ANNEXURE -A

SPECIFICATION OF CRYOGENIC TANKER

1. **SCOPE OF WORK**

The overall scope of work comprises design, detail engineering, sourcing of raw materials and bought-out flow components & instruments, fabrication, testing, coordination for inspection, mounting on suitable semi trailer, temporary registration of trailer, transportation and delivery of super insulated road tanker for LOX service to IPRC, Mahendragiri.

2. **DESIGN DATA**

2.1 Tag number for tanker : **CTK 170**

2.2 Service fluid : Liquid Oxygen (LOX)

2.3 Gross (geometrical) volume/ Water capacity (WC) : 20 m³ (20000 litres)

2.4 Usable volume (Gross volume – Ullage volume) : 18 m³

2.5 Maximum Expected Operating Pressure (MEOP) of Inner Vessel : 1.36 MPa (a)

2.6 Maximum Allowable Working Pressure (MAWP)/ Design pressure of Inner Vessel : 1.7 MPa (a)

2.7 Minimum Working Pressure of inner vessel : 0.0145 MPa(a)

2.8 Working temperature of inner vessel at design pressure : 75 – 350 K

2.9 Working temperature of outer vessel : 290 to 350 K
2.10 Permissible evaporation loss rate
Note: To be specified by the results of calculations during Detail engineering review.

2.11 Liquid Expulsion flow rate from tanker during usage.

2.12 Expected service life

2.13 Type of thermal insulation:

- **Super insulation**
  [Double-walled construction with vacuum and multi-layer in the annular jacket]

2.14 Permissible leakage rate across inner and outer vessels:

\[ < 1 \times 10^{-7} \text{ Pa.m}^3/\text{s} \]
\[ (1 \times 10^{-6} \text{ mbar.l/s}) \]

2.15 Vacuum pressure in the jacket (at atmospheric temperature):

\[ < 1 \text{ Pa} \] \[ (1 \times 10^{-2} \text{ mbar}) \]

2.16 Expected periodicity of re-evacuation:

- Once in 5 years
  (to be confirmed during Detail Engineering Review)

2.17 Design code

**Note:**

- **Cold stretched/ pressure strengthened material should not be used.**

- **Inner vessel:** Section VIII, Division 1 of Boiler & Pressure Vessel (BPV) code by American Society of Mechanical Engineers (ASME).
- **Outer vessel:** ASME Section VIII, Div.1 (or) CGA 341:2007 (or) EN 13458-2: 2002.

2.18 Wind speed:

- Wind load shall be calculated as per IS 875 (Part 3 – 1987) with basic wind speed of 39 m/s. Probability factor (risk coefficient) K1 of 1.08,
Terrain, height & structure size factor $K_2$ for terrain category 1 of specific to width & height of structure and Topography factor $K_3$ of 1.36 shall be considered.

2.19 Seismic zone : Zone 3 of IS 1893
(The seismic force is 0.08 times the weight of mass of the tanker)

2.20 Acceleration load : 1.5 g in vertically upward direction

**Note:** The design consideration regarding dynamic loads shall account for the horizontal mode transportation of tanker. The speed limit for road transportation on trailer shall be defined.

2.21 Allowable internal pressure of outer vessel (not more than the set pressure of outer vessel safety devise) : 0.15 MPa(a)

2.22 Allowable external pressure of outer vessel (External overpressure) with full vacuum inside : 0.15 MPa(a)

2.23 Safety system to prevent vacuum jacket from overpressure. : Bidder shall suitably size the Rupture disc device and install in the outer vessel.

2.24 Safety system to prevent inner vessel from overpressure due to loss of vacuum in jacket and fire engulfed condition: Bidder shall suitably size the safety relief devices as per code and specify during Detail engineering review and install in inner vessel as shown in P&ID. The size of nozzle for installing safety relief devices shall also be verified by results of calculations during Detail engineering review.
The inner vessel shall be protected against internal overpressure by four sets of safety devices as shown in PID. Each set comprises a burst disc and safety relief valve. Burst disc provides the sealing to preclude air entry from atmosphere especially during evacuation of the vessel to 14.5 kPa for sub cooling LOX. The burst discs shall be suitable for this vacuum operating condition. The safety relief valve, mounted in series with the burst disc, prevents total loss of the contents of the tanker after rupture of the disc. A tell-tale pressure gauge is used between them to check the integrity of the disc.

Burst discs CBD430 and CBD431 and safety relief valves CVR430 and CVR431 constitute the primary safety devices to protect against loss of vacuum. Burst discs CBD432 and CBD433 and safety relief valves CVR432 and CVR433 constitute the secondary safety devices to protect against fire-engulfment. One primary set and one secondary set will be in service at a time. The three-way valve CVM434 facilitates the change over from one group of safety devices to another. The set pressures of the devises and flow capacities shall be as per the code. The flow capacities shall be adequate to sufficiently limit pressure rise in the tanker in case of typical emergencies like loss of vacuum in the jacket and fire-engulfment of the tanker.

2.25. **Note:**

The inner vessel of cryogenic tank in which sub cooling is envisaged shall be designed for external pressure of 0.15 MPa in the annular jacket with vacuum pressure inside the inner vessel equal to lower limit of working pressure of inner vessel. This is to preclude the possibility of buckling of inner vessel due to loss of vacuum in the jacket while sub cooling is in progress.

### MATERIAL OF CONSTRUCTION

| 3.1 | Inner vessel | : ASTMA 240 304L/ 316L (or) Dual certified 304/304L or 316/316L |
| 3.2 | Outer vessel | : ASTMA 516 Gr. 70 |
| 3.3 | Pipes & tubes | : ASTMA 312 TP 304L/ 316L (or) Dual certified 304/304L or 316/316L |
| 3.4 | Pipe fittings | : ASTMA 403 WP 304L/ 316L |
3.5 Flanges : ASTM A 182 F 304L/ 316L/ 321

3.6 Bolts : ASTM A 320 B8

3.7 Nuts : ASTM A 194 8

Note: Cold stretched/ pressure strengthened material should not be used.

4. CONFIGURATION DETAILS

4.1 Configuration details of tanker:

4.1.1 The inner vessel of the tanker shall be designed for MAWP and also for vacuum.

4.1.2 The inner & outer tank shall be of cylindrical configuration.

4.1.3 The fill/ drain port of the tanker shall be provided with suitable anti-vortex baffles.

4.1.4 The pressurization / vent ports of the tanker shall be provided with diffuser.

4.1.5 All the nozzles of DN 50 and smaller sizes shall be suitably stiffened with gusset plates.

4.1.6 Suitable earthing bosses shall be provided for protection against lightning and static electricity.

4.1.7 LOX in the tanker will be expelled by pressurizing with Gaseous Nitrogen at ambient temperature.

4.1.8 The required size of different nozzles (N1 to N9) in tanks is specified in the Figure- 1. Blank-off flange for the Nozzle N4 shall be supplied along with metal gasket. Also additional blank off flange for N4 nozzle with 3 Nos. of metal gaskets shall be provided.

4.1.9 The fluid temperature & level sensors array mounted on a cylindrical pipe assembly will be realized by IPRC (Purchaser) to measure the LOX temperature & level of inner vessel. The top end of the pipe assembly will have flanged interface to mate with Nozzle N4.
4.1.10 A separate vacuum jacket (external vacuum chamber) with flanged interface N8 shall be fabricated for the sensor piping assembly interface nozzle N4 as shown in Figure-1 and supplied along with the tanker. This removable vacuum jacket shall have a vacuum pump-out port cum seal-off valve, a vacuum gauge head and a Nozzle N9 with blank-off flange.

4.2 **Configuration details of Trailer:**

4.2.1 The semi-trailer shall be suitably designed to accommodate the LOX tanker on it.

4.2.2 The semi trailer shall have fifth wheel coupling of reputed make to suit with standard prime movers available with IPRC. The requirements for the fifth wheel coupling shall be finalized during DER.

4.2.3 During the operation of tanker the prime mover will be detached by engaging leg support. Accordingly the leg support of the tanker shall be designed considering load and moments.

4.2.4 The assembly of tanker with semi trailer is to be carried out at supplier’s works. Also the design details of the trailer with drawings cleared by TPI agency shall be submitted to IPRC for approval prior to fabrication.

4.3 **STATUTORY CLERANCES**

4.3.1 The supplier shall obtain approval from PESO for the LOX tanker before commencing fabrication.

4.3.2 Approval from State Transport Authority shall be obtained for semi-trailers.

4.3.3 The supplier shall obtain temporary registration for the trailer before delivering the tanker.

5. **FABRICATION:**

5.1. **Forming:** All the forming works of the tank shall be carried out by suitable forming process. After forming, the parts shall be suitably stress-relieved.

5.2. **Welding:** The welding on stainless steel parts of the tank shall be carried out by Gas Tungsten Arc Welding (GTAW) with Gaseous Argon of 99.995 % purity as the purge medium. All the welding on carbon steel parts of the outer vessel of the
tanks shall be carried out by Shielded Metal Arc Welding (SMAW). Prior to commencement of welding on the tanks, welding procedure qualification and welder’s performance qualification tests shall be carried out in accordance with Section IX of ASME BPV code.

5.3. **Surface Treatment**: The following procedure shall be employed for surface treatment of the tanks.

5.3.1. **Cleaning of stainless steel surfaces**: After fabrication, the interior and exterior surfaces of the inner vessel and the interior surfaces of the nozzles, interconnecting pipelines and flow components shall be cleaned, employing the following procedure:

5.3.1.1. **Mechanical cleaning**: All the metallic surfaces with scales and newly welded surfaces shall be cleaned by scrubbing with stainless steel metallic wire brush. The loose scales and particles obtained from mechanical cleaning shall be removed by blowing with dry air, sucking with vacuum cleaner or washing with water.

5.3.1.2. **Degreasing**: The surfaces shall be degreased to Oxygen service standard as per CGA G-4.1 (Compressed Gases Association Inc, USA) or MIL-C-52211 or ASTM G-93 or equivalent.

5.3.1.3. **Pickling**: In order to remove rusts and scales, the surfaces are pickled with a solution containing Hydro-fluoric acid (HF) and Nitric acid (HNO₃). The composition of pickling solution and duration are to be adjusted after trial test on a sample piece to remove uniformly less than 25 μm thick material. Mostly, the composition is as follows:

- HF : 5 % (by mass)
- HNO₃ : 15 to 20 %
- Water : Remainder

This is followed by rinsing with water.

5.3.1.4. **Passivation**: In order to form a protective layer, the surfaces are passivated with a solution of the following composition:

- HNO₃ : 25 % (by volume)
- Water : Remainder
- Duration : 2 h (minimum)

This is followed by rinsing with De-Mineralized (DM) water.
5.3.1.5. **Drying**: The surfaces of the tanker shall be dried by purging with dry Air or Gaseous Nitrogen until the moisture content in the medium is brought down to 20 ppm, v. Before transportation, the inner vessel be kept pressurized at 0.15 MPa(a) with Gaseous Nitrogen.

5.3.1.6. **Buffing**: The exterior surface of inner vessel shall be finished by buffing.

5.3.2. **Cleaning of carbon steel surfaces**

5.3.2.1. The interior and exterior surfaces of the outer vessel shall be sand–blasted and mechanically cleaned.

5.3.2.2. **Painting**: The exterior surfaces of the outer tank shall be painted with 2 coats of primer (Zinc or Red oxide) and 2 coats of white color Poly Urethane (PU) or Epoxy paint. A black color band of 200 mm width shall be painted circumferentially at the middle of the tank.

6. Valves and instruments are to be located in a cabin & panel respectively at the rear end of the tanker. The panel shall have suitable doors and locking mechanism. The valves and instruments shall be accessible for operation, maintenance and calibration.

7. All the flow components shall be procured from reputed manufacturers. All the valves shall be of extended stem bellow sealed type to prevent entry of air in to the vessel during sub cooling. The instrument valves shall be of needle type. The instrument isolation valves V1, V2, V3, V4 are bellow sealed needle type valves.

8. Make of flow components is subject to approval by Purchaser during DER.

9. All the flow components and instruments shall be provided with permanent, easy-to-read tag number plates.

10. **FLOW COMPONENTS**

10.1 **VACUUM COMPONENTS**

The outer vessel of the tank shall be fitted with a vacuum safety disc, a vacuum pump-out port cum seal-off valve. The vacuum safety disc shall be set to relieve at an internal pressure of 0.13 MPa (a) to 0.15 MPa(a). However, during
normal period, the vacuum safety disc shall withstand an external pressure of 0.1 MPa(a) with full vacuum inside.

10.2 **ELECTRO PNEUMATIC & MANUAL VALVES**

The Electro Pneumatic & Manual valves shall be as per specification enclosed in Anneure-1. The pipes & tubes used in the tanker shall be tested as per Quality Assurance Plan (QAP) enclosed in Annexure 2 & 3.

11. **INSTRUMENTS**

11.1 **Vacuum gauge head & vacuum gauge:** The outer vessel of the tanker and the external vacuum chamber for the nozzle N4 shall be fitted with suitable gauge heads for measuring the vacuum. One vacuum gauge (pressure controller), suitable to mate with the vacuum gauge head of the tanker shall also be supplied.

11.2 **Pressure and level gauges:** The tanker shall be mounted with level (differential pressure) gauge CDL170 and the local pressure gauge CPL170.

11.3 **Free Issue Materials:** The absolute and differential pressure transmitters along with suitable manifold valves required for this tanker will be free issued by the Department against submission of bank guarantee. The bidder shall suitably accommodate the instruments in the panel and ensure the provision for removal / re-fixing of instruments in the panel after periodic maintenance.

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Item</th>
<th>Price, Rs.</th>
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<tbody>
<tr>
<td>1.</td>
<td>Absolute pressure</td>
<td>CPI170 80,000/-</td>
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<tr>
<td>2.</td>
<td>transmitter</td>
<td>CPI171 80,000/</td>
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<tr>
<td>3.</td>
<td></td>
<td>CPV171 80,000/</td>
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<tr>
<td>4.</td>
<td>Level transmitter</td>
<td>CLI 170 1,20,000/-</td>
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<tr>
<td>5.</td>
<td></td>
<td>CLI 171 1,20,000/-</td>
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12. **TESTS**

The following tests are to be performed as per the standards mentioned therein.

12.1 **Material certificates:** The material test certificates shall be provided for all the principal and pressure-bearing parts of the tanks (including plates, nozzles, interconnecting pipes, flow components, etc) to ascertain the physical and chemical properties.
12.2 **Ultrasonic test:** All the plates used for the fabrication of inner vessel & outer vessel and the pipes used for the nozzles and interconnection shall be subject to ultrasonic test.

12.3 **Radiographic test:** All the (100 % of the) stainless steel butt weld joints on the inner vessel as well the nozzles, interconnecting pipelines, etc. and 10 % of the butt weld joints on the outer vessel shall be subject to radiographic test with X-rays to 2% sensitivity.

12.4 **Inner vessel pressure test:** The inner vessel shall be pneumatic pressure tested with Gaseous Nitrogen or dry Air. The pneumatic test pressure shall be as per design code. Alternatively, hydraulic pressure test at a pressure as specified by the design code may be conducted. In such case, the water with pH at 6.5 to 7.5 and chloride content < 30 ppm shall be used. After draining water, the vessel shall be dried down to a residual moisture content less than 20 ppm(v).

12.5 **Outer vessel pressure test:** The outer vessel (in assembled form) shall be pneumatic pressure tested with Gaseous Nitrogen or dry Air. The pneumatic test pressure shall be as per design code.

12.6 **Leak test:** The leak tightness across the inner vessel as well as the outer vessel shall be tested with Gaseous Helium Mass Spectrometer Leak Detector (MSLD) as per Article 10, Section V of ASME BPV code by **hood technique.** While leak-testing the inner vessel, the internal volume shall be charged with a mixture of 75 % Gaseous Nitrogen + 25 % Gaseous Helium and the annular volume between the inner vessel and the outer vessel be evacuated and connected to MSLD. While leak-testing the outer vessel, the exterior surface of the outer vessel shall be shrouded by synthetic bag with a mixture of 75 % Gaseous Nitrogen + 25 % Gaseous Helium and the annular volume between the inner vessel and the outer vessel be evacuated and connected to MSLD. The **global leakage rate thus measured and extrapolated for 100% Helium shall be finer than 1E–7 Pa.m³/s.**
12.7 **Vacuum retention test:** The annular space between inner and outer vessel (vacuum jacket) to be evacuated & sealed and the vacuum pressure in the jacket (at atmospheric temperature) shall be <1 pa. Subsequently the vacuum level shall be periodically monitored and recorded for a minimum period of 120 hrs and there should not be deterioration in the vacuum level. The vacuum pressure should stabilize at <1 pa (at atmospheric temperature).

12.8 **Performance test:** The performance test with LN2 shall be conducted by supplier at their premises. The tank shall be properly chilled and then filled with Liquid Nitrogen to 90 % of its gross volume and the evaporation loss rate to be measured using a gas flow meter, pressure & temperature in the vent line. The measured evaporation loss rate with Liquid Nitrogen shall be extrapolated to that with the working fluid (Liquid Oxygen) by theoretical computation. The evaporation loss rate thus measured and extrapolated to the working fluid (Liquid Oxygen) shall be less than the value specified.

   a) On the day of performance test the vacuum level in the vacuum jacket shall be measured and recorded before start of chill down.

   b) After completion of performance test and draining LN2 & warm up, the vacuum level in the jacket shall be measured and ensure that the vacuum level is not deteriorated.

13. **INSTRUCTION**

The in-process (stage) and pre-delivery inspection of the tanks shall be carried out by one of the following Third Party Inspection (TPI) agencies:

- Lloyds Register Industrial Services Pvt Ltd (LRIS)
- Det-Norske Veritas (DNV)
- Technischer Uberwachung Verein (TUV–NORD)
- Technischer Uberwachung Verein (TUV–SUD)

It shall be the responsibility of the Supplier to arrange for and coordinate with the TPI agency. The scope of inspection shall be as follows.

13.1 Review and approval of the design calculations, fabrication drawings and QAP.

13.2 Identification of raw materials and review of the material test certificates for compliance with the relevant requirements.
13.3 Review of test and calibration certificates for compliance with the specification and visual examination of the bought-out flow components and instruments.

13.4 Witnessing and certification of welding procedure qualification and welder’s performance qualification tests. If the welders already possess the performance certificate, the TPI agency shall review and authorize the same.

13.5 Review of X-ray films of radiographic tests for possible defects in the weld joints.

13.6 Witnessing of formed head solution annealing and simulation test coupon results.

13.7 Inspection at any stage of fabrication to ensure that the methodology employed for fabrication is in compliance with the requirements of standard codes and practices and the approved documents.

13.8 Witnessing of inner vessel final volume measurement test.

13.9 Witnessing of pressure test.

13.10 Witnessing of leak test.

13.11 Review of vacuum retention test.


13.13 Issuance of Pre-Delivery Inspection (PDI) certificate and stamping on the tanks.

Note: Apart from inspection by the TPI agency, the Purchaser’s representative(s) shall also witness any test as may be deemed necessary at their discretion.
Annexure-B

1. PRE-QUALIFICATION CRITERION

The Bidder’s capability shall be evaluated based on the following Pre-Qualification (PQ) criteria. The Bidders shall suitably fill-up the information solicited in “Item specification” and submit as part of the Techno-Commercial Bid (TCB). Those Bidders who comply with the PQ criteria only will be screened-in for opening and evaluation of Price Bid. The information to be submitted in the TCB shall be complete in all respects substantiated by attached documents and there shall not be any further opportunity for the Bidders to submit any information or document unless the Purchaser solicits so at their own discretion. Any lack of information or incomplete/ambiguous information or false information or information non-compliant with the PQ criteria shall be treated as sufficient cause to reject such Bids.

1.1. The bidder shall be a regular Supplier of vacuum jacketed (VJ) cryogenic road tanker. The bidder should have manufactured & supplied at least 3 VJ cryogenic tankers during last three years. The claim shall be substantiated by purchase order(s) AND inspection release note(s)/ acceptance certificate(s) by third-party inspection agency or client dated between 01/04/2016 and 31/03/2019.

1.2. The bidder must have technical competence in design, manufacture, testing & supply of Vacuum Jacketed (VJ) cryogenic tanker as demonstrated by VJ Cryogenic tanker of at least 10m$^3$ (10000 liters) volume and 1.0 MPa (10 bar) pressure. The claim shall be substantiated by purchase order(s) AND inspection release note(s)/ acceptance certificate(s) by third-party inspection agency or client.
Annexure-C

General terms & conditions:

1 **DOCUMENTATION**

The following documents (in English) in 2 hard prints/ copies as well as in electronic/ soft copy shall be furnished at different stages specified thereupon.

1.1 **Detail engineering review:** Within 2 months from placement/ award of the Purchase order, the Purchaser shall conduct the **Detail Engineering Review (DER).** The following documents duly reviewed and approved by the TPI agency for compliance with the requirements of the relevant design codes as specified in the Purchase order and statutory regulations, shall be submitted to the Purchaser during the DER. These documents are subject to review by the Purchaser and only upon approval of the same by the Purchaser, the Supplier shall proceed with fabrication. However, the Purchaser’s approval shall not absolve the Supplier of their responsibility to comply with the specifications of the Purchase order.

a. An overall dimensioned General Arrangement (GA) drawing of the tanker, showing the assembled view along with all accessories shall be provided. The details of the interconnecting pipelines and their location with respect to the tanker shall also be shown in the GA drawing. The interface details for both fluid connections and instrument connections, including the relative positioning among the interfaces, their location with respect to the tanker and the end connection/ preparation details for each interface shall also be shown in the GA drawing.

b. The detailed design **calculations for the tanker (thermal & structural) and trailer** shall be provided.

c. A detailed Quality Assurance Plan (QAP) shall be provided.

d. A schedule chart detailing the various activities involved in fabrication and the time required for completing the same, so as to comply with the specified overall delivery period, shall be furnished.

e. The make, model number and specifications of the flow components and instruments along with the relevant catalogues shall be provided.
f. Detailed procedure shall be provided for conducting performance test including chilldown procedure and the methodology of computing evaporation loss rate of actual working fluid from the measured evaporation loss rate of LN2.

g. Detailed procedure shall be provided for commissioning at Purchaser’s site.

1.2 **On completion of DER:**

1.2.1 The bidder shall obtain PESO approval of drawings / documents within one month from the date of completion of DER.

1.2.2 The bidder shall obtain approval from State transport Authority for semi-trailer.

1.2.3 **During the course of fabrication:** The details of activities completed by the end of every month shall be sent to the Purchaser. The delay, if any, from the agreed schedule and the reasons, if any, therefore shall be highlighted. The schedule chart shall also be updated in such cases.

1.3 **Pre-delivery review:** On completion of fabrication and testing, but prior to delivery of the consignment, the Purchaser shall conduct a pre-delivery review. During the review, the following documents, duly approved by the TPI agency, shall be submitted to the Purchaser. The Purchaser shall review the same to ensure compliance with the specification of the Purchase order. On being satisfied, the Purchaser shall issue a “Purchaser’s delivery clearance”, only upon receipt of which the Supplier shall proceed with delivery of the consignment.

a. The certificates of all tests and calibration (including those for the bought-out flow components and instruments) shall be provided. Each page of the certificates shall be duly counter-signed and stamped by the TPI agency.

b. PDI certificate by the TPI agency.

c. Warranty certificate.

d. Calibration chart for the level gauge with respect to water column, liquid Nitrogen and liquid oxygen.
1.4 Along with supply:

The supplier shall send the following documents along with supply.

- Warranty certificate
- PDI certificate by the TPI agency.
- As-built GA and fabrication drawings – 2 sets
- Design reports / documents mentioned under DER
- Instruction manual for commissioning, operation, troubleshooting and maintenance.
- Test certificates of tanker.
- Test certificates of flow components used.
- Temporary registration of Trailer.
- PESO approval document.
- State Transport approval document.

2. COMMISSIONING

After receipt of the tanker at the Purchaser’s site at IPRC, Mahendragiri, the tanker shall be commissioned by the Purchaser based on the documents to be provided by the Supplier for the same. The commissioning shall comprise pressure test up to the MEOP with the actual working fluid (Liquid Oxygen) and functional check of the flow components and instruments. Though commissioning is NOT included under the Supplier’s scope of responsibility, in case any discrepancy or ill-performance is observed during commissioning, it shall be the Supplier’s responsibility to rectify/ replace the defective/ ill-performing subsystems or the entire tanker. The Supplier may, at their discretion, depute their representative(s) to witness the commissioning, but at their own expense. In case the defective/ ill-performing sub-systems or the entire tanker require rectification/ rework to be carried out at the Supplier’s works, it shall be Supplier’s responsibility to transport the same to the Supplier’s works and item back to the Purchaser’s site.
3. **DELIVERY TERM:**
The tanker shall be delivered in totally integrated and ready-to-use form on FOR Mahendragiri basis. The supplier shall make their own arrangement to deliver the road tanker at IPRC, Mahendragiri. The supplier shall arrange for temporary registration and transit insurance. The supplier shall furnish the Temporary registration of semi-trailer.

4. **DELIVERY PERIOD:** The delivery period shall not exceed 14 months from the date of Purchase Order. The delivery period of 14 months include the period for DER, obtaining PESO and State Transport Authority approvals and the work shall be deemed to have been executed after the tanker is received at IPRC, Mahendragiri. In case the delivery stretches beyond the stipulated period, the Purchaser shall recover from the Supplier, as Liquidated Damage (LD).

   Wherever Purchaser’s approval is required on the documents submitted by the Supplier, the Purchaser will dispatch/ transmit their approval or comments within 10 calendar days from the date of receipt of such documents at the Purchaser’s end. Wherever Purchaser’s representatives are required (for Detail Engineering Review, Pre-Delivery Inspection, etc.) at the Supplier’s premise, the Purchaser will depute their representative within 15 calendar days from the date of readiness of documents for review or hardware for inspection and receipt of intimation from Supplier.

5. **Security Deposit:** The Supplier shall provide Bank Guarantee (BG) for an amount equivalent to the 10% (TEN PERCENT) of the Purchase Order (PO) value towards Security Deposit for the due performance of the Purchase Order. The security deposit can be submitted in the form of Bank Guarantee or Fixed Deposit receipt obtained from any Nationalized / Scheduled Bank and it shall be kept valid for a period of sixty days beyond the date of completion of Purchase Order. This Security Deposit will be returned to the Supplier only upon successful completion of all the Purchase Order obligations or shall be adjusted/ forfeited against non-fulfillment of any of the Purchase Order obligations. The security Deposit shall be submitted within 30 days from the date of receipt of purchase order.

6. **Liquidated Damages (LD):** The delivery period shall be the essence of the purchase order. If the supplier fails to meet delivery date within the time specified in PO or any extension thereof, the Department will recover from the Supplier as Liquidated Damages(LD) a sum of 0.5% of the total order value for each calendar week of delay subject to a maximum of 10% of the total order value.
7. **Warranty:** The tank shall be warranted for satisfactory performance over a period of 24 months from the date of receipt of the tanks at the port of entry in the Purchaser’s country in case of import or Mahendragiri in case of indigenous supply. The Supplier shall furnish a Performance Bank Guarantee (PBG) for 10% of the value of the Purchase Order for the Warranty period.

8. **Performance Bank Guarantee:** The Supplier shall provide Performance Bank Guarantee (PBG) for an amount equivalent to the 10% (TEN PERCENT) of the Purchase Order (PO) value valid for a period up to 60 days beyond the completion of warranty period. The Security Deposit can be extended as PBG also.

9. **Payment Terms:**

The payment shall be made within 30 days after receipt and acceptance of LOX tanker at IPRC, Mahendragiri. The Department does not normally entertain advance payment. However, in case the Bidder proposes for advance payment, the Department may consider it, subject to the following conditions.

a. Bank Guarantee for equivalent sum from a nationalized/scheduled bank approved by RBI valid till final acceptance of tanker with additional claim period of 2 months is to be submitted.

b. In case of different advance payment terms proposed by the Bidders, Department will load simple interest on the advance payment over the execution period at the rate of marginal cost of funds-based lending rate [MCLR] as notified by State Bank of India [SBI] applicable on the due date for submission of bid for comparison of the price bids.

Moreover, in case of delay in execution of the Purchase Order by the supplier beyond the stipulated period due to reasons not attributable to the Department, the Department will recover interest on the advance payment after at the at the rate of MCLR as notified by SBI on the scheduled date of completion.

10. **DOCUMENTATION ALONG WITH THE QUOTATION**

Along with the quotation, the following documents shall be furnished in English. Any lack of the following details in the quotation will be treated as sufficient cause for rejection of the bidder.

a. A complete technical description of the tanker offered shall be furnished. Technical deviations, if any, from the tender specification shall be explicitly indicated in the quotation. The following details shall be specifically highlighted:
1. Overall dimensions (outside diameter & length) of the inner vessel of the tanker.
2. Overall dimensions (outside diameter & length) of the outer vessel of the tanker.
3. Overall size of the trailer.

b. A detailed profile of the bidder, in terms of the design and fabrication shall be provided in the quotation.

c. The capability to meet Pre Qualification Criteria shall be substantiated with documentary evidences in the form of Purchase order/ Contract and Inspection/ acceptance certificate by TPI agency or Client.

d. A list of clients (including address, telephone and fax numbers and contact person) to whom tanks of similar specification have been supplied shall be furnished.

e. Suggested list of vendors for flow components is given below. If the bidder proposes alternate sub vendors other than listed, such details may be submitted in the bid. The decision of the IPRC in regard to acceptance/ rejection of the sub vendor proposed by the bidder shall be the final.

1. **Extended stem EP & Manual bellow sealed globe valves :**
   
   a. M/s. Herose GmBH, Gurgaon
   b. M/s. Ireland SA, France
   c. M/s.MIL Controls Ltd, Aluva, Kerala
   d. M/s. Samson controls Pvt. Ltd, Pune

2. **Manifold valves, Needle valves & bellow sealed needle valves:**
   
   a. M/s. Swagelok
   b. M/s. Parker
   c. M/s. Weka AG Switzerland
   d. M/s. Schneider
   e. M/s. Hoke

3. **Safety Relief valves:**
   
   a. M/s. LESSER India, Mumbai
   b. M/s. Herose GmBH, Gurgaon
   c. M/s. Tyco Sanmor, Chennai

4. **Burst discs :**
   
   a. M/s. BS&B Safety systems (India) Ltd, Chennai
   b. M/s. FIKE India Ltd, Pune
ANNEXURE -1

TECHNICAL SPECIFICATION OF
ELECTRO PNEUMATIC (EP) AND MANUAL GLOBE VALVES

VALVE TYPE

I. The pneumatically-actuated valve shall comprise valve, actuator and status switches.

a. Extended stem cryogenic Vacuum jacketed bellow sealed EP Globe valve - EPVBG

II. The Manual globe valves are of the following 2 types as given in Table- 1.

a. Extended stem cryogenic Vacuum jacketed bellow sealed Globe valves - EVBG
b. Extended stem cryogenic bellow sealed globe valves - EBG

1. Quantity : As given in Table 1
2. Tag number : As given in Table 1
3. Pattern : Globe
                  2. Hand-operated by wheel (Manual)
5. Fluid medium : As given in Table 1
6. Working temperature range : As given in Table 1
7. Nominal size : As given in Table 1
8. Pressure rating class : As given in Table 1
9. Valve coefficient : As given in Table 1
10. Permissible leakage rate across body : $\leq 1 \times 10^{-6}$ mbar-lit/sec of GHe
11. Permissible leakage rate across seat : $\leq 1 \times 10^{-5}$ mbar-lit/sec of GHe
12. Guaranteed cycles of operation : 3,000
13. **End connection**: BW: Butt welding ends as per ASME B16.9/16.25 with pipe stubs as per ASME B 36.19/ 36.10 of 100 mm length each shall be butt-welded to the body on either side, the ends of which shall be prepared for butt welding. The butt welding ends shall be suitable to mate with the interfacing pipe size and schedule number as given in Table 2A.

14. **Style of construction:**

14.1 **Body**: With full port (standard bore)

14.2 **Bonnet**: Bolted or screwed to body with suitable seals (*bonnet shall be top of stem extension*)

14.3 **Stem**: Non rotating rising stem. The stem operation for high pressure valves may be assisted by requisite bearing for easy operation of valve stem with/without load.

14.4 **Stem extension length (For ESG valves)**: *As per BS 6364*

14.5 **Stem (dynamic) seal**: By bellows with redundant gland packing. Between bellows seal and the redundant gland packing, a *tell-tale* indicator pressure gauge port with suitable plug shall be provided.

14.6 **Plug**: Renewable (replaceable) from stem with insert.

14.7 **Seat**: Seat shall be integral with body of material harder than the plug insert.

14.8 **Shut off mode**: Bi-directional shut off

14.9 **Flow direction**: Flow-to-open (Flow-under-plug)
15. **Material of construction:**

15.1 **Body and bonnet:**
- ASTM A 182 F 304L/ 316L/ 321 for nominal size ≤ DN40
- ASTM A351 CF3/3M for nominal size ≥ DN50

15.2 **Stem, plug, seat, seat insert:**
- ASTM A 479 304L/ 316L/ 321

15.3 **Bellows (for BSG valves):**
- Stainless steel 316Ti/ 321/Hastealloy C276/ Inconel 600/ 625

15.4 **Gland packing:**
- PTFE/ Glass-filled PTFE/ PEEK

15.5 **Plug insert/ trim:**
- PCTFE/ Polycarbonate / PEEK

15.6 **Pipe stub:**
- ASTM A 312 TP Grade same as that of the body

15.7 **Bolts:**
- ASTM A 320 Gr. B.8

15.8 **Nuts:**
- ASTM A 194 Gr.8

16. The valves shall be either inherently anti-static or provided with anti-static features.

17. **Design code:**
- BS 5352/ BS 1873/ API 6-D/ ASME B16.34

18. **Test code:**
- BS 6755 Part 1/ API 598/ ANSI B 16.34

19.0 **Tests:**

19.1 **Material certificates:** The material certificates, detailing the physical and chemical properties, of the principal pressure-bearing parts shall be provided.

19.2 **Dimensional inspection:** All valves have to be subjected to dimensional inspection as per the approved drawings.

19.3 **Welding joint test (wherever applicable):** All butt welding joints in the valve (including the joints between the body and the pipe stubs) shall be subject to radio-graphic test with X-rays or gamma rays to 2-2T sensitivity as per Section IX, ASME. All the socket welding joints shall be subject to dye-penetrant test.
19.4 **Bellows cyclic life test:** 3 sample bellows drawn from each batch of the same size and type shall be subject to (destructive) cyclic life (proto-type) test as per BS 5352 or equivalent. **If the manufacturer of the bellows has already performed such test, copy of the certificate may be produced and this test need not be performed.**

19.5 **Pre-assembly Hydraulic shell pressure test:** The valve shell, prior to assembly in fully open position, shall be subjected to pressure test with Water (with suitable corrosion inhibitor) at 1.5 times the maximum rated working pressure of the particular pressure rating class of the valve.

19.6 **Final Hydraulic shell pressure test:** The valve, upon final assembly in partially open position, shall be subjected to pressure test with Water (with suitable corrosion inhibitor) at 1.1 times the maximum rated working pressure of the particular pressure rating class.

19.7 **Hydraulic seat pressure test:** The valve, in closed position, shall be subject to pressure test with Water (with suitable corrosion inhibitor) at 1.1 times the maximum rated working pressure of the particular pressure rating class of the valve.

19.8 **MSLD shell leakage test:** The global leakage rate across body shall be measured with gaseous Helium Mass Spectrometer Leakage Detector (MSLD) to establish the permissible leakage rate values specified above by *hood technique* as per Article 10, Section V, ASME. The leakage test shall be performed by shrouding the entire outside surface of the valve with a plastic bag to hold gaseous Helium at a positive pressure and by evacuating and connecting the inlet/outlet port to MSLD. Leakage test by detector probe or tracer probe technique is not acceptable.

19.9 **MSLD seat leakage test:** The global leakage rate across seat shall be measured with gaseous Helium MSLD to establish the permissible leakage rate values specified above by *hood technique* as per Article 10, Section V, ASME. The leakage test shall be performed by pressurizing the inlet with gaseous Helium and by evacuating and connecting the outlet to MSLD. Leakage test by detector probe or tracer probe technique is not acceptable.

20.0 **MSLD jacket leakage test:** The global leakage rates across jacket shall be measured with gaseous Helium MSLD to establish the permissible leakage rate values specified above by *hood technique* as per Article 10, Section V, ASME. Suitable temporary blank-off shall be used to seal the annular gap between the process (core)
pipe and the jacket pipe for performing this test. The leakage test across the jacket shall be performed by shrouding the entire outside surface of the jacket with a plastic bag to hold gaseous Helium + gaseous Air mixture at a positive pressure and by evacuating and connecting the annular space between the valve and the jacket to MSLD. Leakage test by detector probe or tracer probe technique is not acceptable.

20.1 **Pneumatic seat pressure test:** The leakage rate across seat shall be tested with dry air or gaseous Nitrogen at 0.7 MPa (g) by water displacement (bubble) method.

20.2 **Leak test for reverse flow shut off:** Each valve has to be subjected to reverse flow shut off test by pressurizing the downstream side to the pressure at 0.7 MPa (g) and bubble tightness is to be ensured.

20.3 **Functional test:** Each valve has to be subjected to functional test for verification of free operation of valves to the full stroke length.

20.4 **Ultrasonic test:** 100% ultrasonic test shall be conducted for the pipe stubs.

21. **Cleanliness:** All the interior flow surfaces of the valve shall be degreased and cleaned to Oxygen service standards as per CGA G-4.1 or ASTM G 93. The valves shall be dispatched with end connection sealed by suitable plastic plugs to avoid contamination during transportation.

22. **Marking:** All the valves are assigned tag numbers for the sake of identification. The tag number for each valve, as indicated above, besides size, pressure rating class, material of construction, etc, shall be legibly and indelibly engraved on the body of the valves.

### 23.0 ACTUATOR

23.1 **Type:** Linear actuator, piston/diaphragm type, single acting, spring return, fail-safe.

23.2 **Normal position:** Normally close (NC)

23.3 **Command gas:** Gaseous Nitrogen at 0.55± 0.01 MPa(g)

23.4 **Failure position:** Close
| 23.5 | Response time (for both opening and closing strokes) | **≤5 sec** | If required, flow (volume) booster and quick exhaust valve shall be incorporated to achieve the specified response time. |
| 23.6 | End connection for command gas | DN 8 (¼”) NPT (F) to ASME B 1.10.1. |
| 23.7 | Material | Carbon steel (enamel-painted) |
| 23.8 | Test (along with valve assembly) | The response time taken for opening and closing of the valve shall be evaluated. |

**24.0 STATUS SWITCHES**

The valve shall be provided with a pair of non-contact type proximity status switches to indicate the “opened/closed” status of the valve. The status switches shall be mounted on the valve with such proper arrangement that does not require any adjustment/alignment for the specified cycles of operation of the valve.

| 24.1 | Type | Cylindrical Inductive Type Proximity Sensor (switch) in accordance with **NAMUR** |
| 24.2 | Sensing Distance | 1.5, 2, 4, 5 mm *(The sensing distance shall be suitably selected by the valve manufacturer according to the valve stroke length)* |
| 24.3 | Electrical configuration | DC, 2 wire |
| 24.4 | Nominal voltage | 8 V |
| 24.5 | Operating voltage | 5 – 24V |
| 24.6 | Switching frequency | ≥ 500 Hz |
| 24.7 | Reverse polarity | Shall be Protected against reverse polarity |
| 24.8 | Short circuit protection | Shall be Protected for short circuit |
24.9 Current Consumption Not sensing : ≥ 3mA
          Sensing : ≤ 1mA
24.10 Indication of switching state : LED
24.11 Connection Type : 2 m long PVC cable
24.12 Ambient Temperature : -24°C to 80°C
24.13 Housing material : Stainless steel
24.14 Protection Degree : IP 67
24.15 Hazardous area certification : The switches shall be intrinsically safe for Hydrogen environment in conformance with Ex ia IIC T6, Zone 1 of IEC/ ATEX. The certificate of conformance to this effect from the accredited agency shall be provided.
24.16 Suggested make : a. IFM electronic
                          b. Omron, USA
                          c. Pepperl + Fuchs, Germany
                          d. Rockwell Automation – USA
                          e. LongVale ltd – UK
                          f. Cario Gavazzi
                          g. Euroswitch – UK

25. **Command solenoid valve** : Solenoid valve for the command purpose is not under the scope of the supplier. Hence the solenoid valve need not be supplied along with the Pneumatic valve. It will be provided by IPRC.

26. **Quality assurance plan** : As given in Table 2B.
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Type of Valve</th>
<th>Qty Nos</th>
<th>Tag number</th>
<th>Fluid medium</th>
<th>Working temperature range K</th>
<th>Nominal size metric</th>
<th>Valve coefficient Cv</th>
<th>Pressure rating class/MAWP</th>
<th>Schedule number of interfacing pipe</th>
<th>End connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>EPVBG</td>
<td>1</td>
<td>CVP1</td>
<td>LOX</td>
<td>75-350</td>
<td>DN100</td>
<td>176</td>
<td>class 300</td>
<td>Sch 10 S</td>
<td>BW</td>
</tr>
<tr>
<td>2.</td>
<td>EVBG</td>
<td>1</td>
<td>CVM 1</td>
<td>LOX</td>
<td>75-350</td>
<td>DN100</td>
<td>176</td>
<td>class 300</td>
<td>Sch 10 S</td>
<td>BW</td>
</tr>
<tr>
<td>3.</td>
<td>EBG</td>
<td>1</td>
<td>CVM 2</td>
<td>LOX</td>
<td>75-350</td>
<td>DN100</td>
<td>176</td>
<td>class 300</td>
<td>Sch 10 S</td>
<td>BW</td>
</tr>
<tr>
<td>4.</td>
<td>EBG</td>
<td>1</td>
<td>CVM 3</td>
<td>LOX</td>
<td>75-350</td>
<td>DN40</td>
<td>25</td>
<td>class 300</td>
<td>Sch 10 S</td>
<td>BW</td>
</tr>
<tr>
<td>5.</td>
<td>EBG</td>
<td>1</td>
<td>CVM 4</td>
<td>LOX</td>
<td>75-350</td>
<td>DN15</td>
<td>3</td>
<td>class 300</td>
<td>Sch 40 S</td>
<td>BW</td>
</tr>
<tr>
<td>6.</td>
<td>EBG</td>
<td>1</td>
<td>CVM 5</td>
<td>LOX</td>
<td>75-350</td>
<td>DN40</td>
<td>25</td>
<td>class 300</td>
<td>Sch 10 S</td>
<td>BW</td>
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<tr>
<td>7.</td>
<td>EBG</td>
<td>1</td>
<td>CVM 6</td>
<td>LOX</td>
<td>75-350</td>
<td>DN25</td>
<td>11</td>
<td>class 300</td>
<td>Sch 10 S</td>
<td>BW</td>
</tr>
</tbody>
</table>
### Table 2B

**QUALITY ASSURANCE PLAN FOR MANUAL EVBG & EBG VALVES**

<table>
<thead>
<tr>
<th>S No</th>
<th>Test</th>
<th>Object tested</th>
<th>Characteristic sought for</th>
<th>Sample size</th>
<th>Test procedure</th>
<th>Acceptance criterion</th>
<th>Form of record</th>
<th>Pre-Delivery Inspection (PDI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Material test</td>
<td>Specimen from raw materials</td>
<td>Chemical composition and physical properties</td>
<td>1 per heat/lot</td>
<td>Relevant standard</td>
<td>Relevant material specification</td>
<td>Material certificate</td>
<td>Test performed by: Accredited laboratory</td>
</tr>
<tr>
<td>2.</td>
<td>Welding joint test (wherever applicable)</td>
<td>Butt welding joints</td>
<td>Absence of defects</td>
<td>100 %</td>
<td>Radiographic test</td>
<td>ASME, Section IX</td>
<td>Test certificate</td>
<td>Vendor</td>
</tr>
<tr>
<td>3.</td>
<td>Ultrasonic test</td>
<td>Pipe stubs</td>
<td>Absence of defects</td>
<td>100 %</td>
<td>Ultrasonic test</td>
<td>Relevant standard</td>
<td>Test certificate</td>
<td>Vendor</td>
</tr>
<tr>
<td>4.</td>
<td>Soundness test for castings</td>
<td>Castings</td>
<td>Absence of defects</td>
<td>100%</td>
<td>Radiographic test or Ultrasonic test</td>
<td>Relevant standard</td>
<td>Test certificate</td>
<td>Vendor</td>
</tr>
<tr>
<td>5.</td>
<td>Bellows cyclic life test **</td>
<td>Bellows</td>
<td>Cyclic life under fatigue</td>
<td>3 per batch of same size and type</td>
<td>BS 5352</td>
<td>BS 5352</td>
<td>Test certificate</td>
<td>Vendor / Manufacturer of bellows</td>
</tr>
<tr>
<td>6.</td>
<td>Dimensional check</td>
<td>Valve</td>
<td>Dimensions</td>
<td>100 %</td>
<td>Metrology</td>
<td>Relevant standard/ Purchaser-approved drawing</td>
<td>Test report</td>
<td>Vendor</td>
</tr>
<tr>
<td>7.</td>
<td>Pre-assembly hydraulic shell pressure test</td>
<td>Valve before assembly</td>
<td>Structural integrity under stress</td>
<td>100 %</td>
<td>1.5 times maximum rated working pressure</td>
<td>BS 6755 Part 1/ API 598/ ASME B 16.34</td>
<td>Test certificate</td>
<td>Vendor</td>
</tr>
</tbody>
</table>
### Table 2B
**QUALITY ASSURANCE PLAN FOR MANUAL EVBG & EBG VALVES**

<table>
<thead>
<tr>
<th>S No</th>
<th>Test</th>
<th>Object tested</th>
<th>Characteristic sought for</th>
<th>Sample size</th>
<th>Test procedure</th>
<th>Acceptance criterion</th>
<th>Form of record</th>
<th>Pre-Delivery Inspection (PDI)</th>
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</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td>Pre-Delivery Inspection (PDI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Final Hydraulic shell pressure test</td>
<td>Valve after assembly</td>
<td>Structural integrity under stress</td>
<td>100 %</td>
<td>1.1 times maximum rated working pressure</td>
<td>BS 6755 Part 1/ API 598/ ASME B 16.34</td>
<td>Test certificate</td>
<td>Vendor</td>
</tr>
<tr>
<td>9.</td>
<td>Hydraulic seat pressure test</td>
<td>Valve in closed position</td>
<td>Structural integrity of seat under stress</td>
<td>100 %</td>
<td>1.1 times maximum rated working pressure</td>
<td>BS 6755 Part 1/ API 598/ ASME B 16.34</td>
<td>Test certificate</td>
<td>Vendor</td>
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<tr>
<td>10.</td>
<td>MSLD shell leakage test</td>
<td>Valve in open position</td>
<td>Leakage rate across body</td>
<td>100 %</td>
<td>25% of MRWP as per ASME, Section V, Article 10</td>
<td>Purchase order specification</td>
<td>Test certificate</td>
<td>Vendor</td>
</tr>
<tr>
<td>11.</td>
<td>MSLD seat leakage test</td>
<td>Valve in closed position</td>
<td>Leakage rate across seat</td>
<td>100 %</td>
<td>25% of MRWP as per ASME, Section V, Article 10</td>
<td>Purchase order specification</td>
<td>Test certificate</td>
<td>Vendor</td>
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<tr>
<td>12.</td>
<td>MSLD jacket leakage test</td>
<td>Vacuum jacket</td>
<td>Leakage rate across jacket</td>
<td>100 %</td>
<td>ASME, Section V, Article 10</td>
<td>Purchase order specification</td>
<td>Test certificate</td>
<td>Vendor</td>
</tr>
<tr>
<td>13.</td>
<td>Pneumatic seat pressure test</td>
<td>Valve in closed position</td>
<td>Structural integrity of seat under stress</td>
<td>100 %</td>
<td>Water displacement method (0.7 MPa(g)</td>
<td>BS 6755 Part 1/ API 598/ ASME B 16.34</td>
<td>Test certificate</td>
<td>Vendor</td>
</tr>
</tbody>
</table>
Table 2B
QUALITY ASSURANCE PLAN FOR MANUAL EVBG & EBG VALVES

<table>
<thead>
<tr>
<th>S No</th>
<th>Test Description</th>
<th>Object tested</th>
<th>Characteristic sought for</th>
<th>Sample size</th>
<th>Test procedure</th>
<th>Acceptance criterion</th>
<th>Form of record</th>
<th>Pre-Delivery Inspection (PDI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Reverse flow</td>
<td>Valve in closed position</td>
<td>Reverse seat leakage</td>
<td>100%</td>
<td>Water displacement method (0.7 MPa(g))</td>
<td>Purchase order specification</td>
<td>Test certificate</td>
<td>Vendor, TPIA/Supplier, Purchaser</td>
</tr>
<tr>
<td></td>
<td>shut off test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Functional test</td>
<td>Valve</td>
<td>Valve function (manual full opening and closing)</td>
<td>100%</td>
<td>Supplier norms</td>
<td>Purchase order specification</td>
<td>Certificate</td>
<td>Vendor, TPIA, Purchaser</td>
</tr>
<tr>
<td></td>
<td>(Manual valves)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Response time</td>
<td>Valve</td>
<td>Response time</td>
<td>100%</td>
<td>bidder’s standard</td>
<td>Purchase order specification</td>
<td>Test certificate</td>
<td>Vendor, TPIA, Purchaser</td>
</tr>
<tr>
<td></td>
<td>test (EP valves)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Cleanliness</td>
<td>Valve</td>
<td>Cleanliness for Oxygen service</td>
<td>100%</td>
<td>CGA G-4.1/ASTM G 93</td>
<td>CGA G-4.1/ASTM G 93</td>
<td>Certificate</td>
<td>Vendor, Purchaser</td>
</tr>
</tbody>
</table>

Note: 1. If the manufacturer of the bellows has already performed Bellows cyclic life test, it need not be again performed and only a copy of the certificate may be produced to Inspector for review. 2. Purchaser – IPRC. 3. TPIA – Third Party Agency

Note: The supplier shall propose alternate QAP for tubes and shall be discussed / finalized during DER.
### Annexure-2: QUALITY ASSURANCE PLAN FOR STAINLESS STEEL PIPES

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Test Description</th>
<th>Object tested</th>
<th>Characteristic sought for</th>
<th>Sample size</th>
<th>Test procedure</th>
<th>Acceptance criterion</th>
<th>Form of record</th>
<th>Test performed by</th>
<th>Test witnessed &amp; certified by</th>
<th>Record reviewed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Visual examination</td>
<td>All Pipes</td>
<td>Surface finish</td>
<td>100 %</td>
<td>Visual examination</td>
<td>Workmen-like finish</td>
<td>Inspection report</td>
<td>Vendor</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
<tr>
<td>2.</td>
<td>Chemical analysis</td>
<td>Specimen from pipes</td>
<td>Chemical composition</td>
<td>1 per heat</td>
<td>ASTM A 751</td>
<td>ASTM A 312/ A 790/ A 790M/ A 928 CL-1</td>
<td>Material certificate</td>
<td>Vendor's or Third party laboratory</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
<tr>
<td>3.</td>
<td>Mechanical test</td>
<td>Specimen from pipes</td>
<td>Mechanical properties</td>
<td>1 per lot</td>
<td>ASTM A 370</td>
<td>ASTM A 312/ A 790/ A 790M/ A 928 CL-1</td>
<td>Material certificate</td>
<td>Vendor</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
<tr>
<td>4.</td>
<td>Dimensional check</td>
<td>Pipes</td>
<td>Dimensions</td>
<td>100 %</td>
<td>Metrology</td>
<td>ASME B 36.19</td>
<td>Inspection report</td>
<td>Vendor</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
<tr>
<td>5.</td>
<td>Pressure test</td>
<td>Pipes</td>
<td>Structural integrity under stress</td>
<td>100 %</td>
<td>ASTM A 530/ A 999</td>
<td>ASTM A 530/ A 999</td>
<td>Test certificate</td>
<td>Vendor</td>
<td>Inspector/ Supplier</td>
<td>Purchaser</td>
</tr>
<tr>
<td>6.</td>
<td>Eddy current test</td>
<td>Pipes of size ≤ DN 20</td>
<td>Internal flaw detection</td>
<td>100 %</td>
<td>ASTM E 426</td>
<td>ASTM E 426</td>
<td>Test certificate</td>
<td>Vendor</td>
<td>Inspector/ Supplier</td>
<td>Purchaser</td>
</tr>
<tr>
<td>7.</td>
<td>Ultra-sonic test</td>
<td>Pipes of size ≥ DN 25</td>
<td>Internal flaw detection</td>
<td>100 %</td>
<td>ASTM E 213</td>
<td>ASTM E 213</td>
<td>Test certificate</td>
<td>Vendor</td>
<td>Inspector/ Supplier</td>
<td>Purchaser</td>
</tr>
<tr>
<td>8.</td>
<td>Flattening test</td>
<td>Specimen from pipes</td>
<td>Ductility and soundness</td>
<td>5 %</td>
<td>ASTM A 530/ A 999</td>
<td>ASTM A 530/ A 999</td>
<td>Test certificate</td>
<td>Vendor</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
<tr>
<td>9.</td>
<td>Inter-Granular Corrosion test</td>
<td>Specimen from pipes</td>
<td>Susceptibility to corrosion</td>
<td>1 per lot</td>
<td>ASTM A 262 Practice A/E</td>
<td>ASTM A 262 Practice A/E</td>
<td>Test certificate</td>
<td>Vendor’s or Third party laboratory</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
</tbody>
</table>

**Notes:**
1. Inspector: Third party inspection agency
2. The Purchaser shall perform Material Receipt Inspection (MRI).

**Note:** The supplier shall propose alternate QAP for pipes and shall be discussed / finalized during DER.
# Annexure-3: QUALITY ASSURANCE PLAN FOR STAINLESS STEEL TUBES

<table>
<thead>
<tr>
<th>S No</th>
<th>Test</th>
<th>Object tested</th>
<th>Characteristic sought for</th>
<th>Sample size</th>
<th>Test procedure</th>
<th>Acceptance criterion</th>
<th>Form of record</th>
<th>Test performed by</th>
<th>Test witnessed by</th>
<th>Record reviewed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Material test</td>
<td>Specimen from SS tubes</td>
<td>Chemical composition and physical properties</td>
<td>1 per heat lot</td>
<td>Relevant standard</td>
<td>Relevant material specn.</td>
<td>Material certificate</td>
<td>Vendor or Third party laboratory</td>
<td>-</td>
<td>Vendor, Inspector</td>
</tr>
<tr>
<td>2.</td>
<td>Hydrostatic Pressure test</td>
<td>S.S. Tubes</td>
<td>Structural integrity under stress</td>
<td>100 %</td>
<td>ASTM A 530</td>
<td>ASTM A 530</td>
<td>Test certificate</td>
<td>Vendor</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
<tr>
<td>3.</td>
<td>Eddy current test</td>
<td>SS Tubes/ Pipes of size ≤ DN 20</td>
<td>Internal flaw detection</td>
<td>100 %</td>
<td>ASTM E 426</td>
<td>ASTM E 426</td>
<td>Test certificate</td>
<td>Vendor</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
<tr>
<td>4.</td>
<td>Flattening test</td>
<td>Specimen from tubes</td>
<td>Ductility and soundness</td>
<td>5 %</td>
<td>ASTM A 530/ A 999</td>
<td>ASTM A 530/ A 999</td>
<td>Test certificate</td>
<td>Vendor</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
<tr>
<td>5.</td>
<td>Inter-Granular Corrosion test</td>
<td>Specimen from tubes</td>
<td>Susceptibility to corrosion</td>
<td>1 per lot</td>
<td>ASTM A 262 Practice A/ E</td>
<td>ASTM A 262 Practice A/ E</td>
<td>Test certificate</td>
<td>Vendor’s or Third party laboratory</td>
<td>-</td>
<td>Inspector, Purchaser</td>
</tr>
<tr>
<td>6.</td>
<td>Cleanliness</td>
<td>S.S. Tubes</td>
<td>100 %</td>
<td>As per Specification</td>
<td>As per Specification</td>
<td>Test certificate</td>
<td>Vendor</td>
<td>-</td>
<td>Inspector, Purchaser</td>
<td></td>
</tr>
</tbody>
</table>

Notes
1. Inspector: Third party inspection agency
2. The Purchaser shall perform the Material Receipt Inspection (MRI).

Note: The supplier shall propose alternate QAP for tubes and shall be discussed / finalized during DER.