SAFETY & HEALTH IN CHEMICAL INDUSTRY

In the present global industrial scenario, for any industry to be successful, it is essential to inculcate safety culture, consciousness in health and environment aspects in each personnel of an organisation. IFFCO-AONLA has identified this as a major thrust area since beginning and is continuously putting efforts for improvement in the Safety, Health and Environment Management.

IFFCO’s continuous best efforts to implement Safety, Health and Environment Systems in the organization have been appreciated and recognised by several Government and safety regulating bodies.

This paper is a brief presentation of various facets of Safety and Health in chemical Industries with a special focus at IFFCO–Aonla unit.

Indian Farmers Fertiliser Co operative Ltd., Aonla Unit

Introduction

The significance of Safety & Health in chemical industries has been a vital issue in achieving productivity and an edge in the competitive world. This paper is an effort to present the various factors governing the safety and Health of chemical industries with a special focus on IFFCO Aonla Unit – the flagship Ammonia-Urea Complex of Indian Farmers Fertiliser Coop. Ltd.

FACETS OF SAFETY & HEALTH IN A CHEMICAL INDUSTRY

Risk Of Accidents And / Or Harmful Exposures : Areas of Concern


Dangerous Materials


Hazards Of Pressure Vessels


Hazardous Chemical Reactions

Understanding about the behaviours of reactions and adopting precautionary and emergency measures

<table>
<thead>
<tr>
<th>Reaction Rate</th>
<th>Normal Arhenious equation</th>
<th>Anomaly 1</th>
<th>Anomaly 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hazards of Unit operations

Understanding the hazards inherent in each unit operation and adopting precautionary and emergency measures. examples
<table>
<thead>
<tr>
<th>Heat Transfer</th>
<th>Surface Fouling &amp; Leakage, Miscalculation in scaling, Mixing of fluids etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size Reduction</td>
<td>Dust Explosions, Dust release, etc.</td>
</tr>
</tbody>
</table>

**Flammable Gases, Vapours And Dust Hazards**

- Identification of potential areas, where possibility of flammable mixture are possible.
- Efforts to avoid hazardous mixtures, by inert gas purging and other methods.
- Declaring hazard zones and providing flame proof electrical fittings and equipments.
- Providing Explosion Vents in spaces with possibility of air-vapour mixtures.
- Explosive meter testing.
- Providing adequate fire control devices.
- Providing arrangements to avoid static sparks. Etc.

**Health Hazards**

- Identification of potential health hazards.
- Assessment of levels of physical and chemical health hazards.
- Control of hazards by various techniques
- Adequate awareness among the workers.
- Periodic medical examination of the workers.
- Personal protection for occasional exposures.
- Proper hygiene and decontamination facilities. etc.

**Hazards Due To Corrosion**

- Weakening and falling of structures and sheds.
- Falling of workers from height due to breaking of raised platforms, hand rails, toe boards, stairs and ladders.
- Spills and toxic releases from pipelines due to corrosion.
- Leakages and bursting of vessels due to corrosion.
- Corrosion monitoring and control.
- Testing and inspection of vessels and structures to ensure safety

**Entry into Confined Spaces**


**Safety While Entry into Confined Spaces**

- Thorough cleaning and purging before hot work.
- Safety belt with one end outside.
- Life line to monitor welfare.
- On going ventilation.
- A person to watch the welfare.
- Low voltage electric appliances.
- Self contained breathing apparatus.
- Environmental monitoring for oxygen, toxic gases and flammable gases before entry.
- Pipeline isolation before entry
- Electric isolation before entry.
- Proper ladder for entry.

**Safety In Use Of Pipelines**

- Hazards due to inadequate Identification of Pipelines.
- Hazards due to leakages and bursting of pipelines.
- Hazards due to collision of vehicles with pipelines.
- Hazards due to improper materials of construction of pipelines.
- Hazards while breaking of pipelines.
• Hazards while tapping of pipelines.
• Bursting due to thermal expansion of liquids in the pipelines.
• Bursting of pipelines due to freezing of pipelines.
• Accumulation of condensates in the pipelines. Etc

**Plant Alterations and Modifications**

Alteration in plant, equipment, component, process, operating procedure, etc. due to some difficulty. Followed by failure in some unforeseen aspect of the system.

• If any alteration is inevitable,
  • Design intention of each and every component of the system should be well understood by every person concerned.
  • Refer the matter to the designers.
  • Carry out HAZOP study by expert team.
  • Pass it through plant modification approval committee

**Sampling And Gauging**

• Exposures of gases, vapours and dust while collecting samples.
• Approaching odd locations.
• Splashes and spillages while collecting samples.
• Exposures due to breaking of sight glasses and glass level indicators.
• Dip gauging of flammable liquids.
• Dip gauging of corrosive liquids.

**Hazards Due To Instrument Failures**

• Absence of fail safety instruments.
• Lack of interlocks and trip systems.
• Human failures in manual and semi automatic operations.
• Need for safety analysis of the instrumentation systems

**TOTAL SAFETY & HEALTH MANAGEMENT AT IFFCO AONLA**

The following are the parameters which were decided after a meticulous study in view of Safety & Health of IFFCO Aonla Unit.

1) Site.  2) Construction Design  3) Protection Zones  4) Process & Safety
5) Set up of fire & safety section  6) Information on preliminary hazard analysis
7) Safety relevant components  8) Special Design criteria  9) Instrument controls and alarms
10) Major Hazardous installations  11) Information on the Hazardous assessment
12) Safety systems  13) Maintenance & Inspection Schedules
14) Implementation safety procedures

**SITE**

Indian Farmers Fertiliser Cooperative Limited (IFFCO) Aonla operates fertilizer plant for manufacturing Urea at P.O. IFFCO Township, Aonla, Distt. Bareilly (U.P.). It comprises of two Ammonia Plant of 1520 MT per day and four streams of Urea plant each of capacity 1310 MT per day and a captive power plant of 2 X 18.0 MW. Urea silo, bagging plant and other related offsite facilities like - water treatment plant, effluent treatment plant, inert gas plant, cooling towers, naphtha. Ammonia storage and supply of utilities like compressed air, water etc. also exists for smooth operation of plant.

The site is located at Latitude – north 28.2 degree equator, Longitude – east 19.2 degree green witch, at a distance of about 28 km south-east of Bareilly, on Bareilly-Aonla highway (SH-33, 22 KMS upto Bareilly-Bhamora-Badaun road and about 6km on Bhamora-Aonla road). The entire project site occupies an area of 1273 acres out of which about 673 acres is occupied by the plant where industrial activity is performed and the balance is occupied by the IFFCO residential township, Drains, open spaces, etc. The site is well far away from the crowded population and near by vicinity only after 2 kms the thin populated villages are there.

**CONSTRUCTION DESIGN**

All the process plants and utility services at IFFCO Aonla unit have been designed and constructed by Consultants and contractors of international repute. The technologies have been carefully selected based on the proven track
record of the respective consultants. Safety and reliability have been the principal criteria in evaluation of the
technologies for the various plants and state of the art technological innovations are being constantly incorporated in
the plants to upgrade them to the current level of expertise available in the field. The consultants and principal
contractors involved in the design and construction of various plants at IFFCO Aonla Unit are of internationally high
repute like Haldor Topsoe(Denmark), SnamProgetti(Italy), Toyo Engineering Corporation, Kawasaki and Mitsui Engg &ship, Diesel Energy (German), Hitachi (Japan), PDI, DCPLthermax, Daharpur, Techno Fab engg, K.G. Khosla,
Ingersol Rand, Matther & Platt, Kirloskar Cummins & BHPV (India)

All the plants have been provided with sophisticated instrumentation for continuous monitoring of the operating
parameters and inherent safety has been in built in the instrumentation system to provided audio visual annunciation
on the control panels in case of any abnormality in the operating conditions to warn the operator. In case the
abnormality persists or exceeds a predetermined limit, a fool proof trip system has also been furnished to trip the
plant and proceed to a safe shut down of the concerned equipment and / or entire plant. Safety interlocks have
been provided at strategic points to eliminate possible human errors. Comprehensive fire – fighting facilities as per
recommendation of Tariff Advisory Committee have been provided at the site consisting of a network of underground
fire hydrant system, fixed foam installation for naphtha tank farm, smoke detector installation for empty bag storage,
CO2 extinguishing system for turbo generator and mobile foam and fire tenders. The fire and safety section, headed
by a trained officer of Manager rank, is manned round the clock by qualified and trained personnel to tackle any kind
of emergency. Safety equipment like - walkie – talkie sets, Safety helmets, hand gloves, ear muffs goggles, face
shields, gas masks, safety belts etc. have been provided to all the concerned operating and maintenance personnel.

PROTECTION ZONES (EXPLOSION PROTECTION, SEPARATION DISTANCES)

Premises are strictly maintained as a “No Smoking” area. For electrical installations and instrumentation, the entire
plant area has been sub-divided into hazardous and non hazardous zones. The hazardous zones have been
classified appropriately as per the National Fire Protection Association (NFPA) code 70, better known as the
National Electric Code. The NFPA classifies Hazardous Areas by three different factors known as classes, groups
and divisions. These factors each identify different elements of concern and combine to define the type of hazardous
substance (Class), and explosive rating of the substance (Group) and the degree of hazard created (Division).

The plant layout has been designed as per established engineering practices in conformity with the provisions of
required safety separation distances have been maintained. The layout of plants, under the purview of the various
statutory regulations has been granted and these regulations are being renewed regularly:
In addition to the fulfillment of statutory requirements, compliance of recommendations of various other national and
international standards and Code of Practices have been kept in view for the layout of the plant facilities.

Separation distance maintained in protection zones as per rules. The equipments, pipings and instruments action
are provided for explosion protection. Explosion proof motors and fittings are used for hazardous areas. Explosive
meters are also provided to plant in-charges for checking gas leak, if any. Proper fire prevention and protection
equipments installed, checked and kept ready.

PROCESS & SAFETY – RELATED DATA FOR INDIVIDUAL PROCESS STAGES:

Physical and Health Occupational Hazards in any large scale Chemical /Hydrocarbon Processing Industry (CPI/HPI)
like our can be broadly classified into the following categories:

i) Mechanical Risks  ii) Electrical Risks  iii) Fire/Explosion Risks  iv) High /low Temperature Exposure Risks  v)

The first two types of risks are of universal nature associated with any industrial activity and not specific to a
particular plant or process. Mechanical risks which are generally encountered are injuries to the head, Limbs, eyes,
etc usually as a results of negligence on the part of operating/maintenance personnel in the use of improper tools,
bypassing prescribed safety procedures neglect of personal protective wear and risks associated with rotating
machinery as well as risks associated with high-energy release from compressed gases. Electrical risks which result
in shock and/or burns are most often a consequence of poor maintenance, ingress of dust or moisture, handling by
unauthorized personnel and use of improper/substandard hardware. Other categories of risks associated with
specific plants are detailed here under:

Ammonia Plant:

The manufacture of anhydrous liquid ammonia involves processing of hydrocarbons under high
temperature, high pressure conditions in the presence of various catalysts, chemicals etc. Typical risks are as
follows:
Fire / Explosion

- Glands/seal leaks in valves, pumps, compressors handling hydrogen, natural gas, naphtha, synthesis gas etc.
- Hose/pipe failure, leakage from flanged joints carrying combustible gases, vapours, liquids.
- Fire box explosions in furnaces.

Critical data for flammable materials in Ammonia Plant is given below:

<table>
<thead>
<tr>
<th>Flammable Material</th>
<th>Flammable Limits in air, % v/v</th>
<th>Auto Ignition Temp., deg.C</th>
<th>Flash Points. Deg. C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
<td>Upper</td>
<td></td>
</tr>
<tr>
<td>Hydrogen</td>
<td>4</td>
<td>74.2</td>
<td>580</td>
</tr>
<tr>
<td>Natural gas</td>
<td>5</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Naphtha</td>
<td>1</td>
<td>6</td>
<td>232</td>
</tr>
<tr>
<td>Ammonia</td>
<td>16</td>
<td>25</td>
<td>651</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>12.5</td>
<td>74.2</td>
<td>700</td>
</tr>
<tr>
<td>Hydrazine Hydrate</td>
<td>2.9</td>
<td>98</td>
<td>270</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dust</th>
<th>CAS No.</th>
<th>TLV, mg/m3</th>
<th>IDLH mg/m3 (NIOSH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos fibers Alumina Total Dust</td>
<td>1344-28-1</td>
<td>0.1 fbr/cc (ACGIH)</td>
<td>-</td>
</tr>
<tr>
<td>Vanadium (As V2O5)</td>
<td>1314-62-1</td>
<td>0.05 (e)</td>
<td>-</td>
</tr>
<tr>
<td>Respirable dust &amp; fume</td>
<td>112926-00-8</td>
<td>0.05 (e)</td>
<td>-</td>
</tr>
<tr>
<td>Silica gel</td>
<td>7440-02-0</td>
<td>10 (e)</td>
<td>-</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.1</td>
<td>0.05A1</td>
<td>-</td>
</tr>
<tr>
<td>Metal</td>
<td>0.05A1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Insoluble compound as Ni</td>
<td>0.05A1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Soluble compound as Ni</td>
<td>0.05A1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Iron Oxide (as Fe)</td>
<td>1309-37-1</td>
<td>10 (e)</td>
<td>-</td>
</tr>
<tr>
<td>Iron Oxide fume (Fe203)</td>
<td>1314-13-2</td>
<td>5</td>
<td>NE</td>
</tr>
<tr>
<td>Zinc oxide</td>
<td>1314-13-2</td>
<td>0.05</td>
<td>-</td>
</tr>
<tr>
<td>Fume</td>
<td>10 (e)</td>
<td>5</td>
<td>NE</td>
</tr>
<tr>
<td>Dust</td>
<td>0.5</td>
<td>0.5</td>
<td>NE</td>
</tr>
<tr>
<td>Metal</td>
<td>0.5</td>
<td>0.5</td>
<td>NE</td>
</tr>
<tr>
<td>Cobalt (as Co)</td>
<td>7440-48-4</td>
<td>0.05</td>
<td>20</td>
</tr>
<tr>
<td>Metal dust &amp; fume</td>
<td>0.05</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>Molybdenum as Mo</td>
<td>7439-98-7</td>
<td>0.5</td>
<td>-</td>
</tr>
<tr>
<td>Insoluble Compound</td>
<td>15</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Perlite</td>
<td>10 (e)</td>
<td>10</td>
<td>NE</td>
</tr>
<tr>
<td>Total dust</td>
<td>15</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>Respirable fraction</td>
<td>5</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Amosite</td>
<td>12172-73-5</td>
<td>0.5 fbr/cc</td>
<td>-</td>
</tr>
<tr>
<td>Chrysolite</td>
<td>12001-29-5</td>
<td>2 fbr/cc</td>
<td>-</td>
</tr>
<tr>
<td>Crocidolite</td>
<td>12001-28-4</td>
<td>0.2 fbr/cc</td>
<td>-</td>
</tr>
</tbody>
</table>

NIOSH - National Institute for Occupational Safety & Health.
ACGIH - American Conference of Governmental Industrial Hygienists.
CAS - Chemical Abstracts Service Registry Number.
STEL - Short Term Exposure Limit
LEL - Lower Explosive Limit.
**IDLH**
- Indicates that no evidence could be found for existence of IDLH.

**NE**
- The value is for total dust containing no asbestos and < 1% crystalline silica.

**AI**
- Confirmed as Human Carcinogens.

**Reactive Chemicals Exposure Risks.**
- Severe burns, damage to eyes, skin & body tissues due to contact with corrosive chemicals like sulfuric acid, caustic soda, anhydrous ammonia, Potassium Carbonate solution, etc. and extremely reactive, pyrophoric Converter catalyst.

The Permissible Exposure Limits for these chemicals are given below:

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>PEL, mg/M3</th>
<th>TWA, mg/M3</th>
<th>STEL, mg/M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphuric Acid</td>
<td>1</td>
<td>1</td>
<td>80</td>
</tr>
<tr>
<td>Sodium Hydroxide</td>
<td>2</td>
<td>(c) 2</td>
<td>250</td>
</tr>
<tr>
<td>Diethanolamine</td>
<td>-</td>
<td>15</td>
<td>-</td>
</tr>
</tbody>
</table>

**High/Low Temp. Exposure Risks**
- Burns due to contact with hot surfaces of pipelines, equipments, etc. or leaking steam lines, process fluids at high temperature.
- Frost bite due to contact with anhydrous liquid ammonia at -33 deg. C
- Burns due to contact with pyrophoric catalyst.
- Asphyxia due to inhalation of simple asphyxiants like CO₂, N₂, H₂, CH₄, naphtha etc. and chemical asphyxiants like CO, NH₃, Nickel carbonyl, V₂O₅, Hydrazine, NOₓ, SOₓ, H₂S etc.
- Acute toxicity due to inhalation of catalyst dusts containing heavy metals like Ni, Cr, CO, Mo, Fe, Zn, Alumina etc. and silica gel molecular sieves, insulation fibers/dusts.

**Urea Plant**

The manufacture of urea involves reaction of Ammonia and Carbon dioxide under high temperature & pressure and subsequent recovery and concentration of the solution at various pressure stages. Typical risks are as follows:

**Fire / Explosion Risks**
- Ammonia leaks from glands / seals Risks involves, pumps or flanged joints piping resulting in formation explosive mixtures in air. Accumulation of H₂ may take place in HP Section in case CO₂ purity from Ammonia Plant is not within allowable limits. Ignition of this accumulated H₂ can occur due to dissipation of static charge.

**High / Low Temperature Exposure Risks**
- Refer to risks in Ammonia Plant

**Toxic Chemicals Exposure Risks**
- Asphyxia due to inhalation of simple Exposure Risks asphyxiants like CO₂ and N₂ and chemical asphyxiant, NH₃. Solution of Urea, Ammonium carbamate and ammonium carbonate containing high NH₃ content. Irritation due to inhalation of urea dust.

**Corrosive / Radioactive Chemicals Exposure Risks**
- Severe burns, damage to eyes, skin and body tissues due to contact with anhydrous ammonia, conc. Urea and Ammonium carbamate solutions.
**Power Plant**

The captive Power Plant involves generation of Power through Gas Turbines and generation of steam in N.G./Naphtha-fired boilers/HRSG units and utilizing the steam in Urea and Ammonia plants. Typical risks are as follows:

<table>
<thead>
<tr>
<th>Fire / Explosion Risks</th>
<th>Explosion and fire risks associated with storage and handling of B Class (Naphtha) and Natural gas handling pipelines (Refer off site Facilities).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fire Box explosion in Boiler</td>
</tr>
</tbody>
</table>

Critical Data for the above flammable materials in Power Plant is given below:

<table>
<thead>
<tr>
<th>Flammable Limits in Air, % v/v Auto Ignition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammable Material</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>High / Low Temp. Exposure Risks</td>
</tr>
<tr>
<td>Toxic Chemical Exposure Risk</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The permissible exposure limits for cyclohexylamine coal dust / fly-ash are given below:

<table>
<thead>
<tr>
<th>Chemicals / Dusts</th>
<th>PEL, mg/m³</th>
<th>TWA</th>
<th>STEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexylamine</td>
<td>40</td>
<td>41</td>
<td>-</td>
</tr>
<tr>
<td>Respirable Fraction</td>
<td>10</td>
<td>2</td>
<td>-</td>
</tr>
</tbody>
</table>

**Offsite Facilities**

The offsite facilities, as already described at the very outset, consist of integrated units for water and effluent treatment, inert gas generation, cooling towers, storage of petroleum products and ammonia, supply / distribution of utilities like compressed air, water, etc. Potential risks in the above offsite facilities are essentially on account of handling of corrosive, toxic and reactive chemicals as well as inflammable petroleum products.

<table>
<thead>
<tr>
<th>Fire / Explosion Risks</th>
<th>Gland / Seal leaks in valves, pumps, compressor, handling naphtha, N.G., ammonia hydrogen, syngas etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hose / pipe failure, leakage from flanged joints in pipes conveying petroleum products, ammonia, hydrogen, syngas, etc.</td>
</tr>
<tr>
<td></td>
<td>Leakage of petroleum products during tanker unloading operations.</td>
</tr>
<tr>
<td></td>
<td>Overflow from storage tanks.</td>
</tr>
<tr>
<td></td>
<td>Overheating / pressurization of storage tanks.</td>
</tr>
<tr>
<td></td>
<td>Improper earthing / lightning protection of storage tanks and pipelines.</td>
</tr>
<tr>
<td></td>
<td>Improper sealing of floating roof tanks.</td>
</tr>
<tr>
<td></td>
<td>In adequate / improper breather valves leading to tank failures.</td>
</tr>
<tr>
<td></td>
<td>Fire Box Explosion in cracker Furnace.</td>
</tr>
</tbody>
</table>

Critical data for flammable materials stored / handled in off sites has already been furnished under Ammonia Plant and Power Plant.

<table>
<thead>
<tr>
<th>High / Low Temp. Exposure Risks</th>
<th>Burns due to contact with hot surfaces of pipe lines, equipments, etc or leaking steam lines.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heat radiation burns from high intensity flames from the flare stack.</td>
</tr>
<tr>
<td></td>
<td>Frost bite due to contact with anhydrous liquid ammonia at – 33 °C</td>
</tr>
<tr>
<td>Toxic Chemicals</td>
<td>Asphyxia due to inhalation of simple asphyxiants like N2, H2, Naphtha, etc. and Chemical asphyxiants like CI2, NH3, NOx, Sox, etc.</td>
</tr>
</tbody>
</table>
Exposure Risks
➢ Toxicity due to inhalation of catalyst dust containing heavy metals like Ni, Pd, Alumina etc. and perlite/insulation fibers, silica gel dust.

Data on Threshold Limit Values Limits for most of the above toxic Chemicals and dusts encountered in off sites has already been furnished under Ammonia Plant. Data for Cl2 are as follows:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>CAS No</th>
<th>TLV, ppm TWA</th>
<th>STEL (ACGIH)</th>
<th>IDLH ppm (NIOSH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>7782-50-5</td>
<td>0.5</td>
<td>1</td>
<td>30</td>
</tr>
</tbody>
</table>

Corrosive Chemicals
➢ Severe burners, damage to eyes, skin & body tissues due to contact with corrosive chemicals like anhydrous liquid Ammonia, Sulphuric acid, Hydrochloric acid, etc.

Bagging Plant
The bagging plant encompasses storage, packing, loading and dispatch activities for product urea via road or rail. Typical risks in this plant are as follows:

<table>
<thead>
<tr>
<th>Fire Risks</th>
<th>Fire hazards due to storage of bulk quantity of polyethylene – lined jute bags or HDPE bags which are easily combustible.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals Exposure Risks</td>
<td>Irritation due to inhalation of urea dust and jute fibers.</td>
</tr>
</tbody>
</table>

Well written safety manual is kept available at all places to know about various hazards and to bring the risk level to tolerable. All necessary instrumentation process interlocks were provided to run the plant safely. Only well trained persons are allowed to operate and to do the maintenance of the plant. Well proven technologies were chosen for the process and for the plant design.

SETUP OF FIRE AND SAFETY AT IFFCO AONLA

All staff of Fire & Safety, Health and Environment sections are well qualified Engineers, Fire & safety officers and Doctors.

Equipments For Fire Fighting
IFFCO-AONLA is well equipped with all Fire & Safety appliances like Fire Tenders-3 with a pick up van, all types of extinguishers like DCP, CO2, WATER CO2 Foam types in adequate numbers, PPES like Breathing Apparatus of different types & capacities, OnLine Air masks at various Hazardous areas, Gas tight Suits, Alumnised Suits, Explosive meters, Portable Gas Detectors, Chlorine Emergency Leakage Kit, Air compressor for air cylinders filling, PVC apron & suits, gum boots, safety shoes, safety belts, Various types of hand gloves, ladders, nylon life saving net, Canisters, safety torches, dust pads etc.

Fire Detection/ Alarm System for Plant Control Rooms, Administrative building, Cable Galleries, Transformers are also provided. These are of Ionization, Optical & Heat sensing type.

Fixed Installations
1. All Naphtha tanks are protected by installation of automatic fixed foam pouring system at their top which is checked periodically and record is maintained.
2. There is a battery of CO2 cylinders installed for the turbo Generator sets GTG-I, GTG-II & GT in Ammonia-2, designed to come into operation in case of fire.
3. In Bagging Plant including Empty bag Storage Fire hydrant system is well laid out & connected with Smoke detectors have been installed to work in case of any fire.
4. Smoke detection system is provided at all the important buildings and control rooms.
5. Well Laid under ground Fire Hydrant System Underground fire hydrant pipes have been laid throughout the premises as per the TAC guideline, keeping in mind area wise hazard categorization, based on which the distance of hydrant posts were provided. To maintain minimum hydrant pressure of 7 kg/cm2 fire pumps & auxiliary systems are provided at fire pump house near Raw water reservoir.
6. At various places Eye wash showers have been installed where hazardous chemicals are being handled.
7. Flame Proof fittings at the hydrocarbon storage and handling areas. 
8. Flame arrestors on moving equipments and Spark arrestors on various hazardous fixed installations.
9. Bounding was done at various flanges to avoid static sparks at the critical hazardous installations

**Safety Equipments**

1. Gas masks for use in leakage of Gases like Ammonia, Chlorine, etc. are available in all the Plant. Apart from this, breathing apparatus supplied by MSA, (USA) are available in all the control rooms and at Ammonia storage tank area.
2. Air line systems are provided in Urea and Ammonia control rooms for which air is supplied from instrument air header. These can be used by the operators working in control room in case of Ammonia leak.
3. Explosive meters supplied by M/s. MSA, (USA) and RESPO PRODUCTS .are available in all the plants for checking any leak of gases and testing the vessel and operating areas, before issue of hot work permit or permit for vessel entry etc.
4. Personnel Protective appliances like safety helmet, safety goggles hand gloves etc., are issued to all the employees. Apart from this Eye wash showers, face shields, PVC suits etc. are installed in all sections of the plant.
5. Gas tight suits, chemical splash suits, Fire proximity suits and other suits are available to handle emergencies like toxic release, fire etc.

**Training In Fire Fighting & Safety ,Ohsas-18001 and other safety & health measures**

1. Training of first aid fire fighting and accident prevention is imparted twice every year to all the employees, by the officers of fire and safety section. Sufficient numbers of employees have also been trained by St. John Ambulance Association on ‘First aid to the injured’.
2. Twice in a year, Fire and safety section exercised Disaster ON-SITE Mock Drill with information to all Local authorities, for proper readiness in case of major disaster.
3. Emergency instructions are displayed at required places indicating actions to be taken in case of any leaks of Ammonia, Chlorine and Naphtha. Hoarding of hidden hazards are also displayed in different plants along with the control measures to be adopted while working there.
4. Wind socks are provided in Ammonia Plant, Ammonia Storage and handling area, Chorine handling area and other strategic locations to indicate wind direction in case of any toxic gas leak.
5. Portable oxygen meters and Explosive meters/Combustible Gas Indicators are also available in fire and safety section for checking the area or vessel, before entry and job to be carried out.
6. Periodic medical examination is being done for the employees
7. Proper hygiene and decontamination facilities have been provided and being done regularly
8. By putting the objectives and targets in OHSAS-18001like various trainings on Fire & Safety ,environment and health matters, periodic health check of the employees, training of Truck drivers and transporters and Importantly to contract and casual labour. and then follow up is being done rigorously to meet the objectives
9. All chemicals MSDS (Material Safety Data Sheet) are kept at easily available places to know about the properties and other values.
10. Each chemical antidotes are also kept available in the hospital and at various places.
11. In order to create sense of safety consciousness safety section organises, various competitions every year like safety essay, slogan, debate and quiz competitions for regular employees and safety drawing competition for their children. Prizes are also given to the winners for motivation.

**Communication during Emergency**

i) Fire and safety section has two phone numbers with one emergency phone number (i.e.100). All these numbers are well displayed in different locations in plants so that fast communication can be possible in case of emergency.

ii) Two nos. Sirens having range of 10 to 16 Km. are installed at two different locations in the plant premise. In case of emergency, these are operated from Fire and safety section

**INFORMATION ON THE PRELIMINARY HAZARD ANALYSIS**

**Types of Accident**

It is clear that during the course of Urea manufacture, furnaces, reactors, moving machineries, material handling, cranes, chain, pulley blocks, wire ropes, chemicals, Rail wagons, etc. are involved. Past reportable accidents are related to these agencies.
Type of personnel injuries indicates burn, cut, bone fracture burn injury etc. A brief resume of types of accidents may happen are as follows :-
1. Burn injury due to handling cleaning of burners in furnaces.
2. Fire accidents in furnaces leading to property damage.
3. Burn injury accident due to attending electrical faults.
4. Burn injury accidents due to handling of acids / alkalies.
5. Hit / cut type accidents due to various maintenance jobs.

**System Elements or Events that can lead to a major Accident**

All the section / plants of IFFCO Aonla unit are constructed and designed taking care of all relevant safety measures possible. However the system elements such as Ammonia storage, Naphtha storage, Chlorine tonners, Ammonia Plant area, Urea Plant HP section are some of them which can lead to a major accident. Although, Fire, explosion and release / leakage of toxic chemicals may lead to major accident, all necessary safety measures have been duly incorporated in the plant design and regular up gradation of safety appliances is carries out.

**Hazards**

Urea manufacturing process involves many chemicals such as NG, as feed stock, Ammonia as an intermediate product and chlorine, hydrochloric / sulfuric acids, as water treatment chemicals. Furnaces, High pressure vessels, Reactors, pipe lines, storage tanks are also involved in the course of Urea and Ammonia manufacturing. Handling and storage of these Hazardous chemicals and their use in the process may leak to a hazardous situation.

**SAFETY RELEVANT COMPONENTS**

The design and operating procedures has been so developed that it enables the safe handling, operation and upkeep of plants. However, so far no major accident has taken place. The built in Safety has been the prime factor while selecting the equipments, processes etc. Standards codes of practices are being followed seriously during the erection, modification etc. Some Safety relevant components are mentioned below :-

- Use of relief valves, rupture discs, explosion vents of adequate sizes with proper testing. Checking of these safety relevant components are done in every annual shut down.
- Automatic control valves, solenoid operated quick shut off valves are installed to control any sort of emergencies.
- Alarms, sensors, relays, trip systems have been provided.
- Proper training, disclosure of information related to Safety rules / procedures have been given.
- Appropriate operating procedures, manuals etc. are implemented since inception.
- Flare stack for burning of vent gases like Ammonia, Natural Gas and Naphtha Vapours have been provided.
- All the statutory requirements are being fulfilled and followed.

**SPECIAL DESIGN CRITERIA**

Based on Preliminary hazard analysis the design criteria of system elements are as follows –

**Plant Design**

All Plants are redesigned with a great deal of safety. The whole plant is open with proper lay out of pipe lines, trenches, cables and flame proof lighting arrangements. A proper spacing between the equipments, reactors, pumps, turbines, and compressors has been kept. Insulation of pipe lines, vessels have been done wherever required. Proper marking, arrows, colour coding has been done for convenience and statutory requirements. Control room with emergency doors and safety equipments are established. Safety trip systems with alarms and trip relays (intrinsically safe) have been provided to control and safe shut down of the plant during emergencies. Stacks for furnaces and flare stack for burning of vent / excess gases of 30 M. height have been provided.

Safety valves, Rupture discs, explosion vents, vacuum breakers have been provided as extra safety precautions other than automatic tripping of concerned equipment / unit in case of any abnormality.

All safety measures have been adopted to ensure safe handling and operation of these plants. Safety devices are of adequate sizes. Waste disposal being done with great care. The stack of Power Plant is 120
High and analysis of CO2 is being carried out regularly. SPM (Suspended particulate matter) and SO2 are monitored on weekly basis. All the parameters are always well with in the prescribed standard of U.P. Pollution control Board / Central Board.

**INSTRUMENT CONTROL AND ALARMS**

**Ammonia Plant/Urea Plant/Other Facilities**

Kick back antisurge valves on compressors to avoid surging in compressors. Pressure controls at different points of the plants to control operating pressure automatically well within the limits. Flow controls to control and regulate flow of fluids automatically at desired level. Temperature controls to control requisite temperature automatically. Level controls to control level in various equipments automatically.

Likewise several alarms and trip circuits with automatic actuation are given in all the plants for safe operation and process control.

**Special Relief System**

There are a number of relief valves provided in Ammonia, urea, power plant and off sites to protect the vessels/reactors from over pressurization. There checking / inspections are carried out regularly once in year.

**Emergency Valves (Solenoid Operated)**

Solenoid operated emergency valves have been provided on steam inlet lines to turbines and on Fuel system to furnaces for quick shut down off.

**Technique and procedure of testing of safety alarms, tripping and interlocking devices and other safety instruments**

All the main centrifugal compresses trains of ammonia and urea plant are having de-energise to trip system. The trip switches are checked in the annual shut down and before every start up.

Turbo generatorS of the power plant are also having trip system with de-energise to trip. The trip switches are checked during annual shut down / half yearly and before every start up. All the annunciators of all the plants are checked every week. All the emergency trips of Ammonia and Urea Plants are checked in shut down before every start up. Vibration report along with comments of inspection engineers is sent to respective plant manager immediately for corrective action required if any.

**MAJOR HAZARDOUS INSTALLATIONS**

**Ammonia Storage Tanks**

- IFFCO AONLA has two no.s of double wall double integrity domed roof atmospheric ammonia storage tanks constructed by TOYO ENGG JAPAN. Consultants for the ammonia storage tank is HALDOR TOPSOE. Both the tanks were originally commissioned in 1988. T-2301 was re-commissioned in 2002 and T-3301 was re-commissioned in 2003 respectively. Earlier decommissioning of the tanks was carried out to assess their suitability to continue in service. Inspection and re-commissioning work was done by PDIL in co-ordination with IFFCO
- Refrigeration compressors Adequate safety valves, vacuum breathers, relief valves and other instrument controls & indicators with alarms have been provided to maintain the tank pressure under control. Tank is well insulated with Poly urethane foam, perlite, foam glass, dry sand, asphalt sheet etc to avoid heat ingress.

**Insulation Details of Ammonia Storage Tank:-**

- Roof Insulation: Urethane Foam(150mm)
- Wall Insulation : Urethane Foam(150mm)
- Bottom Insulation: Foam Glass + Dry Sand(200mm+100mm)
- Bottom Block Insulation: Perlite Concrete
**Inspection Schedule**
- In situ testing of safety valves is carried out by raising the vapour pressure in the tank.
- Calibration of liquid level indicator, using Ir.192 gamma-rays-isotopes.
- Visual inspection of surface of outer tank is carried out every year.

**Naptha Tanks**

**Collecting Tanks – Day Tanks**

In IFFCO aonla unit, Naphtha from rail tankers is unloaded into main storage tanks. From there it is sent to day tank in Power Plant which are of 24 hours capacity only. Similarly for Acid and Alkali, the Chemicals first stored in main storage tank from where it is pumped to small capacity tanks to different locations for use.

**Sprinkler System**

At IFFCO Aonla unit, medium velocity water sprinkler system provided at all Naphtha Tanks in two rings besides auto foaming system. This system operated manually with a valve provided at outside of the buntwall/dykewall.

**INFORMATION ON THE HAZARD ASSESSMENT**

**Identification of hazard**

The following main hazards exists in the factory under the situations given below-
- High temperature and pressure.
- Fire & explosions (due to inflammable / combustible materials).
- Toxic and corrosive chemicals.
- Toxic and poisonous gases and dust.
- Electricity (Receiving / Cluervation / Distribution).
- Disposal of wastes.
- Work at heights.
- Work in confined spaces / vessels / tank etc.
- Specific jobs carried under highly hazards atmosphere (CO2, NH3, Naphtha vapours etc.).
- Non working of safety devices, inter locks, failure of high RPM machineries.
- Failure of boilers etc.
- Any other consequences due to leak of Ammonia, Chlorine gases.
- Hazards during heavy equipment handling (Crane, etc.)
- Road accidents

However, the threats posed to the aforesaid hazards may be on account of (i) Fire or (ii) explosion or (iii) Release of toxic or corrosive liquid / gas from their confinement.

**The cause of major accidents**

Following Major causes may lead to major accidents :-
1. Release of Ammonia in huge quantity from storage tank.
2. Release of chlorine due to leakage / rupture in chlorine toner or its valve failure of injection pipe failure feeding to cooling tower.
3. Fire / explosion in Naphtha tanks due to leakage, unconfirmed clouds, or boil over, etc.
4. Explosion in High pressure equipments, reactors in Ammonia / Urea Plants.
5. Fire / explosion in furnaces of Ammonia Plant and boilers in Power Plant.

**Assessment of accident consequences**

A major accident may cause severe danger to life and properties. The assessment will be based on:
- Onsite losses.
- Offsite losses.
The first one will be loss of life, property damage and injuries to the scene of occurrence where the people are working or combating with the accident control. The offsite losses will include the loss of lives, injuries and properties damages of neighborhood bases on the affected area of accident or major event, if any.

SAFETY SYSTEMS

There exists a well organized safety management system at IFFCO Aonla unit with well defined “Safety, Health & Environment Policy”. Besides IFFCO has well defined Quality policy (ISO-9001), Environmental policy (ISO-14001) & Occupational Health and Safety policy (ISO-18001). IFFCO has all three systems of above mentioned topics which were certified by external agencies of international repute.

The brief description of activities of safety management system is as follows:-

Safety Committees

At IFFCO Aonla unit, there are following safety committees who meet regularly to discuss safety problems. These are –

(i) Central Safety Committee

There is a central safety committee. The Joint General Manager (Production) chairs meetings of central Safety Committee, which meets once every quarter. Manager (Fire & Safety) is the secretary. This central Safety Committee meets with an agenda. Minutes of the meetings are drawn and circulated to all members. Departments responsible for implementation of various recommendations of this committee are decided in meeting itself. This committee mainly talks on procedural matters of safety and reviews overall Safety Management System.

(ii) Plant Level Safety Committees

There are 7 such committees’ viz. Ammonia-1 & 2, Urea-1 & 2, Power Plant, offsite and Bagging Plant. These committees are headed by the concerned Department Incharge and include equal participation of officers, workers from plants maintenance, production. It deals with plant safety problems and follows up to identify accidents causes and implementation of remedial measures.

(iii) Safety Audit by external agency

There is a Safety Audit by external agency which once in a year conduct thorough audit of entire complex, in line with guidelines mentioned in IS 14489: 1998, and submit recommendations for improvement.

(iv) Internal Safety Audit

There are Internal Safety Audits by core group members of ISO-9001, ISO-14001 & OHSAS-18001 covering the plant area, workshops and stores quarterly. Each core group members visit their allotted other than their working area quarterly in a year and give recommendations for improvement of safety standards and compliances of other sections according to above ISO standards. These recommendations are circulated to all concerned department for implementation.

Responsibility of monitoring implementation of recommendations of different committees is that of Safety department.

(v) Motivation for Safety

For motivating safety, IFFCO Aonla unit management has introduced following schemes for enhancing safety consciousness of employees:

1) Safety slogan competition. 2) Safety essay competitions
3) Safety films screening 4) Safety suggestion schemes
5) Safety debate competition 6) Safety drawing competition among employees and their children
7) Safety quiz competition. 8) Marathon run four times a year to increase awareness on health and safety.
9) Conducting various training programs on health and safety topics.
10) Publishing informative articles in each issue of in-house magazine

(vi) House keeping committee
There is House keeping committee constituted by unit head. This committee is chaired by any Senior Management level employee and constituted of equal members from officers and workers of different plant of mechanical and production personnel. This committee visit each plants quarterly with one surprise visit in a year and allocated marks on their good house keeping. On that basis of these marks, plants has been declared as Winner & Runner in Good house Keeping in two groups during Safety Week celebration Closing Ceremony. This competition made IFFCO aonla unit as one of the best clean and green plant among fertiliser industry.

(vii) Safety Poster

To arouse Safety consciousness among the employees different posters and banners related to safety are displayed at relevant locations in the factory. These related to safety are rotated and changed from time to time to educate all the employees about the followings:
1) About home safety 2) About road safety 3) About working on machines and guarding
4) About working with dangerous chemicals 5) About working on heights 6) About electrical safety
11) About Air / Dust pollution 12) About eye and head safety 13) About toxic substances

(viii) Safety Contests

Following safety contests are arranged to motivate the employees and their family members towards safety:
In all the above competitions, attractive prizes are given to the winners, and to the winning team (Good house keeping) a shield is given on rotation basis.

(ix) Safety Week

At Aonla unit, Safety Week is celebrated every year with great enthusiasm and the function is started from 4th March unto 10th March and prizes are distributed to the winners of the various safety competitions which are organized during that week.

(xi) Safety Articles

In each issue of in-house magazine “AONLA JYOTI”, IFFCO Corporate Magazine “IFFCO NEWS” informative articles are published for enhancing safety awareness of all employees as well as their family members. The papers which were presented by Safety staff got several awards in the various forums like ICQESMS-2006, FAI & NSC.

(xii) Safety Calendars

Safety Calendars received from National Safety Council, Bombay having 07 pages of different safety pictures are distributed for putting on the wall at conspicuous places in offices, canteen, control rooms of the plant for educating employees on safety aspects.

(xiii) Celebration of National Safety Day

Every year on 4th March National Safety Day is celebrated. This is accompanied with different activities in that week as mentioned below in the detailed report.

(xiv) Work Permit System

In this Fertiliser Plant the Safety Work Permit system covers Cold work, Hot work and Vessel entry and a separate permit form is for Excavation work, Work at height & Work inside drains. The shift-incharge issues permit for Cold work. For major jobs including Hot jobs and Vessel entry, permit is counter signed by Plant Manager as well as officer of Fire & Safety Department. The Safety department personnel countercheck each permit issued as well as job sites, to ensure safety.

Validity of the permit is for the duration of shift (8hrs) in which it is issued. However its validity can be extended shift wise. The total validity of work permit is for 24 Hrs.

(xv) Safety Inspection and Audit Programme
Routine inspections of the Safety equipments are carried out by the Safety department. Internal safety audit is carried out twice a year. The recommendations of internal audits are implemented. Third parties having required expertise, are also commissioned, to conduct safety audit. The recommendations made, are implemented to the extent practicable.

(xvi) Incident/ Accident Investigation And Reporting

We have a written accident investigation procedure. This investigation procedure is included in safety manual, which has been issued to all employees. The company has adopted the policy that all incidents and accidents should be reported and investigated. For reporting accidents there is a standard format.

Whenever an accident takes place, the initiation of the format is done by the Shift-in-charge of the particular area. Logging is done. The Safety department investigates minor accidents and the major ones by suitably constituted committees, "Near-miss" cases are also investigated, and actions are taken to prevent recurrence.

All accident/ Near-miss cases are discussed in Central Safety Committee Meetings. Recommendations of Safety Committee are percolated down to the shop floor and ensures their implementations.

(xvii) Disaster Prevention Action Plan

A detailed Disaster Prevention Action Plant along with duties of all the Key persons has been prepared and distributed to all concerned. It is printed in flip chart booklet form and a copy of it has been displayed at all the Control Rooms for ready reference. It also contains all important phone numbers of IFFCO Aonla officials as well as of all the external agencies including Government officials.

MAINTENANCE AND INSPECTION SCHEDULES:

Daily inspection schedule is there to check the various types of compressors, pumps, fans, blowers & turbines and to monitor the vibration levels. If any abnormality found the corrective action by both production and maintenance people will be initiated at the utmost priority.

Temperature measurement schedule  
Tuesday : Ammonia – I Primary reformer catalyst tubes skin temp. measurement, Wednesday Ammonia – I Secondary reformer skin temp. measurement  
Thursday : Ammonia – II Primary reformer catalyst tubes skin temp. measurement  
Friday : Ammonia – II Secondary reformer skin temp. measurement

Overload test of Rigging Tools and tackles

♦ YEARLY : Overload testing of slings, D-shackles, chain pulley blocks, E.O.T. cranes & mobile cranes

Vibration monitoring activities

♦ Continuous condition monitoring of high speed critical rotary equipment such as turbines, compressors & Gas turbine generator by Offline vibration Entek IRD data collector & Online vibration monitoring system using Bently Nevada Data manager 2000 system

Compliance of Statutory Regulations related to Factory Act & IBR

♦ Hydro test of Boilers 12 nos. boilers
♦ All Pressure Vessels testing and records maintained in Form-9.
♦ Witnessing load testing of all lifting tools and tackles -yearly and maintenance of records by mech. maint.Turnaround Activities
♦ Ultrasonic thickness measurement of selected High pressure and temperature lines and Vessels for assessment of corrosion / Erosion.
♦ Radiography of high pressure critical weld joints
♦ Ultrasonic testing of high Pressure weld joints
♦ Automatic ultrasonic scanning of Primary Reformer Tubes
Metallography examination at some selected points on weld, HAZ and parent metal of critical vessels.

Internal Visual Inspection, D.P. testing & thickness measurement of Static Equipments.

Creep measurement of Primary Reformer tubes.

Hydraulic and pneumatic testing of pressure vessels, heat exchangers and piping are being carried out by maintenance dept. after maintenance activities as per requirement.

Inspection of heat exchangers

Fibrescopic Examination of Inaccessible areas in Heat Exchanger tubes, Turbine / Compressor Blades etc. on need basis

Welder qualification test

Dye Penetrant Testing for detecting surface defects in critical weld joints, vent drains tappings

Magnetisation Check & Demagnetisation of High speed critical rotary machine components

Magnetic Particle Testing for detecting sub-surface defects.

Eddy Current Testing of Urea Stripper tubes.

Remote field eddy current testing (RFET) of R. G. boiler tubes in Amm-I & II plants.

Other Need Based Activities

RPM measurement of Rotary machines

In-Situ Balancing as well as balancing on hard bearing dynamic balancing machine

Hardness Measurement of various metals.

Hardness measurement of Rubber Lined pipes & vessels in Shore "A" & "D" scales.

Thickness measurement of rubber

Spark Testing of wrapping/coating and rubber lined pipes and vessels

Ferrite measurement of Austenetic steel weld joints

Magnetic particle inspection / D.P. testing of weld joints

Gauss measurement and demagnetisation of rotor parts and bearing etc.

Moly detection

Vibration measurement / analysis

Sound level measurement

Bearing inspection by shock pulse meter

Skin temperature measurement of Reformer wall, bearing etc.

Thickness measurement by ultrasonic thickness meter

Naphtha tank, Ammonia storage tank inspection

Loaded ammonia tankers inspection

Skin temperature measurement of E-1206 / E-3206 / Cold collector and various other equipments as per requirement

Thermal insulation survey of pipe lines

A unit level Visual Inspection of hazardous Installation committee constituted of Unit head and other senior officers routinely checks all hazardous installations like Ammonia storage tanks, chlorine handling areas, naphtha storage area and filled checklist with observations. The compliance of these committee reports strictly carried out and the same is being sent to higher officers of IFFCO head office at New Delhi.

In the year 2001& 2003, various inspection tests carried out by M/S PDIL Sindri at Ammonia storage tanks. The plant level management committee quarterly carried out the visual inspection of the hazardous Installations.
SYNOPSIS OF INSPECTION OF AMMONIA STORAGE TANK T-2301

SCOPE OF WORK :-
1. Deployment of manpower, NDT equipments, tools, tackles, lighting inside the tank & consumables.
3. Inspection of Ammonia storage tank as per salient details given overleaf.
4. Repair of Defects/ Damage, if any.
5. Hydro Test.
6. Re-commissioning of the Tank after Inspection & Repair.
7. Certification of the Tank after Inspection and Repairs.
8. Submission of Reports.

Salient features of inspection activities:
1.0 Visual inspection of the complete tank shell (Inner & Outer), top roof and bottom bracing including nozzles, parent plates and weld seams broadly before sandering and thoroughly after sandering / buffing.
2.0 Sander /shallow grinding / buffing wherever necessary of the heat affected zones (HAZ) and weld beads of entire tank for removal of rusting/scaling etc.
3.0 100% percent MAGNETIC PARTICLES TEST (MPT) of the weld joints and heat affected zones (bead and HAZ) of the inner surface of outer shell and both the surfaces of inner cup shell wall, bottom plates, annular plate butt-joints, nozzle weld joints etc.
4.0 DP TEST of lap/fillet weld joints of the bottom bracing plates and top roof including nozzle weld joints, if MPT poses difficulty in interpretation of nozzle fillet joints, or else where it is felt necessary in addition to MP test.
5.0 Ultrasonic flaw detection of T-joints and some of the straight lengths including HAZ of the tank shell walls, and else where, if it is felt necessary to ascertain the presence of doubtful defects in the tank.
6.0 RADIOGRAPHY of 10% OF THE TEE JOINTS of the Inner shell courses as marked by IFFCO Engineers on 6" X 4" Film size (fine grain D-7 Agfagaevert or equivalent make) at random and else where if felt necessary to confirm presence and nature of defects revealed during Visual, DP, MPT & UT Inspection.
7.0 ULTRASONIC THICKNESS SURVEY of the tank shell walls, bottom plates, top roof plates, all connected nozzles to the tank and internal piping to ascertain the extent of corrosion, if any.
8.0 HARDNESS TEST at about 200 points is to be conducted randomly on welds, HAZ & parent metals covering bottom plate, roof plate, outer shell plate & inner shell plates using essentially a hardness tester based on Impact Rebouncing principle.
9.0 IN-SITU MICRO STRUCTURE EXAMINATION at around selected 30 locations on bottom plate, cup shell, outer shell & nozzle covering weld joints, HAZ & parent material.
10.0 Visual inspection of the condition of the INSULATION OF THE TANK.
11.0 Thorough Inspection of the FOUNDATION OF THE TANK as applicable to the Inspection of such tanks.
12.0 Inspection of the sealing joints wherever applicable.
13.0 100% VACUUM BOX LEAK TESTING under the vacuum of approx. 200 mm of Hg of the weld joints of bottom plate including annular space for detecting the leakage through defects.
14.0 After completion of all inspection and tests, HYDROSTATIC TEST of the tank by filling water upto 24.7 mtrs. height (or as decided by IFFCO) and then vacuum test of the tank at 50 mm of water gauge has to be carried out.
15.0 Inspection & witnessing of testing of safety relief valves, block valves, refrigeration vapour removal system, instrument level gauges and earthing system.
16.0 All the tests are to be carried out as per the ASME/IS code and relevant standard requirements of Indian Explosives Directorate.
In addition to above, any other inspection/test, if required as per the latest inspection practices/development may also be incorporated & quoted accordingly.

IMPLEMENTATION OF SAFETY PROCEDURES

IFFCO Aonla Unit is a certified OHSAS-18001 unit. In line with the requirements of this system we have defined and documented safe work procedures for all the significant activities. The trained auditors audit the safety management system at all the plants of IFFCO aonla unit quarterly. The observations made by the auditors are implemented/compiled within the prescribed target date. All the statutory requirements pertaining to safety are fulfilled at IFFCO Aonla unit. Safe operating rules, procedures, safety work permits, electrical work permits etc. are also followed very strictly.

Lifting tools and tackles are checked, inspected and proper record is being maintained. Testing of boilers, pressure vessels are done yearly regularly and Form No. 9 is maintained. Reporting of accident on Form No. 18 is also done and records are maintained. Beside this Injury Report and Near Miss reports are also filled & maintained.

CONCLUSION

With all above mentioned efforts and achievements IFFCO-AONLA stands as an example for maintaining best safe practices and for the accident free and cordial working atmosphere to the other industries.