controller.

They shall guide the staff under their control for providing assistance/support for controlling the emergency situation and evacuation of personnel.

HOD OF MAINTENANCE SERVICES:

Mobilize staff and necessary tools & tackles for help if required by Incident Controller / Site Main Controller for emergency Maintenance work at the place of Incident. Direct concerned personnel for providing necessary help for tackling the Emergency. Keep constant contact with Chief Emergency Controller at ECC & act as per instruction received from him.

Depute one person from each discipline i.e. Mechanical, Electrical, Instrument to look after the services of Fire Pumps till all clear siren is blown.

SECURITY SERVICES

ROLE OF SECTIONAL HEAD / SHIFT INCHARGE / SECURITY GUARDS

A) SECTIONAL HEAD / SHIFT IN-CHARGE:

- On request from Shift Incharge of Fire Control room depute four security guard, three for tackling emergency with fire tender and one in Fire Control room for assistance.
- After hearing Siren, inform the location of fire / Gas leak to the essential key personnel and guide the personnel coming to plant.
- During non General Shift hours, inform All HODs regarding emergency i.e. Fire / Gas leak
- Guide Statutory authority to go to Emergency Control Centre.
- Depute Security Guard for manning the gates & traffic control at the scene of incident.
- Prevent unauthorised entry in the Factory.
- Render assistance as requested by Fire & Safety Incharge / Incident Controller at the scene of Incident.
- Mobilise additional Security for help if required.
- No vehicles should be allowed inside the plant except Ambulance, Fire Tenders & emergency vehicles along with essential personnel & also direct them to the scene of incident.
- Help to evacuate the persons at the scene of incident.
- Arrange to provide list of contractor workers working, visitors & vehicles for evacuation purpose if required by Assembly point incharge / Chief Emergency Controller.
- To operate Jeep with Public Address system to warn surrounding public as directed by Chief Emergency Controller.
B) SECURITY GUARDS:

On hearing the emergency Siren contact Shift Security In Charge & work under his instructions.

ADMINISTRATION & PERSONNEL SERVICES

ROLE OF HOD / SECTIONAL HEAD

On getting information of emergency immediate report to Chief Emergency Controller at Emergency Control Centre (ECC).

- Arrange vehicles to shift causalities from plant site to Hospitals & evacuation of persons from assembly points to outside shelters.
- In addition to our vehicles arrange for hired vehicles and additional drivers if necessary for other services such as Welfare / Stores / Purchase.
- Give direction to Security Chief for Manning Main gate, traffic control, to operate Jeep with public address system for alerting peoples. Arrange for additional Security if required.
- Ensure that telephone operator is deputed to convey messages. Keep board free to the extent possible for incoming calls. Convey messages to Senior Officials / Organisation Head etc as directed by Chief Emergency Controller.
- Organise canteen services for hot drinks / snacks / food as required & other welfare services etc at the scene of incident & required locations.
- A messenger / runner is to be kept ready to pass the messages in case of failure of communications.
- Keep in touch with local Govt. Authorities and near by fire services for their help.
- Inform District Collector, Sr. Insp. of Factories, Police Deptt., GPCB etc. as per statutory requirements.
- Ensure that the media is properly guided and authentic news made available for press and media.
- Arrange round the clock availability of persons at hospital to look after the affected persons.
- Prepare records of affected personnel with local and permanent addresses & inform their nearest relatives.
- Take necessary action for compliance of statutory need such as information / reports etc to concerned authority as per existing guidelines.
- Depute one person for manning Assembly Point & maintain records of evacuated persons at various shelters / locations.

ROLE OF HOD / SECTIONAL HEAD OF MEDICAL SERVICES

ROLE OF SECTIONAL HEAD / SHIFT INCHARGE PLANT DISPENSARY / MEDICAL STAFF

SHIFT INCHARGE PLANT DISPENSARY:

- On receipt of instruction from Incident Controller / Fire Control room direct Ambulance to the scene of incident OR on Hearing Siren of Fire Tender send Ambulance and advice to follow Fire Tender to the scene of incident.
- Inform Sectional Head regarding incident.
- Be ready for providing First Aid to Victims / Injured.
**ON-SITE EMERGENCY PLAN**

**HEAD OF MEDICAL SERVICES:**
On receipt of information from Plant Dispensary immediately report to the first aid centre of plant and take following actions.

- Keep all necessary Medicines, artificial respiration equipments etc. ready.
- Render first Aid to Victims / Injured Persons & send them in time for further treatment if required.
- Inform all Hospitals / Doctors of Kandla, Gandhidham regarding Incident and gear up hospitalisation and treatment of Victims / Injured persons.
- Advise HOD of Technical for additional Medical Assistance from out side if necessary.
- Contact Chief Emergency Controller for further situation.

**MEDICAL STAFF:**
After receiving information or hearing Siren contact Sectional Head / Shift Incharge and work as directed by them.

**ENVIRONMENT & POLLUTION CONTROL**

**ROLE OF SECTIONAL HEAD / SHIFT INCHARGE / CHEMIST -( LABORATORY)**

**SHIFT INCHARGE / CHEMIST - (LABORATORY) :**

*On request of Fire & Safety Shift Incharge , Laboratory Shift Incharge / Shift Lab. Chemist (In order of Priority he will work as Shift Incharge of Fire & Safety Control Room till emergency exist / All clear siren blown.):*

- Inform Sectional Head (F&S) about the incident.
- Ensure that ambulance is gone to the place of incidence.
- Inform Security Shift Incharge.
- After getting information from Incident Controller (Shift Incharge of Affected Plant or area / Site Main Controller - HOD / SHD of affected plant ) blow the emergency Siren as per required code i.e. Fire / Gas Leak .Confirm the Name & Designation who is instructing for blowing the siren.
- Ensure that the pressure in the fire hydrant system is maintained, if required put available pumps in auto system and still pressure is not available in hydrant system get help of Maint. Service staff for smooth running of Fire pumps.
- He will record all the messages received in a register and will work as per the direction of Incident Controller till arrival of Chief Emergency Controller (Unit Head)

**SECTIONAL HEAD ( LABORATORY ) :**

- After getting information of emergency remain present at your normal work places.
- Ensure that Lab Shift Incharge has taken charge of Fire & Safety Control room as a shift Incharge of F&S and send another manpower if he requires. Follow the decision made by Incident Controller / Site Main Controller / Chief Emergency Controller or HOD in light of information received by them on the developing situation at emergency. Keep constant touch with HOD
- Arrange to carry out ambient air and effluents samples test as directed by Chief Emergency Controller / HOD
- They shall guide the staff under their control for developing situation at emergency for work / evacuation etc.
ON-SITE EMERGENCY PLAN

ASSEMBLY POINT / EVACUATION & MEDICAL MANAGEMENT

ROLE OF HOD OF TECHNICAL DEPTT

ROLE OF SECTIONAL HEAD / SHIFT INCHARGE (TRANSPORTATION)

On hearing the Siren or intimation of Emergency immediately proceed to Emergency Control Centre and after reporting to Chief Emergency Controller take the charge of Assembly Point and act as under till arrival of additional help from HOD OF TECHNICAL DEPTT.
- Manning the Assembly Point and get help from Sectional Head of (P&A) and maintain the record of Persons & causalities reported at assembly points and transfer them to other places.
- Arrange the evacuation of all non essential staff from Assembly Point to Shelters as per instruction received from Chief Emergency Controller.
- Call all non essential staff to Assembly Point by informing other Key Personnel depending upon the situation / Emergency.
- Causalities to be shifted to First Aid Post.
- Direct the victims / injured persons to hospitalisation available ambulance / vehicle as per advise of Chief Medical Officer.
- Arrange for further Medical Aids as per the requirement of First Aid incharge.
- Direct Sectional Heads (Laboratory) to carry out ambient air and effluents samples test as directed by Chief Emergency Controller / Site Main Controller.
- Keep in constant touch with Chief Emergency Controller & Co-ordinate other related activities as per requirement.

ROLE OF CHIEF EMERGENCY CONTROLLER: (UNIT HEAD)

- He on receipt of information about the emergency or hearing the siren, he shall proceed to Emergency Control Centre and take charge of Incident.
- has overall responsibilities of directing operation and calling out side help from emergency control room. OR An alternative ECC in case of adverse condition which is EF Train Control Room.
- Assess the situation quickly and decide the level of emergency (L2 or L3 ) after getting information from Incident / Site Main Controller and act accordingly.
- If emergency of L3 level or L2 is turning to L3 level inform District Authorities for operating Offsite emergency plan.
- Keep contact with Site Main Controller and direct him for handling emergency. Ensure that all services for tackling emergency are in line and advise them accordingly.
- Ensure that one person from each discipline is deputed to look after the services of Fire Pumps till all clear is blown.
- Direct all emergencies within the affected area with following priorities.
  a) Personnel Safety
  b) Plant, Property & Environment Safety.
  c) Minimum loss of production.
- Direct safe shut down of plants in consultation with incident controller & key personnel, if necessary.
- Ensure that all non essential workers, visitors, contractors are evacuated to assembly points.
- If necessary arrange for evacuation of neighbouring population with the help of District Collector, Dy. DSP , Dy. Director (IS&H).
- Ensure that search for causalities within the affected area has been carried out and arrange for hospitalisation of victims.
- Seek outside help from Mutual Aid and others if required by Site Main Controller.
ON-SITE EMERGENCY PLAN

- Ensure that HOD (P&A) liaise with outside agencies such as Police, District emergency authorities i.e. Collector, officials of Directorate of Industrial Safety & Health and Local Pollution Control Board. Provide advice on possible effects to areas out side the factory.
- Arrange for up to date recording of emergencies as per Annexure - 30 of On Site Emergency Plan.
- Ensure that press note is prepared and released to press & media.

SUPPLY AND REPLENISHMENT MANAGEMENT

ROLE OF HOD (MATLS) / (F&A)

- On receipt of information about the emergency or hearing the siren, Immediately report to Chief Emergency Controller at Emergency Control Centre (ECC).
- Direct all other Sectional Heads under their control to remain at their normal work places with their staff and work as per the instruction of Chief Emergency Controller for further action.
- Arrange additional man power for handling Store items etc.
- Arrange to issue items / equipments required during emergency.
- Take immediate action of emergency procurement and arrange additional manpower for local purchase etc. If required.
- Co-ordinate with Chief Emergency Controller.

MUTUAL AID SCHEME

ROLE PLAYED BY MEMBERS OF MUTUAL AID SCHEME

- On receiving the call they proceed immediately with fire crew and Fire Tender.
- The place of incident will be guided by IFFCO MAIN GATE SECURITY GUARD.
- Fire Crew Incharge will report to Sectional Head / Shift Incharge (F&S) and assist the emergency operation as guided.
- Safety of Fire Crew will be ensured by In Charge of Assisting Fire Brigade in emergency operation.

3. Outside organization if involved in assisting during onsite emergency.

(a) Type of accidents.

At IFFCO Kandla Unit, following five major types of accidents envisaged;

- Major ammonia leak due to catastrophic rupture of ammonia storage tanks
- Heavy ammonia leak from ammonia lines in process plants.
- Failure of unloading arm at Jetty and Ammonia Storage area.
- Ammonia leak in Ammonia Transfer pump area.
- Ammonia leak from transfer line from Storage Tank to Plants.
- Major fire in Furnace Oil Tank area.
- Major fire at Empty Bags Storage area.
- Severe natural calamities.
- Damage during war.

(b) Responsibility assigned

At IFFCO Kandla unit, regular mocks are being conducted to ensure preparedness for handling emergency. For detailed information on the key responsibilities please refer point 2 of this schedule. Besides this following administrative agencies and organizations shall be involved to perform their respective activities to bring the emergency situation under control.
District Collectorate - Bhuj
4. **Details of liaison arrangement between the organizations.**

There is no mutual agreement among the industries in nearby area. But it has mutual understanding with nearby KPT, CRL, FOCT, IOCL, BPCP and HPCL to assist each other in case of any fire gas release emergency with possible available resources and district administration authorities are involved in handling emergency situation.

5. **Information on the preliminary hazard analysis:**

   (a) **Type of accidents**

   The types of accident, where “Onsite Emergency Plan” is to be involved, during the course of manufactureing NPK/ DAP Fertiliser with the help of raw material such as Ammonia, Phosphoric Acid and Sulphuric Acid may be considered as listed below :

   1. Fire
   2. Explosion
   3. Release of Toxic material like Ammonia
   4. A combination of more than one

   However, types of personnel injuries may include: Burn injury, cut/ blunt injuries, or fracture injuries during the course of industrial activity.

   (b) **System elements or events that can lead to a major accident**

   The following types of accident hazards are find out which may lead to major potential accidents: -

   - Release of huge quantity of ammonia due to failure of unloading pipeline or transfer pipeline.
   - Release ammonai from from joints / flanges.
   - Release of huge quantity of ammonia due to rupture of tank.
   - Release of huge quantity of ammonia due to rupture of piping.
   - Release of ammonia ammonia due to failure of unloading arm.
   - Release of sulphuric acid from storage tank.
   - Explosion in pipeline/ tank.
   - Major fire in Furnace Oil Tank, Diesel Tank and Empty bags storage area.
   - Destruction during war.
   - Occurrence of severe natural catastrophes or Earthquake beyond design considerations
ON-SITE EMERGENCY PLAN

(c) Hazards

NPK/ DAP manufacturing process involves hazardous chemicals like Ammonia, Phosphoric acid and Sulphuric acid. Handling and storage of these hazardous chemicals and their use in the process may lead to a hazardous situation.

A brief on types of accidents may happen are as follows:-

1. Injury due to inhalation of ammonia.
2. Burn injury accident due to attending electrical faults.
3. Burn injury accidents due to handling of acid.
4. Hit / cut type accidents due to various maintenance jobs.
5. Falling from height.
6. Burn injury accident due to steam

(d) Safety relevant components

Design stage is much more important in any installation. It is the stage where inbuilt safety can be considered, which will be more effective and as a result, failure of equipment's or an accident can be eliminated. Selection of material of construction, planning proper layout, providing inter locks arrangements, safety valves and other sophisticated instrument control for measurements of various parameters for safe operations are the factors which were considered for the fail safe arrangement in Ammonia storage and handling process at IFFCO - Kandla.

Some Safety relevant components are mentioned below:-

1. Remote operated valve at tanks inlet and outlet.
2. Automatic ammonia tank vent valve with interlock.
3. Electronic tank pressure indicator and recorder.
4. Safety relief valves on tanks, pipeline and heat exchangers.
5. Electronic level indicator and controller for the annular space.
7. Tank level height / low level alarm and shut off interlock.
8. Common flare stack for ammonai storage tanks.
9. Wind indicators.
10. Lighting arrestors.
11. Earthing of the tanks.
12. Refrigeration system for maintaining tank pressure and temperature with various interlock for safety of Tanks and compressor.
13. Control Room equiped with DCS system.
14. Adequate annular space between the cup and the tank.
15. Insulation of the tanks and piping with fire retarding properties.
16. Pressure controller at transfer line to plant, etc.
6. Details about the site:

(a) Location of dangerous substances

Plant is situated away from town and the population around the plant is also very less. One side of the plant is surrounded by the Kandla creek.

The wind direction at Kandla is normally from South - West to North - East for eight months and opposite for remaining four months. Hence the location of Ammonia storage is selected at the North East corner of the plant. In case of Ammonia leakage, the vapor cloud will be carried away by the wind towards sea and will not affect the employees and surrounding population.

Sulphuric acid is stored in storage tanks in dyke wall area.

(b) Seat of key personnel

All key personnel as per the role of Onsite emergency plan are sitting in plant area.

(c) Emergency Control Room

At IFFCO Kandla, Fire Control Room at Fire & Safety Section is Emergency Control Room and alternate Emergency Control Room is E&F Train Control Room if wind direction is towards Time Office.
7. Description of hazardous chemicals at plant site:

(a) Chemicals (Quantities and toxicological data)

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Chemicals</th>
<th>Type of Storage Tanks</th>
<th>Storage Capacity of each Tank</th>
<th>No. of Tanks</th>
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<tbody>
<tr>
<td>1</td>
<td>Ammonia</td>
<td>MS Horton Sphere, 3.0 Kg/Cm² Pressure</td>
<td>1500 MT</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MS, Cylindrical, vertical tank, Double wall, Double integrity, Fixed Roof, Atmospheric Pressure Tank.</td>
<td>10000 MT</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>5000 MT</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td>15000 MT</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Sulphuric Acid (98%)</td>
<td>Vertical Cylindrical Mild Steel Storage Tank.</td>
<td>5000 MT</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vertical Cylindrical Mild Steel Tank. (Day Tank)</td>
<td>75 MT</td>
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<td></td>
<td></td>
<td>275 MT</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Phosphoric acid</td>
<td>Vertical Cylindrical MSRL Storage Tanks.</td>
<td>10000 MT</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vertical Cylindrical MSRL Day Tanks.</td>
<td>1350 MT</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vertical Cylindrical MSRL Day Tanks. (Urea Phosphate)</td>
<td>160 MT</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Hydrochloric acid</td>
<td>Vertical Cylindrical MSRL Storage Tanks.</td>
<td>16 MT</td>
<td>2</td>
</tr>
</tbody>
</table>

Toxicological data:

As it clear that hazardous chemicals responsible for initiating on-site Emergency plan are ammonia and sulphuric acid. The MSDS (Material Safety and Data Sheet) of these chemicals is enclosed as Annexure- I. A brief description and safety precautions about these hazardous chemicals are given below

AMMONIA

Ammonia is the main raw material for producing Phosphatic Fertiliser. Total ammonia storage capacity at IFFCO – Kandla is 33,000 MT.

Hazards of ammonia

- Liquid anhydrous Ammonia will produce severe burns on contact with the skin or eyes. Loss of eye sight is possible where liquid Ammonia contract the eye.
- Gaseous Ammonia is strong irritant where to the skin, but specially goes to the eyes and respiratory tract where severe damage can occur.
- Because of the unpleasant, pungent and suffocating odour, it is unlikely anyone would voluntarily remain in a contaminated area. However, it may quickly overcome if escape is not possible.
- Effect of exposure of gaseous Ammonia upon the concentration of Ammonia in air.
<table>
<thead>
<tr>
<th>VAPOUR CONCENTRATION (PPM)</th>
<th>GENERAL EFFECT</th>
<th>EXPOSURE PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Odour detectable to some persons.</td>
<td>Threshold Limit Value maximum for 8 hours working period.</td>
</tr>
<tr>
<td>50</td>
<td>Odour detectable by most of the persons.</td>
<td>Odour Threshold.</td>
</tr>
<tr>
<td>100</td>
<td>No adverse effect for average worker.</td>
<td>Deliberate exposure for long period not permitted.</td>
</tr>
<tr>
<td>400</td>
<td>Immediate nose and throat irritation.</td>
<td>½ - 1 hour exposure causes no serious effect.</td>
</tr>
<tr>
<td>700</td>
<td>Immediate eye irritation.</td>
<td>½ - 1 hour exposure causes no serious effect.</td>
</tr>
<tr>
<td>1700</td>
<td>Convulsive coughing. Severe eye, nose and throat irritation.</td>
<td>Could be Fatal after ½ hour</td>
</tr>
<tr>
<td>2000 - 5000</td>
<td>Convulsive coughing. Severe eye, nose and throat irritation.</td>
<td>Could be Fatal after ½ hour.</td>
</tr>
<tr>
<td>5000 - 10000</td>
<td>Respiratory spasm Rapid asphyxia.</td>
<td>Fatal within Minutes.</td>
</tr>
</tbody>
</table>

- Ammonia is inflammable when mixed in concentration of 16% - 25 % in air. Due to this range of flammability and its high ignition temperature, Ammonia dose not constitute a fire hazard.
- Liquid ammonia expands with temperature much more than liquids. A vessel or pipeline blocked in with full of liquid is subjected to rupture on rise in temperature. Pressure relief valves are usually installed on such equipment to protect against over-pressurization.
- If no relief valve is installed, there is danger of bursting the equipment.
- High vapourisation rate from a liquid Ammonia source and a gas escape from a pressure source is more likely to create a Fire hazard than vapourisation from a cold pool of liquid anhydrous Ammonia. A large pool of anhydrous Ammonia may be considered to constitute a negligible Fire hazard.
- Ammonia vapour can be ignited from a vigorously boiling pool. Burning ceases when boiling stops. Flames above cold pool do not radiate enough heat to maintain the vaporisation rate for continuous burning. As auto ignition temp. of Ammonia is high and Fire is not stable in open air we need not consider it as a Fire risk. However, in an enclosed or almost enclosed space risk of explosion must not be ignored.
- Contact of Ammonia with other chemicals like Mercury, Chlorine, Iodine, bromine, calcium, Silver Oxide or Hypochlorites can form explosive compounds.
- Ammonia Fire should not be fought with water but allowed to be burnt out. If water is sprayed into liquid storage the vaporising rate of Ammonia increases and aggravates the Fire.
Hazard of Sulphuric acid

- Extremely hazardous in contact with many materials, particularly metals. Dilute acid reacts with metals releasing hydrogen which can form explosive mixtures with air in confined spaces.
- Reacts violently in water with evolution of heat. Spattering occurs when water is added to the compound.
- Decomposes on heating emitting toxic fumes and oxides of sulfur.
- Contact with vapour mist causes irritation to eyes, nose and throat.
- Harmful if inhaled, can possibly cause harmful corrosive effect. High concentrations of vapour can cause severe irritation of the respiratory tract. Will cause coughing, difficult breathing, or loss of consciousness.
- Corrosive to eyes. Eye contact can cause corneal burns. Permanent eye damage including loss of sight may occur.
- Liquid will burn skin. Highly corrosive to skin. Causes severe burns.
- Can kill if swallowed in large amounts. Swallowing will cause severe damage to the mucous membranes. May cause severe burns to the mouth, throat and stomach. Ingestion can cause nausea and can result in abdominal pain.

Safety Precautions - (Ammonia)

a) Ammonia gas being lighter than air it moves along with air in the direction of the wind. Hence, one should move away from the wind direction in order to escape from Ammonia.

b) Ammonia being highly soluble in water, a pad of wet cloth held against the nose will give some relief while escaping from the region contaminated with Ammonia gas.

c) When it is noticed that atmosphere is contaminated with Ammonia gas beyond endurable limits escape immediately from the area holding the breath and if breathing becomes unavoidable try to have short breaths. Take care not to inhale deep breaths of Ammonia contaminated air.

d) Avoid all possible contacts with Ammonia. Do not work in an area where ammonia fumes are continuously present. If a contaminated area must be entered, use adequate equipments.

e) Self contained breathing apparatus, fresh air supply mask are necessary for emergency or rescue work where toxic concentration of Ammonia is present.

Safety Precautions: (Sulphuric acid)

Following personnel protective equipment must be worn:

Overalls or similar protective apparel, Safety glasses / goggles or face shield, as appropriate, Rubber boots, Elbow length PVC gloves, Splash apron, Wash contaminated clothing before storing / reusing. Avoid all contact.
(b) Transformation if any, which could occur.

Forms of chemical stored and expected release in atmosphere.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of Chemical</th>
<th>Form under normal condition</th>
<th>Expected form of Chemical under abnormal condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Ammonia</td>
<td>Liquid state at 0 °C temp. &amp; 3.0 Kg/ Cm² pressure.</td>
<td>Vapour / Gaseous form.</td>
</tr>
<tr>
<td>3.</td>
<td>Sulphuric Acid</td>
<td>Liquid at ambient temp. &amp; pressure.</td>
<td>Acid fumes</td>
</tr>
<tr>
<td>4.</td>
<td>Hydrochloric Acid</td>
<td>Liquid at ambient temp. &amp; pressure.</td>
<td>Acid fumes</td>
</tr>
</tbody>
</table>

(c) Purity of hazardous chemicals.

A brief resume of purity of these chemicals and analysis is given below:

<table>
<thead>
<tr>
<th>Name of hazardous chemicals</th>
<th>Formula</th>
<th>State</th>
<th>Purity / Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>NH₃</td>
<td>Liquid, Gas</td>
<td>Ammonia - 99.90%</td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>H₂SO₄</td>
<td>Liquid</td>
<td>99.0%</td>
</tr>
<tr>
<td>Hydorchloric acid</td>
<td>HCl</td>
<td>Liquid</td>
<td>30%</td>
</tr>
</tbody>
</table>

8. Likely dangers to the plant.

In spite of possibilities of fire, explosion and/or toxic chemicals leakage or release during start-up shutdown or normal operations the following dangers to the plant can not be ruled out:

- **NATURAL CALAMITY**
  - 1. Earthquake
  - 2. Flood
  - 3. Storm
  - 4. Volcano

- **DUE TO HUMAN ERROR**
  - 1. Civil War
  - 2. Bombardment of enemy
  - 3. Nuclear explosion
  - 4. Sabotage

However, the technological risks posed by this fertiliser factory constitutes threat to
(i) Its workers.
(ii) To a third party who may be present either in the factory or in its vicinity at the time of accident.
(iii) Inhabitants living in the immediate neighborhood of the factory and their property

9. Enumerate effects of:

(i) Stress and strain caused during normal operation:

These risks manifest due to accidental failure, break down or rupture of equipment, tank ages or pipelines or part of refrigeration system. These may also result from undetected loss of confinement. Because of which liquids or gas contents gradually leak out in sufficient quantities to create dangerous situations. The major substances involving loss of confinement or posing risk or likely dangers to the plant is ammonia (refer MSDS in Annexure-I for details).

Design of Storage & Handling system of Ammonia:

Design stage is much more important in any installation. It is the stage where inbuilt safety can be considered, which will be more effective and as a result, failure of equipment's or an accident can be eliminated. Selection of material of construction, planning proper layout, providing inter locks arrangements, safety valves and other sophisticated instrument control for measurements of various parameters for safe operations are the factors which were considered for the fail safe arrangement in Ammonia storage and handling process at IFFCO - Kandla.

Material of Construction:

Material of construction is very important aspect in construction of storage and handling system of any chemicals. Although Ammonia is not normally aggressive to steel but the presence of minute quantities of oxygen in liquid Ammonia can cause stress corrosion cracking. As Ammonia is stored at very low temp. acceptable resistance to stress corrosion cracking are to be considered for the selection of material of construction.

Horton Spheres and Atmospheric storage tank are constructed with BS-1501-224 Gr. & 32 ALT 30 -TT S + E 36 or TT S + E 29 & A 537 as per API 620 (Revise) respectively. These materials have low carbon content due to which they are meeting the above requirements.

General Information:

For effective & workable disaster planning the list of facilities available around the plant which can be used in emergency should be ready with the coordinator. The information regarding strength of public, route of evacuation & rescue, location of fire station, hospital, police station, assembly point etc., should be known to every-body.
ON-SITE EMERGENCY PLAN

Total strength of residence surrounding area and IFFCO employees who can be effected by ammonia if disaster strikes are as under.

<table>
<thead>
<tr>
<th>Category</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFFCO Employees</td>
<td>600</td>
</tr>
<tr>
<td>Other employees at plant</td>
<td>400</td>
</tr>
<tr>
<td>Hut men residence</td>
<td>7000</td>
</tr>
<tr>
<td>K.P.T. Employees &amp; their family member</td>
<td>6500</td>
</tr>
<tr>
<td>Other</td>
<td>3000</td>
</tr>
</tbody>
</table>

Maximum people required to be evacuate may be around -17,000.

(ii) Fire and explosion inside the plant and effect if any, of fire and explosion out side.

Keeping in view, the inventories of different hazardous material, plant process parameters etc. following are the selected failure case which may be considered for consequence analysis. This includes the worst case scenario i.e. catastrophic failure of Ammonia storage tanks and from the system handling ammonia. This can occur as given below:

<table>
<thead>
<tr>
<th>Incident</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic rupture of Ammonia storage tank or major leakage from the ammonia handling system.</td>
<td>Refrigerated liquid ammonia or liquid ammonia spill and dispersion.</td>
</tr>
<tr>
<td>Pipeline fracture / Nozzle failure</td>
<td>Liquid ammonia spills at hydraulic head or pump delivery pressure and dispersion.</td>
</tr>
<tr>
<td>Gasket failure</td>
<td>Liquid ammonia spill and dispersion. Fire if the FO leakage due to gasket failure and the leakage catch fire.</td>
</tr>
</tbody>
</table>

System elements or events that can lead to major accident.

a. Catastrophic rupture of Ammonia storage tank or major leakage from the ammonia handling system.

b. Catastrophic failure of FO / Diesel Storage Tanks or major leakage from the handling systems of these materials catching fire.

c. Pipeline fracture / Nozzle failure.

d. Gasket failure leading to flange leakages

Gas dispersion concentration

The detailed procedure to be followed to carry out the consequence analysis, damage criteria needed to be adopted for meaningful interpretation in consequence analysis.
The consequence analysis has been carried out for the possible failure cases at IFFCO, Kandla. Consequence analysis quantifies zones of influence for conceived incidents and once the vulnerable zones are quantified for an incident the measures are proposed to minimize damage to plant and personnel.

The ammonia storage tank shell rupture will occur only in the rare circumstances such as due to attack by missile or bomb during war. The type of hazards possible at IFFCO Kandla are ammonia leakage due to failure of outlet line of storage tank, marine unloading arm detachment and compressor suction vapour line failure at ammonia tanks, etc. There may be other failure cases also for ammonia release but these have been considered most credible.

The zone of influence have been calculated for ammonia pipeline failures, sudden rupture of storage vessel shell, etc. In order to quantify the zone of influence worst meteorological conditions have been used. These conditions are as follows:

- Barometer Pressure: 1008 milibars
- Ambient Temperature: 25 deg.C
- Wind Speed: 1 m/s
- Relative Humidity: 75%
- Pasquill Stabilities: A, D and F

Ammonia causes toxic hazards at a concentration of above 25 ppm. In its dispersion calculations the distances of occurrence of IDLH, LFL and UFL concentrations have been computed.

- **Consequence Analysis of various ammonia release scenarios**

  The probable accidental scenarios identified for ammonia release are as given below:

  I. Tank shell rupture of a maximum inventory tank (15000 MT storage Tank)
  II. Transfer pump suction line (of ammonia storage tank) failure
  III. Storage tank vapour line (going to compressor suction) failure

- **Storage Tank Shell Rupture**

  There are three storage tanks and two hortan spheres for ammonia storage. The single largest capacity storage at Kandla is of 15000 tonnes cylindrical tank. The shell rupture of this tank has been assumed to occur and ammonia dispersion due to 15000 tonnes release has been analysed. It has been assumed that at the time of accident this storage tank is full. Once tank shell rupture takes place released ammonia will form vapour cloud due to ambient heating and adiabatic flashing. The vapour cloud will disperse in the influence of local wind. The distances of occurrence of IDLH (Immediately Dangerous to Life and Health), Lower flammable Limit (LFL) and upper Flammable Limits (UFL) concentrations have been computed for dispersion of vapour cloud formed. These distances are given in Table 5.1. It is clear from the table that IDLH concentration under worst conditions of weather (pasquill stability –F, wind speed 1m/s, Night Time) occurs at a distance of 48.25 km. This means in such eventuality the population is downwind direction upto distance of 48.25 km will be affected. The IDLH concentration is for a duration of 30 minutes exposure. Hence all evacuation should be affected within half an
hour. In such a situation Off-Site Emergency Plan need to be activated. IFFCO should make public aware of ammonia hazards in the vicinity of plant and mitigatory measures to be adopted in the event of occurrence of such mishaps.

Since IFFCO plant is located close to coast and there is persistence of higher wind speeds the weather stability - F occurrence will be rare. The more realistic worst condition for IFFCO is neutral weather condition i.e. stability. In neutral weather conditions the distance of occurrence of IDLH concentrations is 20.62 km. The distances of occurrence of LFL, and UFL concentrations are much lower than IDLH distances. The distances of occurrence of LFL concentration under worst weather conditions is 952.0 m. The literature survey of ammonia releases show that ammonia clouds do not explode easily. Chances of ammonia cloud explosion are more in confined spaces such as a room, hall and that too in presence of strong ignition source such as welding arch or electric ignition. Since ammonia facilities are mostly located in open the chances of occurrence of vapour explosion are almost nil.

### Table 5.1 DISPERSION RESULTS OF AMMONIA FOR TANK SHELL RUPTURE

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Pasquill Stability</th>
<th>Distance (m) of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>UFL</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>196.0</td>
</tr>
<tr>
<td>2</td>
<td>D</td>
<td>296.0</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>952</td>
</tr>
</tbody>
</table>

#### Transfer Pump Suction Line Failure

The ammonia transfer pumps transfer ammonia to NPK plants at the rate of 50TPH. It has been assumed that full bore rupture of suction line occurs and leakage persists for 2 minutes, considering that in two minutes either ammonia leakage will be rectified or pump will be stopped. The total leaked quantity has been estimated as 1500 kg. The distances of occurrence of LFL, UFL and IDLH concentrations are given in Table 5.2. It is clear from this table that hazard distances of this scenario are much lower than tank shell rupture scenario. The distance of occurrence of IDLH concentration under worst weather conditions is 2.7 km. Hence the effects of this failure will also be felt outside plant boundary and offsite emergency plan needs to be activated.

### Table 5.2 DISPERSION RESULTS OF AMMONIA FOR STORAGE TANK OUTLET LINE FAILURE

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Pasquill Stability</th>
<th>Distance (m) of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>UFL</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>D</td>
<td>123</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>96</td>
</tr>
</tbody>
</table>
ON-SITE EMERGENCY PLAN

- Marine Unloading Arm Failure

The ammonia transfer from ship to IFFCO takes place through marine unloading arm either at jetty of IFFCO or at jetty of Kandla Port Trust. A significant quantity of ammonia is imported. Many of times marine unloading arm gets detached at jetties. This failure has been observed frequently at ports. In the present case it has been assumed that released takes place for 2 minutes. Pumping rate from ship has been considered at 525 TPH. The total released quantity has been estimated as 17.5 tonnes in two minutes. The dispersion results of this failure case are given in Table 5.3. It is clear distances of occurrence of IDLH concentration are significant for this failure case and realisation of this failure scenario will also need activation of offsite emergency plan. The distance of occurrence of IDLH concentration under worst weather conditions has been estimated around 7.4 km.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Pasquill Stability</th>
<th>Distance (m) of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>UFL</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>52</td>
</tr>
<tr>
<td>2</td>
<td>D</td>
<td>125</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>257</td>
</tr>
</tbody>
</table>

- Ammonia Storage Tank Compressor Or Suction Vapour Line Failure

The other probable failure scenario identified is compressor suction line failure. In present case compressor suction line of 15000 tonnes storage tank has been considered. The release has been assumed to persist for 5 minutes considering that with in time this compressor will isolated. The released quantity has been estimated as 155 kg. The dispersion results of this failure scenario have been given in Table 5.4. The distance of occurrence under worst weather conditions is calculated as 1155 m. This scenario has smallest zone of influence and effects will more or less be confined within plant boundary.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Pasquill Stability</th>
<th>Distance(m) of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>UFL</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>D</td>
<td>21</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>40</td>
</tr>
</tbody>
</table>

In conclusion, it may be seen that we have considered the catastrophic failure of the ammonia storage tanks primarily because the storage lies in a highly vulnerable area. Moreover, incident heat rediation or pressure rise due to unconfined vapour cloud...
explosion of nearby flammable storage belonging to neighbouring industries to cause significant risk of ammonia storage tank failure is distinct possibility.

10. Details regarding:

(i) Warning, alarm and safety and security systems.

Emergency sirens coded on high and low pitch is available as warning alarm system. In the case of Emergency the Emergency Central Control will blow the Emergency siren in wailing sound for Two Minutes and repeating Twice after every 30 Seconds as shown below.

--------STOP------------STOP----------STOP-------STOP----------
10 2 10 2 10 2 10 Second Second Second Second Second Second

This siren indicate the disaster and all concern should activate on their duties of emergency including the evacuation of the people. The siren is located at E.C.C. & various different locations in the plant area. If the situation is critical and Emergency Central Control is not formed the Incident Controller can asked to blow the siren if required.

The siren is tested on first date of every month at 10.00 hrs to check its effectiveness as per On-site emergency action plan.

Plant security personnel are present on all gates of premises and strategic location for the security of the plant. Any person or employee or contractor personnel is not allowed without proper gate pass.

(ii) Alarm and hazard control plans in line with disaster control and hazard control planning, ensuring the necessary technical and organizational precautions;

(i) Reliable measuring instruments, control units and servicing of such equipments.

Built in Safety Measures:

A) Horton Spheres and Rail Tankers:

1. Each tank car's Liquid drawing valve male coupler is provided with snap tight check valve and provision for level measurement. The snap tight check valve at the unloading arms female coupler will only open until the arm is properly coupled with the tank car.

2. Each tank car is provided with a relief valve to blow off excess pressure. Each unloading arm is provided with temp. indicator and pressure indicator.

3. Each tank car is provided with hand brake, which will be used to keep the wagon in steady position during unloading operation. Further wooden wedges will be put behind the wheel of tank car for better safety.

4. Bullet car is also provided with level indicator, relief valve, pressure gauge etc. As the vapour generated in bullet is directly consumed in the plant and the chances of build up of pressure are less.
5. Emergency shut off valves (V.M. Valves) are provided in discharge line to individual Horton Spheres (which can be operated from panel). These valves will close at a pressure of 3.5 Kg/cm² and max. Level of 85% of spheres to avoid high pressure and level during unloading.

6. Each Horton Sphere is provided with Two nos. of safety valves set at 3.5 Kg/cm².

7. Each Horton Sphere is provided with following instruments.
   a) Panel mounted pressure indicator through transmitter
   b) Alarm annunciation on panel for low, high level (25% & 85%) and high pressure (3.35 kg/cm²) of Horton spheres.
   c) Direct mounted pressure gauge at top and bottom of the Horton Spheres.
   d) Electronic level indicator provided at Horton Sphere control room and New Ammonia control room in SCADA system.
   e) Non return valves are provided in liquid Ammonia line going to Horton Spheres and each transfer pump discharge.

8. 3.0 kg/cm². Pressure of Horton Sphere maintained by using Atmospheric Ammonia Storage Tank refrigeration system.

9. A common flare stack has been provided at the top of Horton Spheres. In case of pressure buildup even when liquefaction unit is working, the control valve provided in common vapour line can be opened manually from the panel itself and the vapour can be flared by LPG flame.

10. Remote operated valve has been provided at Horton spheres outlet for immediate shut off from panel in case of emergencies.

11. Provision for taking vapour ammonia from Horton Sphere to Atmospheric Storage Tank flare stack system is provided. This can be used in case of flare stack system of Horton Sphere is not working.

12. Pressure maintaining by using Refrigeration system of Atmospheric acid storage tanks.

B) Atmospheric Storage Tanks:

For safe unloading, storage and transfer of Ammonia so many measures are being taken care and numbers of automatic safety devices are provided for the operation in atmospheric storage tank. These are as follows.

- Before starting of unloading in order to get good unloading flow rate and less vapour generation in tank, the unloading line is being cooled down to the temp. of about -33°C a day before start up of unloading operation.

- A motorised valve has been provided on jetty in unloading line. This valve can be operated by push buttons provided on jetty and from panel also. The ON / OFF position of valve is also indicated on panel. This valve is in interlock with high pressure & high level of the tank and will shut off automatically at these conditions.

- Safety relief valves are provided on jetty before and after the control valve with it’s discharge going to atmosphere.
The atmospheric storage tank has been provided with numbers of safety devices and instruments are as below.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>Tank pressure indicator (Direct)</td>
<td>Tank vapour pressure.</td>
</tr>
<tr>
<td>02.</td>
<td>Tank pressure indicator (Pneumatic / Electronic)</td>
<td>Panel mounted for tank vapour pressure.</td>
</tr>
<tr>
<td>03.</td>
<td>Tank pressure recorder (Pneumatic / Electronic)</td>
<td>To record vapour pressure of the tank.</td>
</tr>
<tr>
<td>04.</td>
<td>Level indicator (Pneumatic / Electronic)</td>
<td>To measure liquid level of tank in % of volume.</td>
</tr>
<tr>
<td>05.</td>
<td>Level indicator (Digital)</td>
<td>To measure liquid level of Tank in mm.</td>
</tr>
<tr>
<td>06.</td>
<td>Level indicator (Pneumatic / Electronic)</td>
<td>To measure level of the liquid in the annular space between two tanks.</td>
</tr>
<tr>
<td>07.</td>
<td>Pressure switches (Receiver)</td>
<td>Interlocks and annunciation.</td>
</tr>
<tr>
<td>08.</td>
<td>Pressure switches (Direct)</td>
<td>Back up for pressure switch for interlock and annunciation.</td>
</tr>
<tr>
<td>09.</td>
<td>Safety Valves (Pilot Operated)</td>
<td>To blow off at excess pressure.</td>
</tr>
<tr>
<td>10.</td>
<td>Safety Valve (Pneumatic operated)</td>
<td>To blow of excess vapour manually in emergency.</td>
</tr>
<tr>
<td>11.</td>
<td>Continious tank temperature recorder</td>
<td>To check tank liquid condition at all times.</td>
</tr>
</tbody>
</table>

Safety valves are provided in all the ammonia lines and equipment's.

A number of interlocks from operation and safety point of view are provided throughout the installation. Some of them are mentioned below:

- Jetty control valve will stop with pressure and high level of Atmospheric storage tank and thus preventing the tanks with high level & high pressure during unloading.

- All the six compressors of old and new compressor house of atmospheric storage tank are interlocked with tank pressure at various settings of pressure so that required compressors will start / stop automatically to maintain desired pressure.

- Level control valve of saturator and flash vessel and solenoid valve in vapour line condensor to saturator are interlocked with compressor. These valves will close / open with compressor stop / start to avoid any operational problem and hence safety also.
• Ammonia transfer pumps and control valves in suction line of these pumps, both will stop at low level of tank.

• All the six compressors are provided with self interlocked for high discharge pressure, temp. and low oil pressure to ensure safe operation of equipment and personal safety.

• All important parameters are controlled and monitored by DCS. Data acquisition and report generation is done by DCS system. Control of all main parameters has been centralised in control room on a computer monitor. This system is having following control operation either manually or automatically to avoid any damage to the plant and ensure safety.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Control Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>Level indicator / controllers (Auto) for saturator and flash vessel.</td>
</tr>
<tr>
<td>02.</td>
<td>Level indicator in percentage and in mm. for main tank.</td>
</tr>
<tr>
<td>03.</td>
<td>Level indicator in percentage of outer tank (interspace).</td>
</tr>
<tr>
<td>04.</td>
<td>Pressure indicator, controls and recorder for main tank.</td>
</tr>
<tr>
<td>05.</td>
<td>Emergency stop of all Jetty control Valve and suction valve to pumps.</td>
</tr>
<tr>
<td>06.</td>
<td>Stop switch for all motors compressors and pumps.</td>
</tr>
<tr>
<td>07.</td>
<td>Emergency stop of all motors by one lock switch.</td>
</tr>
<tr>
<td>08.</td>
<td>Emergency stop of Unloading compressor to trip breaker from M.R.S.S.</td>
</tr>
<tr>
<td>09.</td>
<td>Audio / visual annunciators have been provided for all important process parameters and equipment’s.</td>
</tr>
</tbody>
</table>

Besides this, the atmospheric storage tank is of double integrity type also known as “CUP IN TANK” type which has the following advantages -

(a). It has large gas space.

(b). There is additional buffer to take care of pressure change & for instance changes in baromatic pressure.

(c). In case of power failure and other interruption there is enough time for initiating action.

(ii) **Precautions in designing of the foundation and load bearing parts of the building.**

All the structures, foundations of equipment, pedestals, frames, etc. are designed and erected as per relevant standards and codes of practices. Most of the foundations are erected on piling and all the Storage Tanks constructed on piling foundations.

(iii) **Continuous surveillance of operations.**

Plant control panel are equipped with DCS (Distributed control system), where computers are installed for continuous surveillance and monitoring of all parameters required to be controlled for smooth operation of a plant.
Audio alarms with trip system are provided to stop any segment of plant to bring under control at any point of time. On line data recorder are provide to monitor the parameters of the process plants. The operators and supervisor are continuously taking rounds of the plant and monitoring the processes parameters through local monitoring instruments provided in the field. Ammonia sensors also provided in ammonia storage area with audio alarm system in DCS system at Control Room.

(iv) **Maintenance and repair work according to the generally recognized rules of good engineering practices.**

**Periodical Inspection:**

Third Party Safety Audit and Testing / Inspection, from Government Authorities like Factory Inspectores & other various statutory bodies & the periodical inspection by committee of company’s official are being carried out. Inspection / Testing of tanks, equipment’s, pipe lines, valve etc. is carried out periodically at regular intervals. The inspection of Ammonia storage tanks is carried out at regular interval as per international standard. The Ammonia storage tanks are being inspected by following test.

- Magnafux Crack detection test.
- Ultrasonic thickness measurements.
- Dye Penetration test.
- Vaccum Box test.
- Hydrostatic test.
- Hardness test & other required testing etc.

Periodical & regular maintenance of all safety equipment’s, pump etc. being carried out. Electrical earthing resistance measurement and continuity is checked. Electrical earth resistance measurement and continuity test for storage tank is carried out quarterly.

**Low Inventory of ammonia and Alternate Storage availability:**

The important factor which determine the degree of hazards is the inventory of toxic chemicals. So low inventory of Ammonia in each tanks is being maintained day to day. All tanks are inter connected with each other to transfer Ammonia from one tank to other in emergency.

It is recognised as per good engineering practices and also insisted by statutory authorities to have some alternative arrangement for storage of hazardous chemicals in case any leakage is observed in a tank/vessel. For this purpose we are having two Horton spheres for liq. Ammonia storage which are operating under pressure at 0°C. with inter transfer facilities.

11. **Details of communication facilities available during emergency and those required for an off-site emergency.**

Internal Telephone No. 4555, 4666
P&T Telephone No. 02836 – 270352
12. **Details of fire fighting and other facilities available and those required for an off-site emergency.**

Fire hydrant system with 10 kg/cm² pressure having fire pumps working on auto is provided all over the plant & around the ammonia storage tanks to create water curtain in case of Ammonia leakage. The Water curtain can prevent the spreading of Ammonia in surrounding area of plant premises. Water monitors, water sprinklers system, contaminated type safety showers and eye washer are provided around the hazardous area. Water curtain system is provided in front of Control Room to prevent entering of Ammonia in control room. Around 250 Nos. of Fire Hydrant, 13 Nos water Monitors, 300 Nos. DCP Fire Extinguishers, 80 Nos. CO2 Fire Extinguishers provided in the plant.

One Foam Tender with latest Fire fighting equipment’s and with experienced & trained Fire staff are always ready to fight with any emergency round the clock. All type of personnel protective equipment’s including artificial respiration equipment’s & Breathing Apparatus sets are available at all important places in plant.

**Requirement from Off-site Emergency Agencies**
Availability of Fire Tenders with fire crew members to render assistance mainly from Kandla Port Trust and nearby industry like CRL, FOCT, Gandhidham Nagarpalika and KSEZ

Arranging the Self Contain Breathing Apparatus and protective equipments, Foam compound, DCP Powder etc.
Availability of expertise from Pollution Control boards to minimise the effect on environment.
13. Details of first aid and hospital services available and its adequacy.

Occupational Health Centre is working round the clock with all facilities including Ambulance and Health Centre at Township. All the required medicine available in the health centre.

List of hospital and Doctors

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name</th>
<th>Telephone No.</th>
<th>Beds Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>IFFCO Township Dispensary</td>
<td>220164</td>
<td>6</td>
</tr>
<tr>
<td>02.</td>
<td>Rambagh Hospital, Gandhidham</td>
<td>220263</td>
<td>20</td>
</tr>
<tr>
<td>03.</td>
<td>Railway Hospital, Gandhidham.</td>
<td>231874</td>
<td>30</td>
</tr>
<tr>
<td>04.</td>
<td>Navajivan Hospital, Gandhidham</td>
<td>220715</td>
<td>25</td>
</tr>
<tr>
<td>05.</td>
<td>Tolani Eye Hospital, Adipur.</td>
<td>260497</td>
<td>20</td>
</tr>
<tr>
<td>06.</td>
<td>Dr. Morkhia’s Hospital (Heart), Gandhidham</td>
<td>222008</td>
<td>15</td>
</tr>
<tr>
<td>07.</td>
<td>Dr. Hotchandani (Orthopedic) Gandhidham</td>
<td>327527</td>
<td>26</td>
</tr>
<tr>
<td>08.</td>
<td>Dr. Naiks Hospital, Gandhidham</td>
<td>231333</td>
<td>15</td>
</tr>
<tr>
<td>09.</td>
<td>K.P.T. Hospital, Kandla.</td>
<td>270205</td>
<td>30</td>
</tr>
<tr>
<td>10.</td>
<td>K.P.T. Hospital, Gopalpuri</td>
<td>220497</td>
<td>40</td>
</tr>
<tr>
<td>11.</td>
<td>Divine life Hospital, Adipur.</td>
<td>260577</td>
<td>20</td>
</tr>
<tr>
<td>12.</td>
<td>Dr. Shyamsunder, Anjar.</td>
<td>242571</td>
<td>30</td>
</tr>
<tr>
<td>13.</td>
<td>Dr. Hamang Patel’s Hospital, Gandhidham (Ortho)</td>
<td>230353</td>
<td>18</td>
</tr>
<tr>
<td>14.</td>
<td>Dr. Vachhani’s Hospital (Ortho), Gandhidham</td>
<td>230400</td>
<td>10</td>
</tr>
<tr>
<td>15.</td>
<td>Dr. Dasani’s Hospital, Gandhidham</td>
<td>229231</td>
<td>15</td>
</tr>
<tr>
<td>16.</td>
<td>Dr. Sakaria’s Hospital, Gandhidham</td>
<td>230114</td>
<td>10</td>
</tr>
<tr>
<td>17.</td>
<td>Dr. Rukesh Gosai’s Hospital, Gandhidham.</td>
<td>230333</td>
<td>12</td>
</tr>
<tr>
<td>18.</td>
<td>St. Joseph Mission Hospital, Gandhidham.</td>
<td>230160</td>
<td>40</td>
</tr>
<tr>
<td>19.</td>
<td>Dr. Rajesh Gandhi’s Hospital (Surgeon), G’dham</td>
<td>230999</td>
<td>06</td>
</tr>
<tr>
<td>20.</td>
<td>Dr. Masand’s Hospital (Eye), G’dham</td>
<td>220139</td>
<td>06</td>
</tr>
</tbody>
</table>
ANNEXURE -I

Material Safety Data of Hazardous Chemicals.

AMMONIA

1. CHEMICAL IDENTITY

<table>
<thead>
<tr>
<th>Chemical name</th>
<th>NH₃</th>
<th>C.A.S. No.</th>
<th>UN No.</th>
<th>Chemical classification</th>
<th>Inorganic compound</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NH₃</td>
<td>7664 - 41 - 7</td>
<td>1005</td>
<td>Shipping Name: Ammonia</td>
<td>Hazchem Codes/ Label: Non Flammable gas, Class 2.</td>
<td>17</td>
</tr>
</tbody>
</table>

2. PHYSICAL AND CHEMICAL DATA

<table>
<thead>
<tr>
<th>Physical state</th>
<th>Appearance</th>
<th>Boiling range/point</th>
<th>Melting/Freezing point</th>
<th>Vapour pressure</th>
<th>Odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>liquefied compressed gas</td>
<td>colourless</td>
<td>-33.4 °C</td>
<td>-77.77 °C</td>
<td>7600 mm Hg at 25.7° C</td>
<td>strong pungent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vapour Density</th>
<th>Solubility in water</th>
<th>Others</th>
<th>Specific Gravity</th>
<th>PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Air = 1)</td>
<td>0.60</td>
<td>highly soluble</td>
<td>Moderately soluble in alcohol</td>
<td>0.771</td>
</tr>
</tbody>
</table>

3. FIRE AND EXPLOSION HAZARD DATA

<table>
<thead>
<tr>
<th>Flammability</th>
<th>LEL</th>
<th>Flash point</th>
<th>Auto Ignition</th>
</tr>
</thead>
<tbody>
<tr>
<td>No / UEL</td>
<td>%</td>
<td>°C</td>
<td>Temp °C</td>
</tr>
<tr>
<td>TDG Flammability</td>
<td>N.A.</td>
<td>16.0</td>
<td>Not pertinent</td>
</tr>
<tr>
<td>Explosion sensitivity to impact</td>
<td>stable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explosion sensitivity static Electricity</td>
<td>Not available.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazardous combustion products</td>
<td>emits toxic fumes of NH₃ &amp; Nox</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hazardous polymerisation :- will not occur

<table>
<thead>
<tr>
<th>Hazardous Material</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustible liquid</td>
<td>Yes</td>
<td>Explosive material :- No</td>
</tr>
<tr>
<td>Flammable material</td>
<td>No</td>
<td>Oxidiser :- No</td>
</tr>
<tr>
<td>Pyrophoric material</td>
<td>No</td>
<td>Organic peroxide :- No</td>
</tr>
<tr>
<td>Corrosive material</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

4. REACTIVITY DATA

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Stability</td>
<td>stable</td>
</tr>
<tr>
<td>Incompatibility</td>
<td>strong oxidisers, calcium hypochlorite, gold mercury, silver, halogens, acetaldehyde acrolein</td>
</tr>
<tr>
<td>Reactivity</td>
<td>Reacts with silver chloride, silver azide, chlorine, bromine, iodine, heavy metals and their compounds. Incandescent reaction when heated with calcium</td>
</tr>
<tr>
<td>Hazardous reaction</td>
<td>Reaction with silver chloride, silver nitrate, silver azide &amp; silver oxide forms explosive silver nitride</td>
</tr>
</tbody>
</table>

5. HEALTH HAZARD DATA

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routes of entry</td>
<td>Inhalation, skin or eyes</td>
</tr>
<tr>
<td>Effects of Exposure / symptoms</td>
<td>700 ppm causes eye irritation and permanent injury may result if prompt medical remedial measure are not taken.</td>
</tr>
<tr>
<td></td>
<td>5000 ppm may cause death from spum inflamation, or edema of the larynx.</td>
</tr>
<tr>
<td></td>
<td>Contact of the liquid with skin freezes the tissues and cause caustic burns.</td>
</tr>
<tr>
<td>Emergency treatment</td>
<td>Inhalation :- remove the victim to fresh air aron and provide artificial respiration or oxygon, if</td>
</tr>
<tr>
<td></td>
<td>skin &amp; Eyes :- wash the attested area with plenty of water for 15 minutes. Seek medical aid.</td>
</tr>
<tr>
<td>LD50 (oral rat)</td>
<td>350 mg/kg STEL : 35 ppm, 27 mg/m³</td>
</tr>
<tr>
<td>Permissible Exposure Limit</td>
<td>25 ppm, odour 18 mg/m³ Threshold : 46.8 ppm, 32.53 mg /m³</td>
</tr>
<tr>
<td>TLV (ACGIN)</td>
<td>25 PPM. 18 mg/ m³</td>
</tr>
</tbody>
</table>

6. PREVENTIVE MEASURES

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal</td>
<td>avoid contact with liquid vapour</td>
</tr>
<tr>
<td>Protective Equipment</td>
<td>provide rubber boots, safety goggles, self-contained breathing apparatus, gas mask and protective clothing in case of liquid Ammonia.</td>
</tr>
</tbody>
</table>
ON-SITE EMERGENCY PLAN

Handling & Storage : avoid storing along with oxidizing materials and away from all possible precaution’s sources of ignition. Store in well ventilated flame resistant locations.

7. EMERGENCY / FIRST AID MEASURES

Fire :- Fire Extinguishing Media :-
Stop flow of gas, use water spray or fog.

Special Procedure :- keep the containers cool by spraying water if exposed to heat or flame.

Unusual Hazards :- gas is suffocating.

Exposure :
First Aid Measures :-
Inhalation :- Remove the victim to fresh air area, provide artificial respiration or oxygen, if needed.

Skin :- Remove the contaminated clothes and wash the affected area with plenty of water and soap.

Eyes :- Flush with plenty of water for 15 minutes, seek medical aid.
Antidotes / dosages : Not available.

Spills : Step : to Taken :-
Contain leaking liquid on sand or earth, allow to evaporate. Dilute the vapors with plenty of water.

Waste Disposal :-
Seal all waste in vapour tight plastic bags.

8. ADDITIONAL INFORMATION / REFERENCES

LCLO : 30,000 ppm/gm. A human poison by an unapocial route. Difficult to ignite. NH3 & air in a fire can detonate. Potentially violent or explosive reactions on contact interhalogone. Forms sensitive explosive mixture with air & hydrocarbons. Those affected with eye and pulmonary diseases should avoid exposure to ammonia.

9. MANUFACTURERS / SUPPLIERS DATA

Name of firm :- Supplier’s name :- Contact person in an Emergency :-
IFFCO Kandla IFFCO Kalol, General Shift : Ch. Manager (Offsite)
Aonla, Phulpur, Phone No. : 270381 / PBX = 639.
Imported Shift timings : Shift Engr. (NPK)

Holiday And on factory : at C&D Train Control Room.
ON-SITE EMERGENCY PLAN

Mailing address :-
IFFCO Kandla Unit, Kandla,
Kutch (Gujarat) - 370 210.
Phone No. : (02836) 270381 to 83
Fax No. : (02836) 270642

Local bodies involved -
Standard packing -
Trem card details / Ref -

10. DISCLAIMER

Information contained in this material data sheet is believed to be reliable but no representation guarantee or warrantee of any kind are made as to its accuracy suitability for a particular application or results to be obtained from them. It is upto the manufacturer / seller to ensure that the information contained in the material safety data sheet is relevant to the product manufactured / handed or sold by him as the case may be. The government makes no warranties expressed or implied in respect of the adequacy of this document for any particular purpose.

Sulphuric Acid

1. CHEMICAL IDENTITY

Chemical Name : Sulphuric acid
Chemical Classification : Hazardous, Corrosive material

Synonyms : Oil of Vitrol, Battery acid, Fertilizer acid, Chamber acid
Trade Name : Sulphuric acid

Formula : H₂SO₄
C.A.S. No : 7664-93-9
U.N. No. : 1830

Regulated Identification : Sulphuric acid
Shipping Name Codes/Label : Sulphuric acid
Hazchem Code : 2P

2. PHYSICAL AND CHEMICAL DATA

Boiling Range / Point (°C)
at 1 atm = 270 °C
Physical State liquid at 15 °C and 1 atm
Appearance Colour less (pure) to brownish liquid

Melting / Freezing Point (°C) : 10 °C
Vapour Pressure : @ 20 °C in mm Hg unless hot < 0.001 mm Hg
Odor : Odourless
<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapour density:</td>
<td>Not Pertinent</td>
</tr>
<tr>
<td>Solubility in Water:</td>
<td>at 30°C, soluble in all proportions</td>
</tr>
<tr>
<td>Others:</td>
<td></td>
</tr>
<tr>
<td>Specific gravity:</td>
<td></td>
</tr>
<tr>
<td>pH:</td>
<td>0.3 of 1N solution</td>
</tr>
</tbody>
</table>

### 3. FIRE AND EXPLOSION HAZARD DATA

<table>
<thead>
<tr>
<th>Flammability : LEL %:</th>
<th>Not flammable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash Point °C:</td>
<td>Not flammable</td>
</tr>
<tr>
<td>Auto Ignition Temperature °C:</td>
<td>Not flammable</td>
</tr>
<tr>
<td>TDG Flammability:</td>
<td></td>
</tr>
<tr>
<td>UEL %:</td>
<td></td>
</tr>
<tr>
<td>Flash Point °C:</td>
<td>Not flammable</td>
</tr>
<tr>
<td>Explosion sensitivity to Impact:</td>
<td>Not pertinent</td>
</tr>
<tr>
<td>Explosion sensitivity to Static electricity :</td>
<td>Not pertinent</td>
</tr>
<tr>
<td>Hazardous combustion products:</td>
<td>Decomposes on heating emitting toxic fumes</td>
</tr>
<tr>
<td>Hazardous Polymerisation:</td>
<td>Not pertinent</td>
</tr>
<tr>
<td>Combustible Liquid:</td>
<td></td>
</tr>
<tr>
<td>Explosive Material:</td>
<td>Not pertinent</td>
</tr>
<tr>
<td>Corrosive Material:</td>
<td>Extremely corrosive</td>
</tr>
<tr>
<td>Flammable Material:</td>
<td></td>
</tr>
<tr>
<td>Oxidiser:</td>
<td>Others:</td>
</tr>
<tr>
<td>Non flammable</td>
<td>Extremely hazardous in contact with many materials, particularly metals.</td>
</tr>
<tr>
<td>Pyrophoric Material:</td>
<td>No</td>
</tr>
<tr>
<td>Organic Peroxide:</td>
<td>No</td>
</tr>
</tbody>
</table>

### 4. REACTIVITY DATA

Chemical Stability: Extremely hazardous in contact with many materials, particularly metals. Dilute acid reacts with metals releasing hydrogen which can form explosive mixtures with air in confined spaces.
Stable during transportation.

Incompatibility with other material:
Extremely hazardous in contact with many materials, particularly metals and combustibles.

Reactivity:
Reacts violently in water with evolution of heat. Spattering occurs when water is added to the compound.

Reactivity with common material:
Extremely hazardous in contact with many materials, particularly metals and combustible. Dilute acid react with most metals, releasing hydrogen which can form explosive mixtures with air in confined spaces.

Hazardous reaction products:
Decomposes on heating emitting toxic fumes and oxides of sulfur.

5. HEALTH HAZARD DATA

Routes of entry: Vapour mist contact, Inhalation, Splashing on eyes / skin, Swallowing.

Effects of Exposure / Symptoms:
- Contact with vapour mist causes irritation to eyes, nose and throat.
- Harmful if inhaled, can possibly cause harmful corrosive effect. High concentrations of vapour can cause severe irritation of the respiratory tract. Will cause coughing, difficult breathing, or loss of consciousness.
- Corrosive to eyes. Eye contact can cause corneal burns. Permanent eye damage including loss of sight may occur.
- Liquid will burn skin. Highly corrosive to skin. Causes severe burns.
- Can kill if swallowed in large amounts. Swallowing will cause severe damage to the mucous membranes. May cause severe burns to the mouth, throat and stomach. Ingestion can cause nausea and can result in abdominal pain.

Emergency Treatment:
- In case of contact with vapour mist, wash immediately with large amount of water.
- In case acid vapours are inhaled, move victim to fresh air. Allow victim to assume most comfortable condition and keep warm. Keep at rest until fully recovered. If breathing is laboured and victim cyanotic (blue), ensure airways are clear and have qualified person give oxygen through face mask. If breathing has stopped apply artificial respiration at
ON-SITE EMERGENCY PLAN

once. In the event of cardiac arrest, apply external cardiac massage. Seek medical attention immediately.

• If splashed in eyes, hold eyelids open and flush with plenty of water immediately for at least 15 minutes. Seek immediate medical assistance. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.

• In case of contact with skin, remove contaminated clothing and shoes. Flush affected areas with plenty of water immediately. Treat skin and clothing with 1% sodium bicarbonate solution to neutralize acid residues. If irritation occurs seek medical advice.

• Can kill if swallowed in large amounts. If swallowed and victim is conscious, have victim drink water or milk. Do not induce vomiting. Rinse mouth thoroughly with water immediately.

TLV : 1 mg/m3 for 60 min STEL : 10 mg/m3 for 5 min

Permissible Exposure Limits LD₅₀: Odour threshold :
IDLH value is 80 mg/m³ > 1 mg/m³

NFPA Hazard Classification :
Health (Blue) : 3 Flammability (Red) : 0 Stability Special (Yellow) : 2

6. PREVENTIVE MEASURES

Personnel Protective Equipment :
Following personnel protective equipment must be worn :

Overalls or similar protective apparel, Safety glasses / goggles or face shield, as appropriate, Rubber boots, Elbow length PVC gloves, Splash apron, Wash contaminated clothing before storing / reusing. Avoid all contact.

Handling and Storage Precautions :

Store in well ventilated area. Store in a cool, dry place. Keep dry, it reacts with water violently and may lead to drum rupture. Keep containers securely sealed and protected against physical damage. Store away from strong bases. Not to be loaded with Class 1, 4.3, 5.1, 5.2, 6 (where the substance is cyanide), 7, foodstuff and foodstuff empties.

Corrosive to most metals in the presence of moisture liberating hydrogen gas which could potentially cause explosion. Reacts violently or explosively with a wide range of organic and inorganic chemicals, including water, alcohol, carbides, chlorates, picrates, nitrates, metals and other combustibles.

Always wear safety glasses. Do not allow the acid or a solution of it to come into contact with skin. Concentrated sulphuric acid should not be diluted by inexperienced users when diluting acid always wear eye protection and always add acid to water (not the reverse) slowly and with great care.
7. **EMERGENCY AND FIRST AID MEASURE**

**Fire Extinguishing Media**

**Fire**: Fires in the vicinity is to be extinguished with DCP or CO$_2$. Toxic fumes emitted on heating. Fire fighters to wear self contained breathing apparatus.

**Special Procedures**:

Shut off all possible sources of ignition. Clear area of all unprotected personnel. Contain spills using sand and earth. Prevent runoff into drains and waterways. For large spills notify Emergency. For minor spills neutralize with lime or soda ash adjusting pH to 6 – 10. Flush to sewer as a greatly diluted solution. Wear full protective clothing while handling sulfuric acid. Self contained breathing apparatus is required for prolonged periods of exposure.

**Unusual Hazards**:

Decomposes on heating emitting toxic fumes of oxides of sulfur. Reacts violently with water.

**Exposure**:

*Maintain concentration below recommended exposure limit.*

Use with local exhaust ventilation or combination particulate / gas respirator, Class B (Inorganic vapour). Self contained breathing apparatus needed for prolonged periods of exposure.

Threshold Limit Value (TLV) of 1 mg/m$^3$ has been recommended. IDLH value is 80 mg/m$^3$.

**Short Term Inhalation Limits**

- 10 mg/m$^3$ for 5 min
- 5 mg/m$^3$ for 10 min
- 2 mg/m$^3$ for 30 min
- 1 mg/m$^3$ for 60 min.

Odor Threshold : > 1 mg/m$^3$

**First aid Measures**:

- In case of contact with vapour mist, wash immediately with large amount of water.
- In case acid vapours are inhaled, move victim to fresh air. Allow victim to assume most comfortable condition and keep warm.
- If splashed in eyes, hold eyelids open and flush with plenty of water immediately for at least 15 minutes.
- In case of contact with skin, remove contaminated clothing and shoes. Flush affected areas with plenty of water immediately.
- If swallowed and victim is conscious have victim drink water or milk. Do not induce vomiting. Rinse mouth thoroughly with water immediately.

**Antidotes / Dosages**: Treat symptomatically as for strong acids.
ON-SITE EMERGENCY PLAN

SPILLS

Steps to be taken: Contain leaking liquid in a sump having acid proof brick lining. Contain using sand and earth – prevent run-off into drains and waterways. In the event of a small spill neutralize remaining product with lime or soda ash, adjusting pH to 6-10.

Waste Disposal Method: Seal all the waste in an acid proof containers for eventual disposal.

8. ADDITIONAL INFORMATION / REFERENCE:

9. MANUFACTURER / SUPPLIER DATA: Hindustan Zinc Ltd, SPIC and other local producer

10. DISCLAIMER

Information contained in this material data sheet is believed to be reliable but no representation; guarantee or warranties of any kind are made as to its accuracy, suitability for a particular application or results to be obtained from them. It is upto the manufacturer / seller to ensure that the information contained in the material safety data sheet is relevant to the product manufactured / handled or sold by him as the case may be. The Government makes no warranties expressed or implied in respect of the adequacy of this document for any particular purpose.

Prepared as per Schedule 8-A as per Gujarat Factory Rules 68-J/12/(1), previously it was prepared as per old format

Updating record
July - 2011