Design, Procurement, Fabrication, Inspection, Testing & Supply of propellants
Storage tanks

Technical Specification

1. General

These Propellants storage tanks are meant for storing hazardous and toxic chemicals
\( \text{N}_2\text{O}_4 \) (Di Nitrogen Tetroxide) & UH-25 (Unsymmetrical Dimethyl Hydrazine with Hydrazine Hydrate).

- \( \text{N}_2\text{O}_4 \) Propellant storage tank – 1 No.
- UH-25 Propellant storage tank – 1 No.

2. Scope

Design, Procurement of materials, Fabrication, Inspection, Testing and Supply of
\( \text{N}_2\text{O}_4/UH-25 \) propellants storage tanks to IPRC-Mahendragiri.

2.1. Dimensions and internal details shall be as per the drawings Nos. IPRC/ESPSF/PRO/DRG/01, 02 & 03.

2.2. The Supplier shall design the Tank and prepare detailed Fabrication drawings. Design calculations and Drawings shall be sent to the Purchaser for approval for functional aspects.

2.3. QAP is furnished in Annexure-I for reference. However, detailed quality assurance plan to be followed during fabrication and testing, shall be submitted to the purchaser for approval prior to the commencement of fabrication.

2.4. Design calculations, Fabrication drawings and QAP should be approved by TPI agency

2.5. \( \text{N}_2\text{O}_4 \) Propellant storage tank drawing should be approved by Chief Controller of Explosives, PESO, Nagpur.

2.6. Fabrication shall be taken up only after the final approvals

2.7. The fabrication shall be carried out using tested and qualified materials only.

2.8. Tanks shall be provided with nozzles as indicated in the drawing. However the supply of Level indicator, Pressure indicator, Relief valve, Burst diaphragm, Temperature indicator are not in the scope of supplier.

2.9. Nozzle pipes, flanges, fasteners, gaskets shall be procured from reputed manufacturers.
2.10. The fabricator shall have the approval of Chief Controller of Explosives, PESO, Nagpur for the fabrication of pressure vessels under Static and Mobile Pressure Vessels (unfired) rules 1981. Copy of the approval shall be submitted along with the Techno Commercial bid.

3. Codes, Standards & Regulations

3.1. The following Codes in their latest edition including their addenda at the time of bidding shall form the basis for design, fabrication, testing, inspection and acceptance of tanks

a. ASME Boiler and Pressure Vessel Code Section VIII Div. 1.
b. ASME Boiler and Pressure Vessel Code Section II.
c. ASME Boiler and Pressure Vessel Code Section V.
d. ASME Boiler and Pressure Vessel Code Section IX.
e. Indian Standard IS: 875 (part 3) for wind load
g. ASME B16.5: for steel pipe flanges and flange fittings
h. Petroleum and Explosives Safety Organization (PESO)
i. Static and Mobile Pressure Vessels (Unfired) Rules 1981

4. Tank Specification

4.1. Type: Horizontal, Cylindrical with 2:1 ellipsoidal dished ends both sides

4.2. Design & Construction:
   i) ASME Boiler and pressure vessel code Sec. VIII Div.1, latest edition
   ii) During design, wind load for survival wind speed of 200 km/hr considering 3 sec gust; operating wind speed of 120 km/hr and Seismic zone 3 as per IS 1893 shall be considered

4.3. Design pressure: 5 kg/cm² (g).

4.4. Allowance:
   i) Corrosion allowance – 3 mm.
   ii) Surface treatment allowance – 1 mm.
   Suitable allowance for thinning during forming (rolling/spinning/pressing) is to be considered.

4.5. Thickness (min):
   i) Shell – 12 mm & Dish end – 14mm.
   Including all allowances.
5. Material of Construction

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<td>Manhole flange &amp; Cover flange</td>
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<td>Saddle support pad &amp; all RF pads</td>
<td>SA 240 GR 304 L</td>
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<td>6.</td>
<td>Saddle supports/saddles, base plates</td>
<td>SA 240 GR 304 L</td>
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<td>7.</td>
<td>Studs / nuts / washers</td>
<td>A 193 GrB8 / A 194 Gr8 / SS</td>
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<td>Gaskets</td>
<td>SS 304 L &amp; PTFE spiral wound with SS 304 L inner and outer rings.</td>
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<td>All internals</td>
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<td>Manhole cover removal assembly/davit arm</td>
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<td>Materials having direct contact with tank &amp; fluids</td>
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6. Tank plates

6.1. The number of circular seam weld joints on the cylindrical portion of the tank shall be minimum. The shell of storage tank shall be fabricated with minimum 1.5 meters wide plates. Single plate shall be used for longitudinal seam weld joints.

6.2. Each dome shall be made out of maximum number of two plates only.

6.3. If the design calls for lower thickness than the minimum thickness specified in the drawing, the thickness specified in the drawing shall be provided. But if higher thickness is called for by design than the minimum thickness specified in the drawing, the higher thickness shall be provided.

6.4. **Welding layout:** The welding layout of the tank shell shall be in such way that either circular seam or Longitudinal seam not to foul with the fillet weld of R.F pads of saddle support and Manhole / Nozzle. A minimum gap of 100 mm shall be maintained between any two weldments/seams.

6.5. All plates used for the fabrication of tanks shall have traceability with MIL certificate for Chemical, Mechanical and IGC. All plates used shall be ultrasonic tested at production MIL itself.
   a) All plates shall be procured from a single MIL.
   b) The plates should have been rolled within one year of procurement.
   c) Plates of age more than one year are not acceptable.
7. **Welding**

7.1. **100% by GTAW process** shall be followed with high purity (99.99%) Argon gas purging and shielding, right from root to final passes for all butt welds (Long seams, ‘C’ seams, nozzles, pipe to flange joints) and all internal and external welds including fillet welds. Fabricator may also use Plasma welding.

7.2. Plasma welding in combination with TIG welding is acceptable to reduce the heat affected zone, weld defects and to improve quality of weld. **SMAW is not acceptable.**

7.3. Welding shall be performed only by welders qualified under section IX of ASME Boiler and Pressure Vessel Code, using procedures mentioned under Section IX. Welding procedures must be approved and welder must be qualified by TPI agency.

7.4. Welding consumables (filler wire) shall be used as per AWS classification / ER 308L. Filler should be IGC tested

7.5. All butt welds shall be full penetration welds.

7.6. All butt welds shall be 100% radiographed (X-ray, 2-2T sensitivity).

7.7. All welds shall be DP tested

7.8. The dye used for Dye-penetrant test shall not have chlorides more than 50 ppm.

7.9. Tell tale holes shall be provided for checking the leakage pneumatically on weld joints of reinforcement / pad plates

7.10. Any re-work / repair have to be carried out as specified in ASME boiler and Pressure vessel code with the approval of third party/purchaser.

8. **Heat treatment**

8.1. **Solution annealing** :

Dished end domes shall be cold formed. After cold forming, solution annealing shall be done to relieve stresses caused due to cold working as per code.

Solution annealing shall be as per the following cycle.

a) Loading Temperature : 400 °C (max.)

b) Rate of heating : 250 °C/hr (max.)

c) Soaking temperature : 1040 °C – 1060 °C

d) Soaking time : 30 minutes (min.)

e) Quenching in water to bring down to temperature 350 °C within 3 minutes (max.)

f) The final hardness shall be checked and ensured to be below 201 BHN
8.2. **Stress relieving**:

The total fabricated tank (full equipment) including saddle to wear plate welding has to be stress relieved at $420 \pm 10 ^\circ C$ as per standard practice (this operation shall be carried out prior to hydrostatic test). The detailed stress relieving cycle is as given below.

- **Loading Temperature**: $300 ^\circ C$
- **Rate of heating**: $100 ^\circ C/hr \pm 20 ^\circ C$
- **Soaking temperature**: $420 ^\circ C \pm 10 ^\circ C$
- **Soaking time (min)**: 2 Hrs.
- **Rate of cooling (min)**: $100 ^\circ C/hr$
- **Unloading temperature**: $300 ^\circ C$ (Vessel to be air cooled inside the furnace by opening furnace doors). Vessel to be air cooled at atmospheric conditions after unloading.

8.3. Solution annealing of domes and stress relieving of total tank preferably carried out in an Electric furnace. If oil furnace is used the fuel shall be of lower sulphur content oil like high speed diesel.

8.4. Precaution should be taken to avoid direct impingement of carbon smoke over the metal surface by suitable protection method like application of thin layer of plaster coat/ fire clay prior to loading into furnace. Suitable digital photos to be taken in presence of TPI agency prior & after stress relieving and signed images shall be sent along with Master Production File.

8.5. The furnace shall be calibrated prior to taking up stress relieving of the tanks. The details of the furnace proposed for stress relieving like clear dimensions, type, number of nozzles, type of fuel used, location and number of thermocouples proposed for temperature measurement shall be submitted and approval of TPI agency shall be obtained prior to performing the stress relieving of entire tanks.

9. **Fabrication**

9.1. **Nozzles**

9.1.1. Inlet nozzle with dip pipe shall be provided. The gap of 100 mm shall be maintained between the tip of the dip tube to the inner bottom surface of the tank and supports to be provided in the bottom of dip tube.

9.1.2. Four Nos. of holes are to be provided on dip tube at 100 mm below from the top inner surface of the tank.

9.1.3. All nozzle pipes are of seamless, shall be as per design code and a minimum schedule of Schedule 160 to be provided.

9.1.4. Outlet nozzle with vortex breaker should be provided.

9.1.5. Nitrogen gas nozzle with perforated pipe terminated inside should be provided.
9.2. **Flanges**

9.2.1. The manhole flange should be of A 182 F 304 L Weld Neck Raised Face (WNRF) serrated finish of Class 150 lbs rating and shall conform to ASME B 16.5

9.2.2. Inside edges of Manholes shall be smooth and rounded off with a minimum radius of 3 mm

9.2.3. All nozzle flanges are A 182 F 304 L Weld Neck Raised Face (WNRF) serrated finish of Class 150 lbs rating and shall conform to ASME B 16.5

9.2.4. Manhole and all nozzle flanges shall be provided with blind flanges of same material, size and pressure rating with necessary studs & nuts, washers and gaskets.

9.2.5. WNRF flange ID should match with Nozzle pipe ID

9.3. **Davit Arm**

9.3.1. A davit arm as shown in drawing shall be provided near manhole to be used for removal & assembly of man-hole cover. Provision must be made to remove the arm when it is not in use.

9.4. **Bolts and Gaskets**

9.4.1. All studs shall have ISO threading. Studs shall be threaded to full length and should have standard SS washers.

9.4.2. All studs shall be provided with double nuts.

9.4.3. The fabricator shall supply two sets of gaskets other than those used for testing and/or during transportation. Service gaskets shall be used during hydrostatic test.

9.5. **Lifting lug**

9.5.1. Four removable type lifting lugs shall be designed and provided on the saddles.

9.6. **Saddle Supports**

9.6.1. Saddle supports shall be designed as per IS: 2825. The included angle of the saddle support shall be 160 deg. minimum.

9.6.2. The saddle supports shall be designed for the density of Liquid Di Nitrogen tetroxide (N₂O₄) i.e., 1.454 gm/cc

9.7. **Name plate**

9.7.1. Tank should have a name plate with bracket permanently fixed on saddle support

9.8. **Earthing boss**

9.8.1. Two numbers of earth boss shall be provided on the saddles
9.9. **Foundation bolts**

9.9.1. Suitable foundation bolts with lock nut & washers should be provided.

Note: Lifting lugs, name plate etc. shall not be welded to the shell or dish. This is mainly to minimize welding on the pressure parts.

10. **Testing**

10.1 **Testing of Materials**

All materials used shall be tested as per code in the reputed Govt. approved testing labs before fabrication. All the plates proposed to be used for fabrication of tank shall be subjected to mechanical, chemical and IGC tests as per A-262 Practice-E in spite of availability of Mill test certificates.

The plates used for construction of tank shall also be ensured free from any lamination and manufacturing defects by 100% Ultrasonic testing as per Practice A-578 Acceptance criteria Level-B in combination with ASTM A 577. All nozzle pipes should be 100% ultrasonic tested. The scanning shall be carried out in four directions during UT test. The test shall be carried out under TPI at fabrication shop.

Ferrite number in weldment shall be measured by testing and this shall be within the specified limit of 3% to 12% as per standard code. Test certificates shall be furnished to purchaser for approval before fabrication.

10.2. **Hydrostatic Test:**

10.2.1. Before Hydrostatic test, the inside and outside surfaces of the tanks shall be mechanically cleaned and buffed.

10.2.2. Hydrostatic test shall be conducted as per code after fabrication and radiography clearance. The test pressure shall be as per design code and it shall be done in presence of TPI agency & purchaser.

10.2.3. Clean fresh potable water having chloride content less than 25 ppm should only be used for Hydrostatic testing.

10.2.4. After Hydrostatic test, the vessel has to be degreased, pickled and passivated.

10.3. **Pneumatic Leak Test:**

After hydro test and pickling & passivation the tank shall be pneumatic tested at 3 bar (g) by using dry nitrogen gas with dew point of minus 40 ºC or better.

11. **Cleaning**

11.1 **Mechanical Cleaning**

All metallic surfaces inside and outside having scales and foreign materials and all
welded surfaces have to be cleaned. This can be done by scrubbing with metallic brush (Stainless Steel) followed by buffing. Buffing should be done on the entire inner and outer surface of the total tank to get a polished surface. The loose scales and powders obtained from the above process can be cleaned by blowing, sucking or washing with water. Mechanical cleaning and buffing shall be carried out after stress relieving, but before hydrostatic test.

11.2 **Degreasing**

Degreasing has to be done on the inner surface by soaking with hot detergent solution of Lissapol at 60 ºC to 70 ºC for at least 2 hours till satisfaction.

11.3 **Pickling**

Pickling is to be carried out for inner and outer surface with solution containing Nitric Acid 15% by volume and hydro fluoric acid (HF) 2% by volume, balance DM water.

- Temperature : Ambient
- Duration : 1 to 2 hours

Thorough DM water rinsing has to be carried out until all traces of acid are removed from the surface.

11.4 **Passivation**

Passivation is to be carried out for inner and outer surface with solution of Nitric Acid 20-25% by volume, balance DM water.

- Temperature : Ambient
- Duration : 2 hours

Thorough rinsing with DM water is to be carried out till $P^H$ of the final rinse water is between 6.5 to 7.5 to minimize staining. Surfaces must not be permitted to dry between successive steps of the acid cleaning or passivation and rinsing procedures.

The concentration of iron should not exceed 5% by weight in case of pickling solution and 2% by weight in case of passivation.

11.5 **Swabbing Method**

The pickling and passivation of the tank inner & outer surface shall be carried out by swabbing method using barium sulphate as carrier (chloride levels 25 ppm) in the form of paste. For each of pickling and passivation operations, the paste has to be applied on the surface and has to be kept for atleast two hours. Paste has to be removed with waste cotton in each operation and finally the surface has to be rinsed with DM water.

11.6 **Checking**

All the relevant tests shall be carried out to ensure proper pickling and passivation as per ASTM A 380.

11.7 **Drying**

The drying is done to remove water and this is done as given below:
Passing dry Nitrogen / Air having dew point less than -40 ºC and free from oil and grease (< 10 PPM) 60 ºC till the moisture level at the exit comes to the inlet concentration value.

11.8 Sealing
After drying, the tank should be sealed so that ambient moisture never enters inside. The tank is to be pressurized to 0.5 bar (g) with dry Nitrogen gas at -40 ºC dew point or better.

12. Documentation
12.1. Three copies of master production files shall be supplied by the fabricator. Each master production file should contain the following

12.1.1. Introduction.
12.1.2. Approved design calculation & drawings
12.1.3. As built drawing approved by TPI
12.1.4. All test certificates
12.1.5. TPI inspection certificates
12.1.6. Statutory approvals
12.1.7. Final release note
12.1.8. Facsimile of stamping
12.1.9. Guarantee certificate

13. General Conditions
13.1. Information to be given along with quotation:
13.1.1. Detailed technical description.
13.1.2. Delivery terms.
13.1.3. Delivery period.
13.1.4. Payment terms & condition.
13.1.5. Validity of the offer.
13.1.7. The supplier shall furnish the client list to whom similar type of pressure vessel/tank fabricated and supplied under reputed TPI agency viz. M/s Lloyds, BVIS with PESO approval etc. during last five years along with copy of purchase orders and TPI agency release note. This will be considered as key criteria for evaluation of technical bid and capability. If these details are not given, the offer may not be considered.

13.2. The fabricator shall arrange CCE approved third party inspection agency like M/s BVIS, Lloyds. The quotation should include third party inspection charge.

13.3. One set of soft copy of as built drawings shall be supplied to the purchaser.

13.4. All radiography films soft copy pertaining to the tanks shall be supplied to the purchaser.
14. Pre-delivery Inspection

14.1. Inspection shall be carried out by the Purchaser, before dispatch of Storage Tanks at manufacturer’s site.

15. Preparation for Shipment

15.1. Procedures proposed for the preparation of tanks for shipment shall be intimated to the purchaser and shall generally be in accordance with the following:

15.1.1. All shipments shall be protected from damage in transit to site.
15.1.2. The vessels should be supplied to IPRC, Mahendragiri, Tirunelveli Dist., Tamil Nadu State.

16. The supplier has to quote on “TWO-PART BID” basis viz., Techno-commercial bid & Price bid separately.

16.1 Form of quotation:

The quotation shall be in two parts tender and shall be submitted in separate templates:

a. Techno-commercial bid: Bidders shall comply all the technical and commercial aspects given in the specification. Techno-commercial bid shall contain all technical details as well as information and confirmation on all aspects mentioned in the section 13(General Conditions) of the specification. It shall also contain confirmation on all Commercial Terms & Conditions, wherever applicable, if any and any additional information the bidder would like to provide. Under any circumstances, the Techno-commercial bid shall not mention prices of any items.

b. Price quotation: The bidder shall quote the price with the individual break-up costs as given in price bid template.

The techno-commercial bid containing the technical and commercial aspects shall be opened first. The price quotation shall be opened only after the evaluation of the techno-commercial bid.

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<td>1</td>
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<td>5</td>
<td>Freight Charges</td>
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**Scope of Inspection (as per QAP):**

The vessel should be fabricated under the inspection of Third party/ Purchaser representative as per QAP

**QUALITY ASSURANCE PLAN**

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<th>Sl. No.</th>
<th>Characteristics / type of check</th>
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<td>Sample selection for each heat lot/heat number &amp; witness of Chemical, Mechanical &amp; IGC Test for pipes, fittings</td>
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<td>W</td>
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<tr>
<td>18</td>
<td>Pneumatic leak test at 3.0 bar(g) with nitrogen gas having dew point of -40°C or better</td>
<td>PO</td>
<td>Visual</td>
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<tr>
<td>19</td>
<td>Pressurizing the tank to 0.5 bar(g) with Nitrogen gas having dew point of -40°C or better</td>
<td>PO</td>
<td>Gauge reading</td>
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<td>20</td>
<td>Stamping of name plate and issue of certificates</td>
<td>PO</td>
<td>Visual</td>
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<td>R</td>
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<tr>
<td>21</td>
<td>Verification of Material test certificates</td>
<td>PO</td>
<td>Review</td>
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<td>Production master file</td>
<td>PO</td>
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Legend: R- Review, W- Witness, H- Hold

Note: 1. The purchaser has rights to participate in the inspection at any stage of fabrication & the bidder shall intimate the work progress periodically.

2. 100% Evaluation of radiography films shall be carried out by third party inspection agency