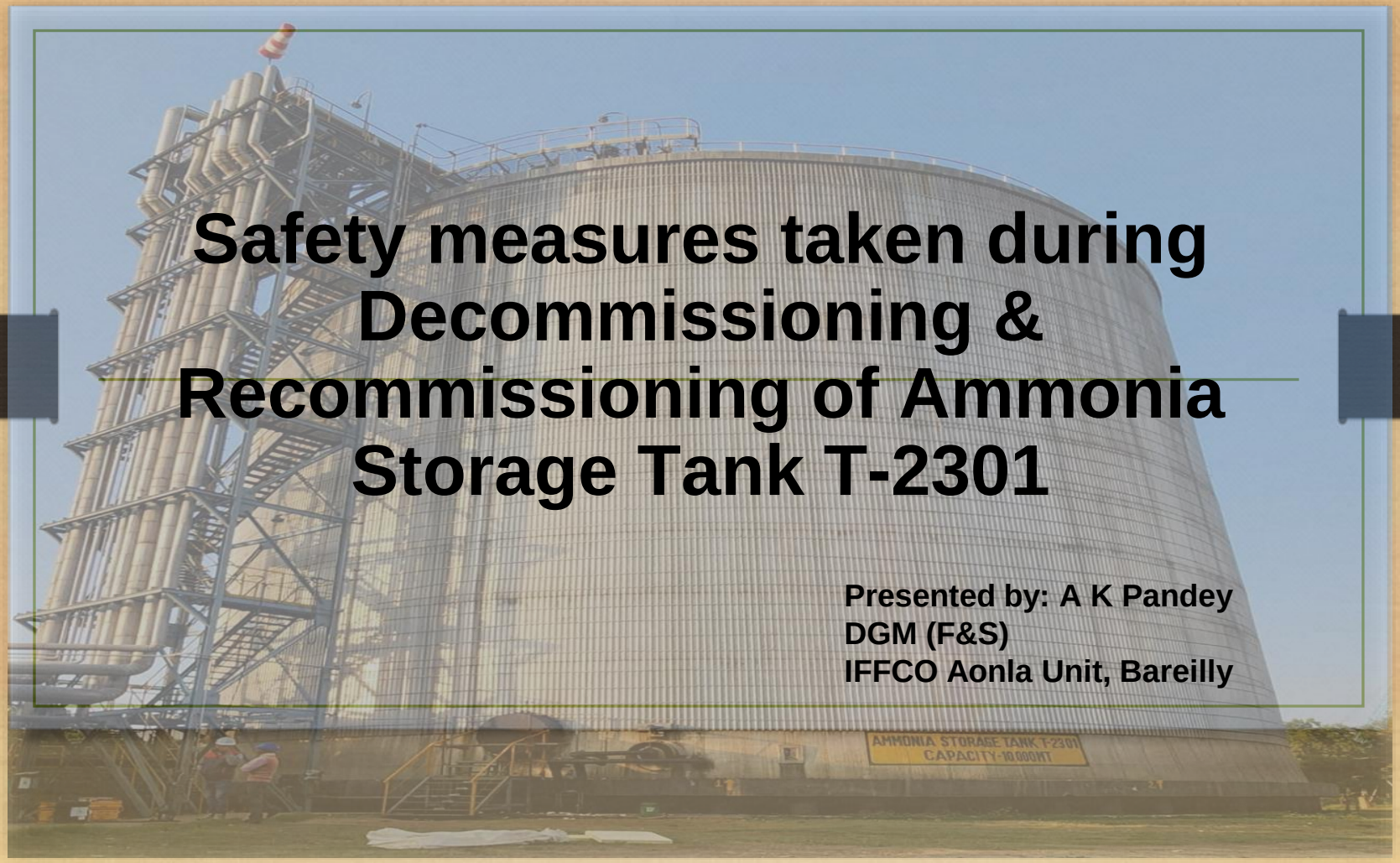
# Safety measures taken during Decommissioning & Recommissioning of Ammonia Storage Tank T-2301

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# 1- About IFFCO Aonla

- Indian Farmers Fertiliser Cooperative Ltd (IFFCO) Aonla unit is Ammonia – Urea fertiliser complex situated approx. 28 Km away from Bareilly in Uttar Pradesh consisting of two units of Ammonia & 04 streams of Urea that were commissioned in May,1988 and December, 1996 respectively.

- Both units have been achieving average annual capacity utilization of more than 110% with minimum energy consumption of the same generation plant worldwide.

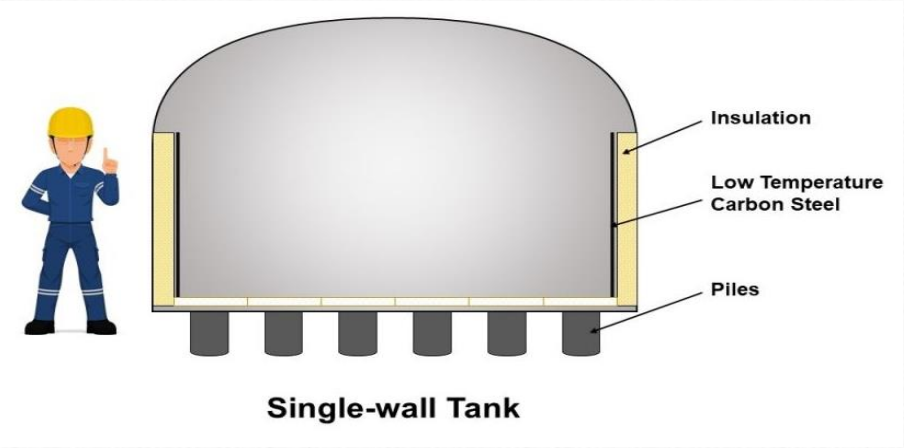
# 2- About Ammonia Storage Tank

- The Aonla complex have two Ammonia storage tanks (T-2301 & T- 3301) common for both Aonla 1 & 2 unit, both tanks have capacity of 10,000 MT each for storage of liquid ammonia at atmospheric pressure (300 – 500 mm WC) and temperature at -33°C.

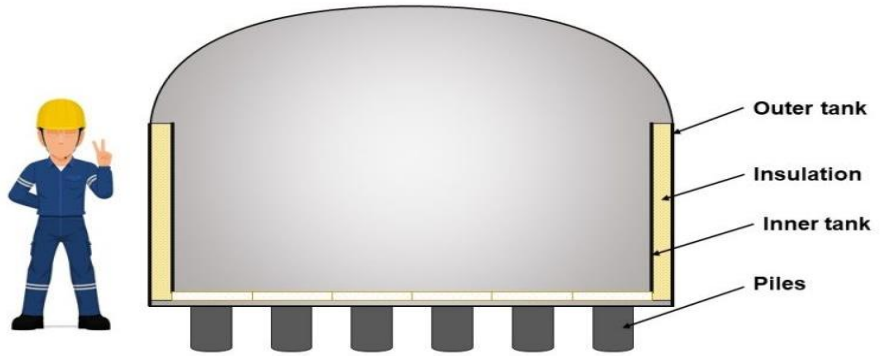
- Both the tanks are of type Cylindrical Flat bottom, Double wall Double integrity, Domed roof, Atmospheric aboveground storage tank constructed according to the design code API-620 (American petroleum institute) and EN 14620.

- These tanks are commissioned in the year 1988 and have completed 33 years of service till the time of decommissioning.

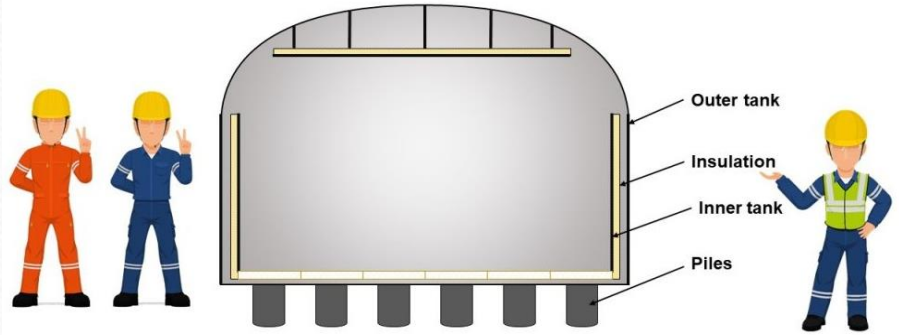
# 2a Types of Ammonia Storage Tanks



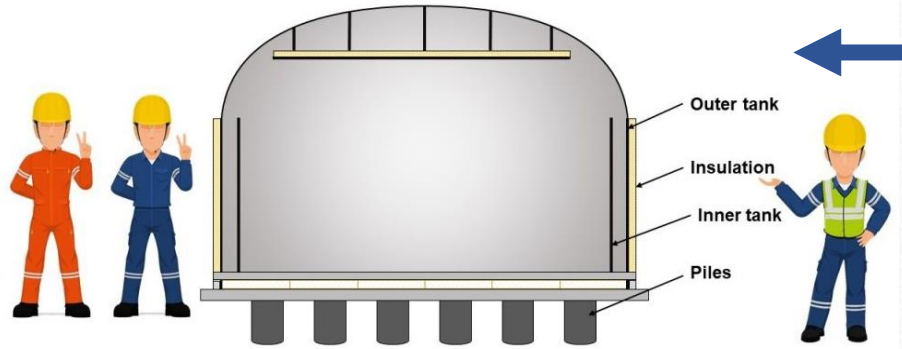

Single-wall Tank




Double-wall Tank (Double Containment)



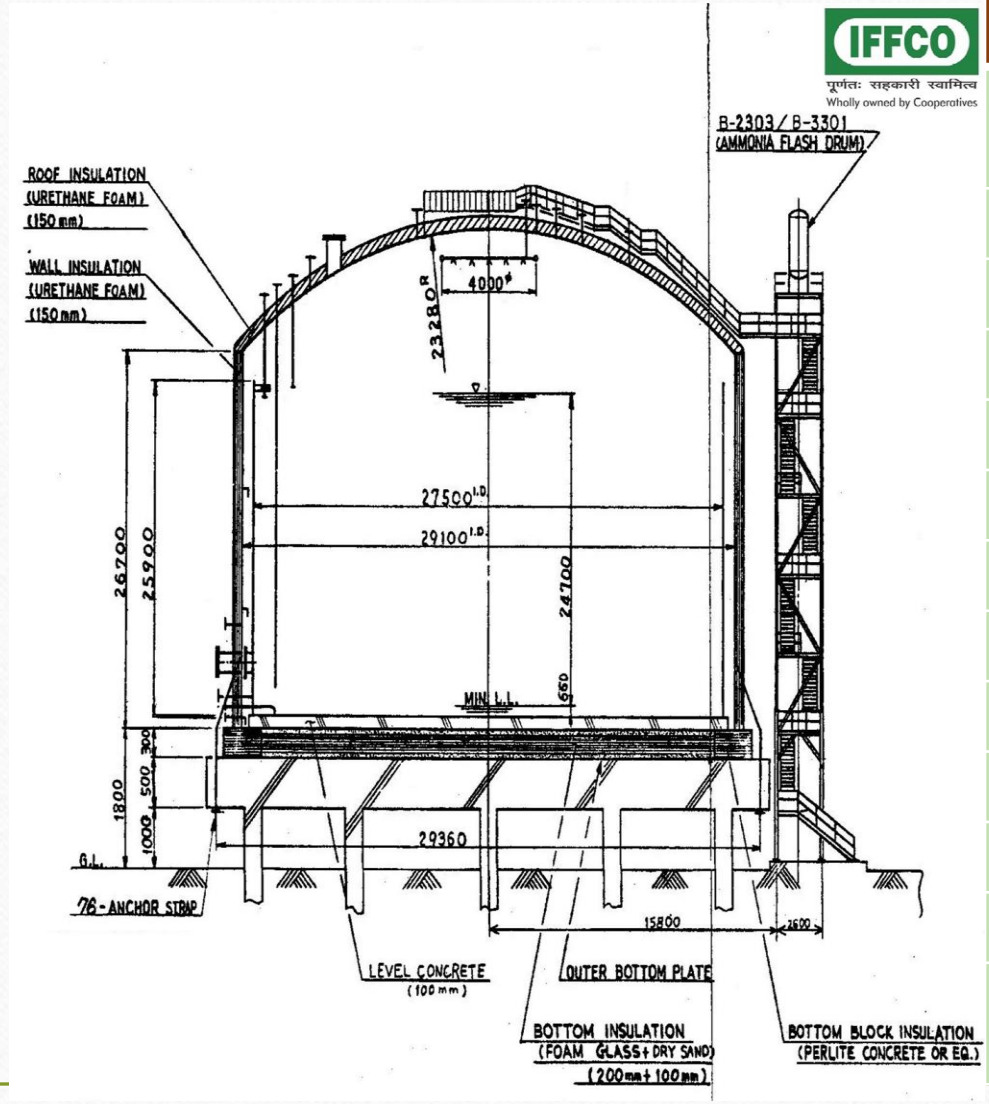

Double-wall, Double Integrity Tank
(Full Containment) with insulation in annular space




T-2301

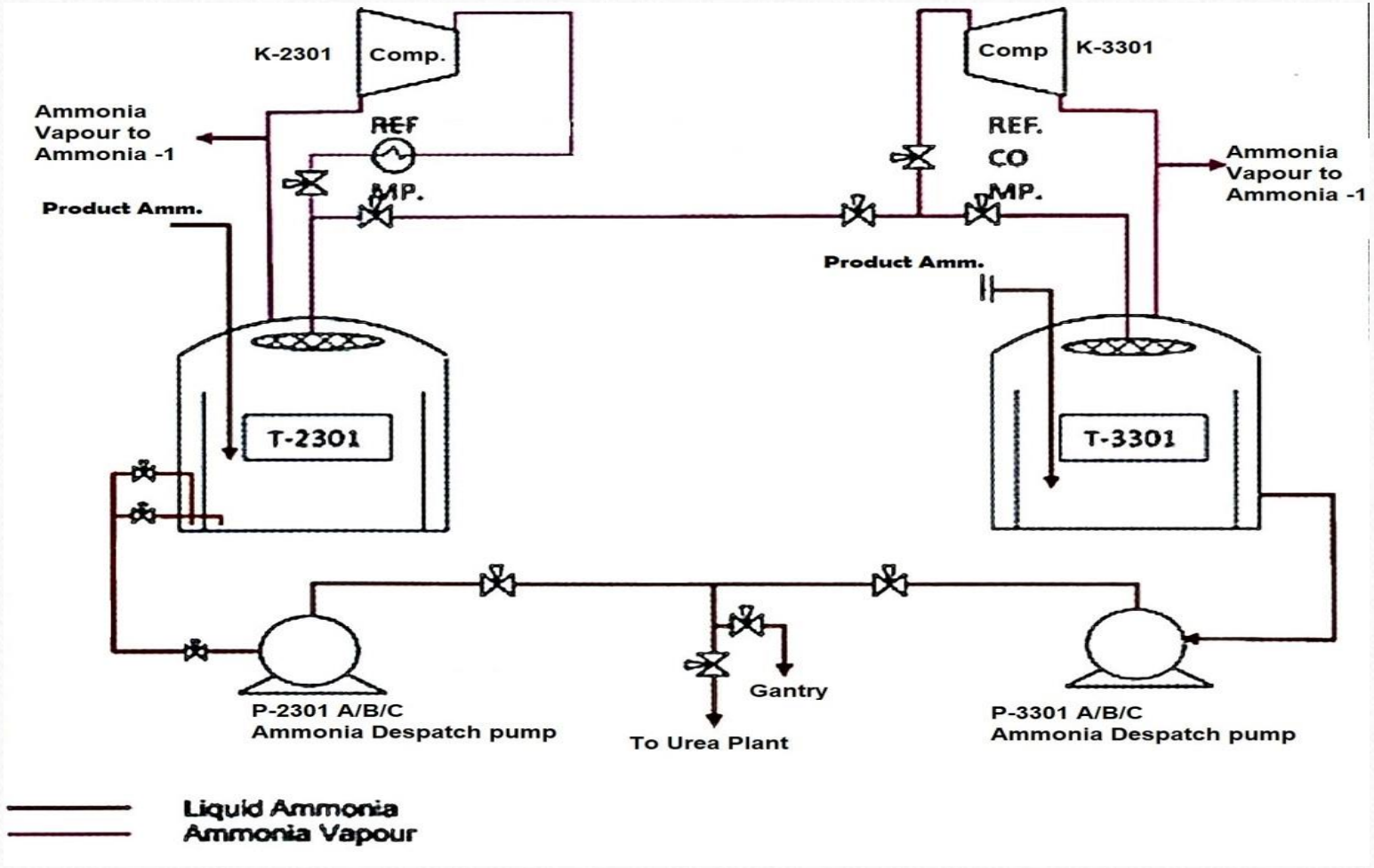
Double-wall, Double Integrity Tank
(Full Containment) with insulation on outer tank

# 2b Tank T-2301 technical details

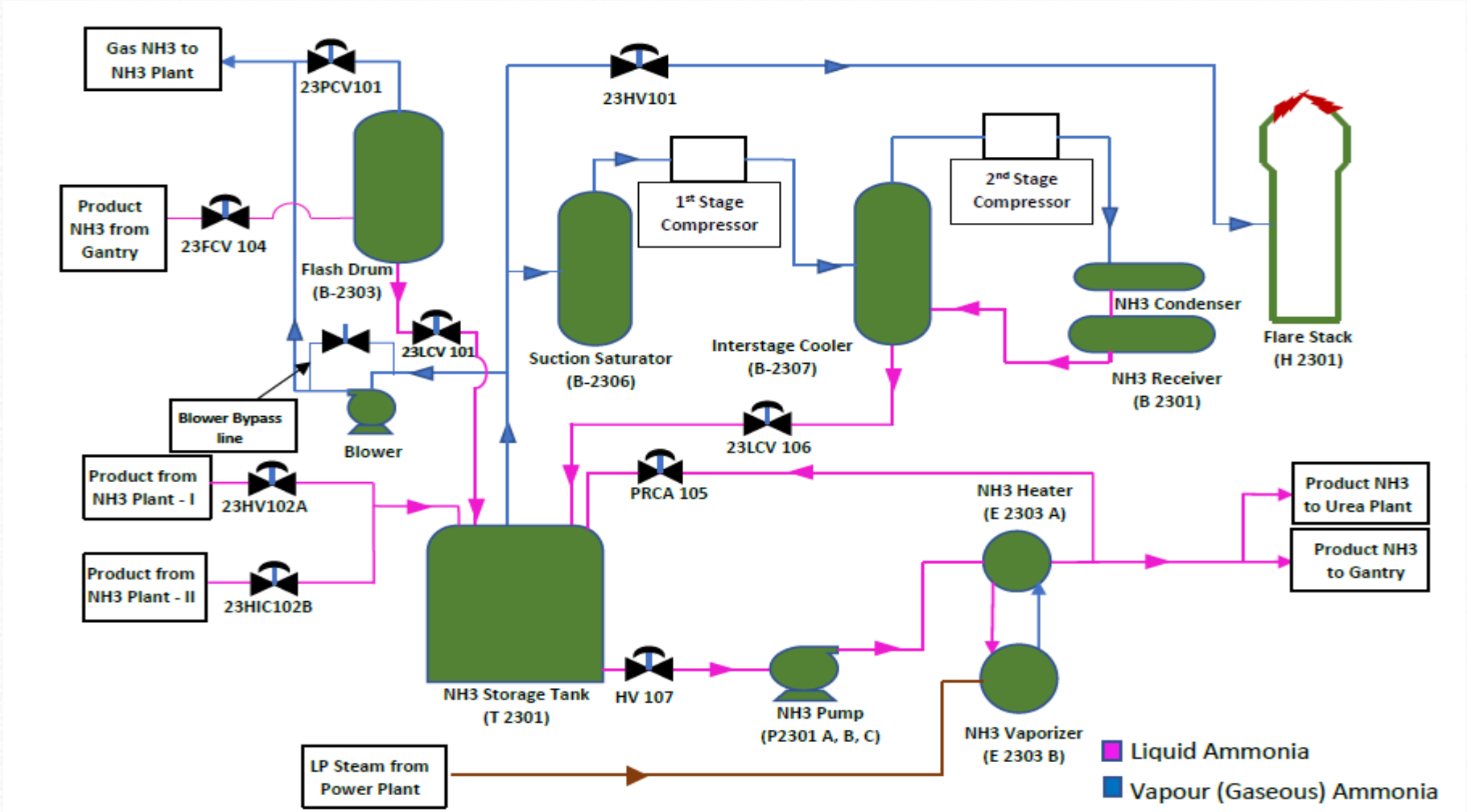



| PERAMETERS | VALUE |
|---|---|
| Type of tank | Flat bottom, Double wall Double integrity, Domed roof, Atmospheric storage tank |
| Capacity | 10,000 MT |
| Inner wall diameter | 27.5 m |
| Inner shell height | 25.9 m |
| Outer wall diameter | 29.1 m |
| Outer shell height | 26.7 m |
| Maximum liquid level | 24.7 m |
| Overall tank height | 31.8 m |
| Fluid | Pure Liquid Ammonia |
| Design Temperature | (-)34°C |
| Deign pressure | (-)50 to 1050 mm WC |
| PSV pop set pressure | 1050 mm WC |
| Vacuum breather pressure | (-) 20 to (-) 50 mm WC |

# Process & Instrument flow diagram of Storage Facility



# Process & Instrument flow diagram of Storage Facility



# 3- Why was Tank Decommissioning required?

- IFFCO Aonla unit both ammonia storage tanks were commissioned in 1988. The tank (T-2301) was last inspected in the year 2001, now after 21 years of service of last inspection, it was necessary to ensure its integrity and now in 2022.
- After 33 years of service of fully refrigerated tank. There was likelihood of Stress corrosion cracking, pitting or any other discontinuities so tank was required to ascertain the health and mechanical integrity.
- Also, it's mandatory to carry third party inspection license for statutory requirements, which would be renewed after thorough inspection. Decommissioning, Inspection and Re-commissioning for Double Wall Ammonia Storage Tank (T-2301) of 10,000 MT capacity at IFFCO, Aonla was carried out by M/S Gulachi Engineers Pvt Ltd, INDIA, from May 2022 to Nov 2022.
- The Inspection has done in accordance with API-653.

# 3a- API-653 (Tank Inspection, Repair, Alteration & Reconstruction)

- API is the worldwide leading standards setting body for the oil and natural gas industry. API has issued nearly 700 consensus standards governing all segments of the oil and gas industry.
- API CODE 620 is for constructing a new above ground liquid storage tank while API 653 recognizes fitness-for-service assessment for evaluating in-service degradation of atmospheric aboveground storage tanks.
- API 653 recommends the Inspection interval shall not exceed 20 years of service.
- Tank T-2301 has completed 20 years of service since last Inspection.

**6.4.2 Inspection Intervals**

**6.4.2.1** Intervals between internal inspections shall be determined by the corrosion rates measured during previous inspections or anticipated based on experience with tanks in similar service. Normally, bottom corrosion rates will control and the inspection interval will be governed by the measured or anticipated corrosion rates and the calculations for minimum required thickness of tank bottoms (see 4.4.7). The actual inspection interval shall be set to ensure that the bottom plate minimum thicknesses at the next inspection are not less than the values listed in Table 6-1. In no case, however, shall the internal inspection interval exceed 20 years.

# 4- Decommissioning Activities for Safe Man Entry

- **Kick-off Meeting and HAZOP**

To Identify hazards involved in the tank isolation for tank de-commissioning process and to mitigate it's effects by suitable preventive measures. Both IFFCO & Contractor teams as participant performed HAZOP, Various Scenarios of the project including Blinding list and SOP was derived and Dry method has been decided for Decommissioning of the Storage tank.

- **Isolation of tank from Ammonia Products**

To isolate the Ammonia Storage tank from Process Plants (Ammonia & Urea Plant) & Gantry. In April 2022, Liquid Ammonia from the tank was transferred to the Urea Plant to the maximum dead level possible (ALARP) after connecting both the Inner and outer tank drains to the pump.

- **Disperse Ammonia vapours by Nitrogen**

Nitrogen was introduced from the Tank Drain Nozzle (Both inner and other drains) and Ammonia Vapours were displaced to Flare from the tank top through HIC-101. Nitrogen flow rate of around 300 to 350 Nm3/hr. was maintained in the tank. Nitrogen purging was done for **10 days** until Ammonia in the inner tank reached below 2% vol.

- **Process lines purging**

All connecting pipelines was isolated at the battery limit. All the line purging took 3 days. All the spectacle blinds were reversed to closed and tank was brought to positive isolation. Line Purging was also carried out to remove all possible Ammonia liquid/vapour from the connecting pipelines. All the line purging took 3 days.

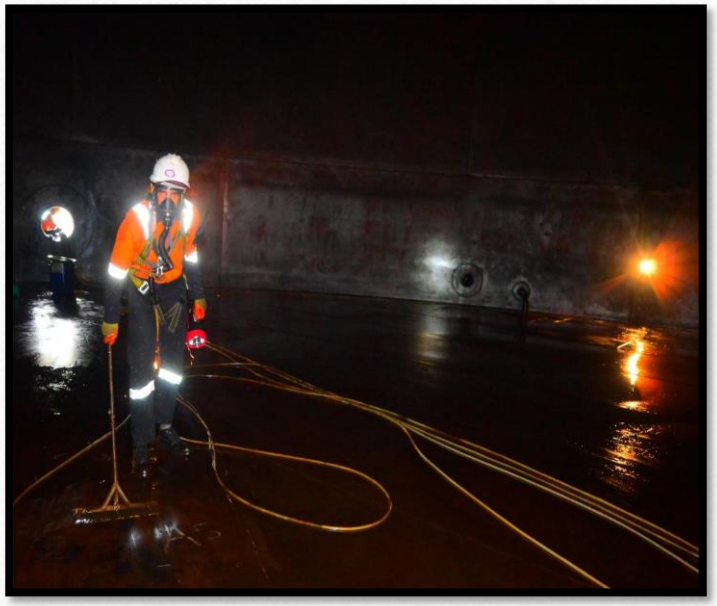
- **Introduction of atmospheric air**

Plant air was introduced from Inner tank Drain Nozzle and discharged from the Dome roof Vent at top. In addition, Roof Manhole was opened. Air purging was continued till it reaches 20% Oxygen and 20ppm Ammonia gas inside the tank. Air Purging was done at approx. 400 Nm3/hr. at 3 Kg/cm2 pressure.

Now the tank is safe for man entry and ready for decommissioning.

- **<u>Confined space Entry inside the Tank</u>**

After opening of manholes of the tank, Toolbox talks were carried out daily before starting of the job before Man entry was carried out to remove oil sludge & visual inspection using Online airline masks despite tenable atmosphere inside the tank to avoid any mishap..



# 5- Safety measures during confined space entry

- ✓ Air sampling was carried out daily by laboratory before man entry and mention ammonia concentration in ppm and oxygen level in %.
- ✓ Safety permit was taken before confined space entry.
- ✓ Toolbox were given to workers before starting the job.
- ✓ Separate confined space entry checklist was prepared and checked.
- ✓ Confined space attendant was placed near tank manhole with confined space entry register for each entry/exit record.
- ✓ Availability of continuous respiratory supply despite Ammonia conc. below TLV value to protect the worker working inside from entrapped ammonia gas.
- ✓ Provision of communication system, 24V lighting, ventilation inside tank.
- ✓ 1 nos. of safety personnel from IFFCO fire & safety dept. and 1 nos. person from contract company safety supervisor present all time while performing confined space entry.

# 6- Innovative ideas used to reduce ammonia concentration inside tank

After oil reclaiming and cleaning of  tank floor and side walls from inside, the concentration of ammonia found around 300 ppm. For carrying out visual inspection entry without respiratory equipment is needed but the ammonia concentration was not reducing below 300 ppm.

- Vacuum blower provided at one end placed in centre of tank  to suck air from top manhole and remove through blower vent.

- Spraying fine water spray inside the tank using fire water hose and nozzles to dilute the ammonia inside tank to further decrease the concentration of ammonia gas.

After following these methods, drastic reduction in ammonia concentration found from 300 ppm to around 25 ppm in different samples. Man entry without airline mask was permitted for carrying out NDT test.

# 7- Different NDT tests performed

1. Bottom Plate Visual Test (VT)
2. Ultrasonic Thickness Gauge (UTG)
3. Die-Penetrating Test (DPT)
4. Phase Array Ultrasonic Test (PAUT)
5. Magnetic Particle Testing (MPT): MPT has used them for detection of surface defects as well as sub-surface defects that are not open to the surface.
6. Magnetic Flux Leakage (MFL)
7. Metallography Analysis
8. Radiography Test (RT)

9. Carbonation Of Concrete: The effect of carbonation on concrete must be tested to assess the corrosive activity in the concrete.

10. Rebound Hammer Test (RHT)

11. Ultrasonic Pulse Velocity (UPV)

12. Half-Cell Potentiometer Test

13. Hydro Pneumatic Static Test Testing: Hydrostatic or Hydro Testing is a process that uses liquid (water) to pressurise the tank for strength and leaks.

14. Wet Fluorescent Magnetic Particles Inspection(WFMPI)

15. Vacuum Box Leak Testing :The purpose of the Vacuum box test is to check the soundness of annular joints, bottom long seam and short seam, and welding joints for annular plates.

# 7a- Glimpses of NDT tests carried out inside the Tank-2301

Visual inspection & DPT


MFL testing

Corrosion mapping test

# 7b - Use of Rope Access system for Dome Roof Inspection

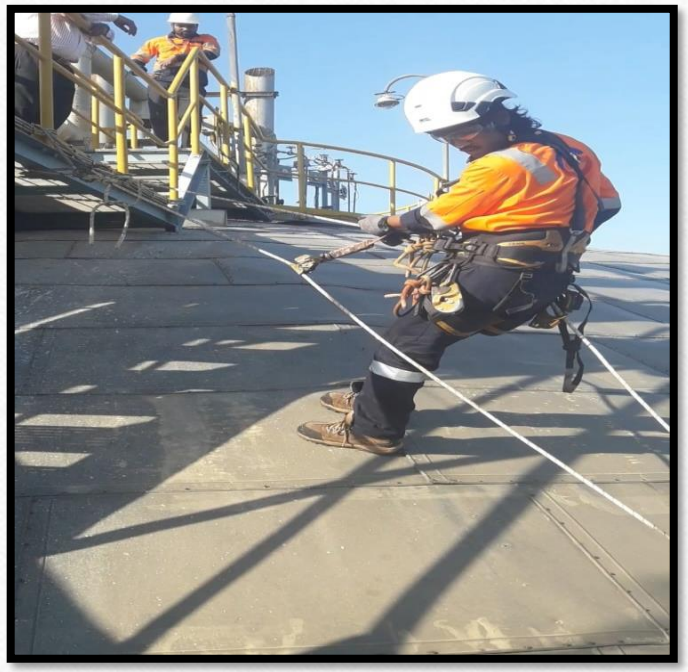
- Rope access system is a safe method of working at height where ropes and associated equipment are used to gain access to and from the work position, and to be supported there.

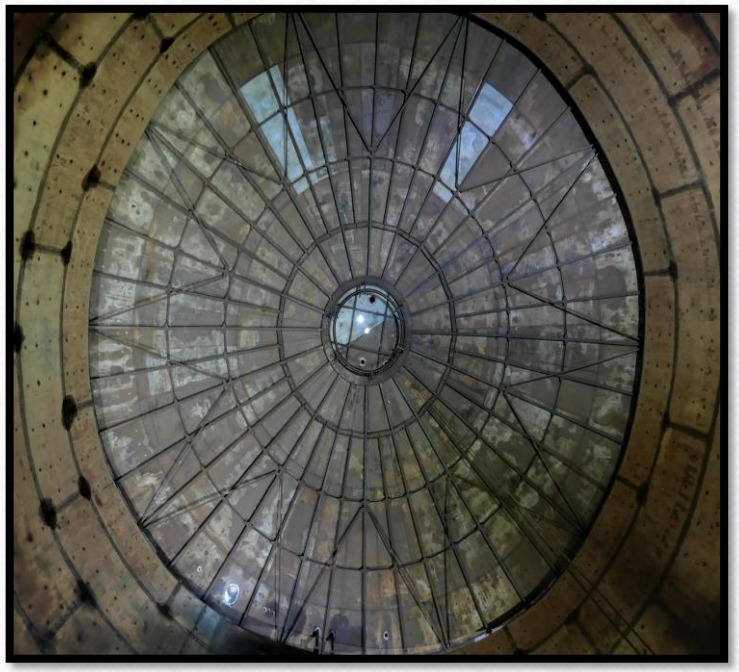
- The advantage of using rope access methods mainly lies in the safety and speed with which workers can get to or from difficult locations in order to carry out their work.

- Another major benefit is the reduction of the combination of the total man-hours and perceived level of risk for a particular task (man-at-risk hours) when compared with other means of access and their associated risks and costs.

- Personnel performing dome roof inspection of the tank were having INTERNATIONAL ROPE ACCESS TRADE ASSOCIATION (IRATA), UK certifications. Two of them having level 2 certificate and one senior personnel holding level 3 certificate.

# 7c - Glimpses of Dome Roof Inspection





All the rope access activities were performed under the observation of IRATA Level 3 certified competent person.

# 8- Recommissioning Activities

1. **Hydro-Pneumatic test of Tank**

Hydrostatic or Hydro Testing is a process that uses liquid (water) to pressurized the tank for strength and leaks. Hydrotest of inner tank was carried out by filling the tank with water upto 13.40 meters at the rate of 60 m3 per hour. The water level was maintained in the tank for a period of 24 hrs and no leak was observed.

2. **Instruments Inspection**

All instruments were checked for working, SS tubing was checked for any leakages. Soap Solution test was performed to check for any leakages in Flange joints, pipes, supports, hangers, Nozzles. All Calibration of Instruments were checked. Flare start-up check was performed. Compressor start-up check were performed.

**3. <u>Nitrogen Purging of Tank</u>**

Nitrogen was introduced from the Tank top sparger Nozzle and PRC 105 Nozzle to displace air inside the tank to avoid formation of possible explosive mixture of Ammonia and air inside the tank. Nitrogen purging was done for 6 days until Nitrogen in the inner and outer tank reached below 2%.

**4. <u>Nitrogen - Ammonia vapour Exchange & liquid ammonia filling in Tank</u>**

It took 4 days to purge Ammonia and displace the Nitrogen inside both the Inner and Outer tank. Ammonia was purged via Tank top Sparger Nozzle and discharged from tank inner and outer drains to the flare. Liquid Ammonia dead level in the tank was built-up and the tank has been **Recommissioned** at its normal operating conditions.

# 9- Recommendation & Conclusion

- As the tank is in continuous operation since last 34 years, it may be planned to inspected by/before 04/12/2032 as per API 650.

- The entire project was completed with following:
  - ✓ Zero Incident
  - ✓ Zero Near Miss
  - ✓ Very Minimal Modification
  - ✓ Minimum consumption of Utilities including Nitrogen, Water and Electricity
  - ✓ Extensive Coverage of Inspection
  - ✓ Entire Schedule was completed in 7 months


THANK YOU