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 Liquid Methane service to IPRC, Mahendragiri.

2. DESIGN DATA

2.1	Tag number for tanker	:	**RTK M40**
2.2	Service fluid	:	Liquefied Natural Gas (LNG)/ Liquid Methane (LCH_4)
2.3	Gross (geometrical) volume/ Water capacity (WC)	:	20 m^3 (20000 litres)
2.4	Usable volume (Gross volume – Ullage volume)	:	18 m^3
2.5	Maximum Expected Operating Pressure(MEOP) of Inner Vessel	:	1.36 MPa (a)/ 12.6 bar(g)
2.6	Maximum Allowable Working Pressure (MAWP)/ Design pressure of Inner Vessel	:	1.7 MPa (a)/ 16 bar(g)
2.7	Minimum Working Pressure of inner vessel	:	0.003 MPa(a)/ 0.03 bar(a)/30 mbar(a)
2.8	Working temperature of inner vessel at design pressure	:	77 – 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.	:	0.5% per day
2.11	Liquid Expulsion flow rate from tanker during usage.	:	27 kg/s liquid methane/ Liquefied Natural Gas
2.12	Expected service life	:	20 years
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	:	< 1E–7 Pa.m^3/s (1x10^-6 mbar.l/s)
2.15	Vacuum pressure in the jacket (at atmospheric temperature)	:	< 1 Pa (1x10^-2 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) (or) EN 13530-2, cryogenic vessels-large transportable vacuum insulated vessel Outer vessel: ASME Section VIII, Div.1 (or) CGA

			341:2007 (or) EN 13530-2.
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 K2 for terrain category 1 of specific to width & height of structure and Topography factor K3 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 g in vertically downward direction 1.5 g in transverse (horizontal) direction 2 g in longitudinal (horizontal) direction
2.21	Allowable internal pressure of outer vessel (not more than the set pressure of outer vessel safety device)	:	0.15 MPa(a)/ 0.5 bar (g)
2.22	Allowable external pressure of outer vessel (External overpressure) with full vacuum inside	:	0.15 MPa(a)/ 0.5 bar (g)
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:

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 0.03 bar(a)/30 mbar(a) for sub cooling. 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 RBD M30 and RBD M31 and safety relief valves RVR M30 and RVR M31 constitute the primary safety devices to protect against loss of vacuum. Burst discs RBD M32 and RBD M33 and safety relief valves RVR M32 and RVR M33 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 RVM M33 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. The rupture disc material shall be suitably chosen considering the compatibility with LCH_4/LNG.

2.25. **Note:**

The inner vessel of cryogenic tank in which sub cooling is envisaged shall be designed for external pressure of 0.5 bar(g) 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.

3. MATERIAL OF CONSTRCTION

3.1	Inner vessel	:	ASTM A 240 304L/ 316L (or) Dual certified 304/304L or 316/316L
3.2	Outer vessel	:	ASTM A 516 Gr. 70
3.3	Pipes & tubes	:	ASTM A 312 TP 304L/ 316L (or) Dual certified 304/304L or 316/316L

3.4	Pipe fittings	:	ASTM A 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 The command gas bottle shown along with the flow components and piping up to the RVP M40-actuator shall be under the scope of vendor.
A thermal fuse shall be provided in the command tubing of the RVP M40 to facilitate isolation of the valve under emergency case of fire condition.

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

4.1.8 LNG/ LCH_4 in the tanker will be expelled by pressurizing with Gaseous Hydrogen at ambient temperature.

4.1.9 The required size of different nozzles (N1 to N10) in tanks is specified in the Figure- 1. Blank-off flange for the Nozzle N4 shall be supplied along with spring energized seals. Also additional blank off flange for N4 nozzle with 3 Nos.

of spring energized seals shall be provided.

4.1.10 The fluid temperature & level sensors array mounted on a cylindrical pipe assembly shall be realized by Vendor to measure the LNG/ LCH_4 temperature & level of inner vessel. The top end of the pipe assembly will have flanged interface to mate with Nozzle N4. The flange N4 shall be provided with an independent vacuum chamber. The wiring of the sensor will be through the evacuated core of the sensor boom pipe. The dimensions required of the sensor boom detailed drawing preparation and the wiring drawing will be provided by the purchaser within a week of placement of the order and the vendor shall prepare a detailed drawing and submitted to Detail Engineering Review (DER). A typical sensor boom pipe assembly is attached as annexure 5(it is only a sample drawing wherein the height of the boom, sensor location etc. will be finalized based on the tanker dimensions). 4 no of temperature and level sensor each shall be mounted in the sensor boom. The wiring of level & temperature sensors shall be carried out by vendor before welding of the sensors to the sensor boom. The soldering and other wiring works including the routing & harness of cables through the boom pipe up to the electrical feed-through (mounted at the top end of sensor boom pipe) shall also be under the scope of vendor.

S. No	Item	Specification
1.	Multi-pin Electrical Feedthrough	➢ Flanged double sided electrical feedthrough ➢ Mil-C-26482 grade ➢ 700V DC and 10 A/contact ➢ leak tightness< 1E-8 Pa.m^3/s ➢ pin to body insulation resistance shall be more than 55 MΩ. ➢ The make of the electrical feed through shall be M/s Ceramtech (or) M/s MDC (or) any other equivalent make. Vendor shall obtain IPRC clearance before finalizing the make and specifications for the procurement of electrical feed through.
2.	Wires/Cables	The inner conductor is made up of stranded conductor (7/ 0.25 mm) of Silver Plated Copper. Dielectric layer is made of spiral wrapped & fused PTFE tape for a thickness of 0.25 mm. Outer conductor is made up of single braid of silver plated copper. The outer jacket is made up of

		PTFE for a thickness of 0.25 mm. Conductor material : Silver Plated Copper Wire No.of strands : 7 Nos. Strand diameter : 0.25 mm Diameter of Conductor : 0.75 mm Dielectric material : PTFE Dielectric thickness : 0.25 mm Dielectric Colour : Natural O.D after insulation : 1.25 mm Braiding Type : Single Braiding Cond. Coverage : 90 % Min Braid conductor size : 0.10 mm Silver plated Copper No. of Picks : 12 ± 10 % Picks / inch No. of carrier : 16 Nos. Outer Jacket Thickness : 0.25 mm Outer dia on Jacket : 2.2 mm Jacket Colour : Red Outer Jacket material : PTFE ELECTRICAL Working Voltage : 600 Vrms min Resistance : 55 ohms/Km Current rating : 7.3 Amp Note : 1. The cable shall be manufactured as per JSS-51034 specification. 2. The party shall provide with detailed catalogue and samples of 0.5m length. Vendor shall obtain IPRC clearance before finalising the make and specifications for the wires/cables.

However, the specifications shall be submitted in DER for approval before placement of order by the vendor to the sub-vendor. Qualified personnel shall be employed to carry out the wiring works for the sensor boom. Each temperature sensor shall be of 4 wire configuration and the level sensor shall be of 2 wire configuration. Separate electrical feedthrough shall be employed for temperature sensor wiring and level sensor wiring. Each feedthrough shall be allotted with two pins for grounding and minimum of 3 spare pins. QAP of the sensor boom is given as Annexure 4.

4.1.11 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 LNG/ LCH_4 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.

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. Also, another leg support to disengage the tanker wheels from the ground shall be provided with mechanical lever mechanism.

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 design approval from PESO for the LNG/ LCH_4 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 (HNO_3). 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)
HNO_3	: 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:

HNO_3	: 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 is 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 red 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 and V5 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 0.3 bar (g) to 0.5 bar (g). However, during normal

period, the vacuum safety disc shall withstand an full vacuum inside the vacuum cavity with atmospheric pressure on the other side.

10.2 **ELECTRO PNEUMATIC** & **MANUAL VLAVES**

The Electro Pneumatic & Manual valves shall be as per specification enclosed in Annexure-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, 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 RLL M40 and the local pressure gauge RPL M40. Instruments given in 11.1 & 11.2 shall be the scope of supplier.

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. The list of material which will be free issued by purchaser is given in Table-A.

Table-A

Sl.No	Item	Tag No.	Price, Rs.
1.	Absolute pressure transmitter	RPI M40	80,000/-
2.		RPI M41	80,000/-
3.		RPV M41	1,20,000/-
4.	Level transmitter	RLI M40	1,20,000/-
5.		RLI M41	1,20,000/-
6.	Fluid Temperature sensors	RTI M40	55000/-
7.		RTI M41	55000/-
8.		RTI M42	55000/-
9.		RTI M43	55000/-
10.	Level Sensor	RLS M40	12000/-
11.		RLS M41	12000/-
12.		RLS M42	12000/-
13.		RLS M43	12000/-

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.m^3/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 LN_2 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 Methane/ Liquefied Natural Gas) by theoretical computation. The evaporation loss rate thus measured and extrapolated to the working fluid (Liquid Methane/ Liquefied Natural Gas) 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 LN_2 & warm up, the vacuum level in the jacket shall be measured and ensure that the vacuum level is not deteriorated.

13. INSPECTION

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 Uberwachungs Verein (TUV–NORD)
- Technischer Uberwachungs 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.

13.12 Witnessing of performance 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 five 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 01/01/2020 and 31/12/2024.

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.

1.3. The bidder must have a fabrication facility /fabrication work shop for fabrication of cryogenic pressure vessel approved under Static & Mobile Pressure Vessel (Unfired) Rules, 2016, by Petroleum & Explosives Safety Organization (PESO). The claim shall be substantiated by the valid certification of approval for the bidder's fabrication workshop by PESO.

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) for tanker 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 LN_2.

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

h. Detailed assembly and fabrication drawings for the sensor boom shall be submitted for review.

1.2 **<u>On completion of DER:</u>**

1. The bidder shall obtain design approval from PESO within one month from the date of completion of DER.

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

3 <u>During the course of fabrication</u>: 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 <u>Pre-delivery review</u>: 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 methane.

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, trouble-shooting and maintenance.
- Test certificates of tanker.
- Test certificates of flow components used.
- Temporary registration of Trailer.
- State Transport approval document.
- PESO 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 Methane/ Liquefied Natural Gas) 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 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 3% (Three 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 and of the tanks at the Purchaser's premises. The Supplier shall furnish a Performance Bank Guarantee (PBG) for 3 % 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 3% (Three 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 Liquid Methane/ Liquefied Natural Gas 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 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.
4. Overall dry weight of the tanker

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
    e. M/s LnT Valves Pvt Ltd, Chennai
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
4.	Actuation	:	1. By pneumatic actuator (EP) 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 1.

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	:	ISO 15761/ ISO 21011/ API 6-D/ ANSI B16.34
18.	Test code	:	ISO 5208(EN 12266-1)/API 598

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% 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 ISO 15761 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 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	:	Aluminium/Stainless steel/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 Not	:	≥ 3mA

	Consumption	sensing	
		Sensing	: ≤ 1mA
24.10	Indication of switching state		: LED
24.11	Connection Type		: 2 m long PVC cable
24.12	Ambient Temperature		: -24^0 C to 80^0 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-1

Sl. No	Type of Valve	Qty (No)	Tag number	Fluid medium	Working temperature range K	Nominal size metric	Valve coefficient Cv	Pressure rating class/MAWP	Schedule number of interfacing pipe	End connection
1.	**EPVBG**	1	RVP M40	LNG/ LCH_4	75-350	DN100	176	class 300	Sch 10 S	BW
2.	**EVBG**	1	RVM M41	LNG/ LCH_4	75-350	DN100	176	class 300	Sch 10 S	BW
3.	**EBG**	1	RVM M42	LNG/ LCH_4	75-350	DN100	176	class 300	Sch 10 S	BW
4.		1	RVM M43	LNG/ LCH_4	75-350	DN40	25	class 300	Sch 10 S	BW
5.		1	RVM M44	LNG/ LCH_4	75-350	DN15	3	class 300	Sch 40 S	BW
6.		1	RVM M45	LNG/ LCH_4	75-350	DN40	25	class 300	Sch 40 S	BW
7.		1	RVM M46	LNG/ LCH_4	75-350	DN25	11	class 300	Sch 40 S	BW
8.		1	RVM M47	LNG/ LCH_4	75-350	DN15	3	class 300	Sch 40 S	BW

Table 2B
QUALITY ASSURANCE PLAN FOR EP/MANUAL EVBG & EBG VALVES

S No	Test	Object tested	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Pre-Delivery Inspection (PDI)		
								Test performed by	Test witnessed by	Record reviewed by
1.	Material test	Specimen from raw materials	Chemical composition and physical properties	1 per heat/ lot	Relevant standard	Relevant material specification	Material certificate	Accredited laboratory	—	Purchaser
2.	Welding joint test (wherever applicable)	Butt welding joints	Absence of defects	100 %	Radiographic test	ASME, Section IX	Test certificate	Vendor	TPIA/ Supplier	Purchaser
3.	Ultrasonic test	Pipe stubs	Absence of defects	100 %	Ultrasonic test	Relevant standard	Test certificate	Vendor	TPIA/ Supplier	Purchaser
4.	Soundness test for castings	Castings	Absence of defects	100%	Radiographic test or Ultrasonic test	Relevant standard	Test certificate	Vendor	TPIA	Purchaser
5.	Bellows cyclic life test **	Bellows	Cyclic life under fatigue	3 per batch of same size and type	ISO 15761	ISO 15761	Test certificate	Vendor / Manufacturer of bellows		TPIA/ Purchaser
6.	Dimensional check	Valve	Dimensions	100 %	Metrology	Relevant standard/ Purchaser-approved drawing	Test report	Vendor	TPIA/ Supplier	Purchaser

Table 2B
QUALITY ASSURANCE PLAN FOR EP/MANUAL EVBG & EBG VALVES

S No	Test	Object tested	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Pre-Delivery Inspection (PDI)		
								Test performed by	Test witnessed by	Record reviewed by
7.	Pre-assembly hydraulic shell pressure test	Valve before assembly	Structural integrity under stress	100 %	1.5 times maximum rated working pressure	ISO 5208(EN 12266-1)/ API 598/ ASME B 16.34	Test certificate	Vendor	TPIA/ Supplier	Purchaser
8.	Final Hydraulic shell pressure test	Valve after assembly	Structural integrity under stress	100 %	1.1 times maximum rated working pressure	ISO 5208(EN 12266-1)/ API 598/ ASME B 16.34	Test certificate	Vendor	TPIA/ Supplier	Purchaser
9.	Hydraulic seat pressure test	Valve in closed position	Structural integrity of seat under stress	100 %	1.1 times maximum rated working pressure	ISO 5208(EN 12266-1)/ API 598/ ASME B 16.34	Test certificate	Vendor	TPIA/ Supplier	Purchaser
10.	MSLD shell leakage test	Valve in open position	Leakage rate across body	100 %	25% of MRWP as per ASME, Section V, Article 10	Purchase order specification	Test certificate	Vendor	TPIA/ Supplier	Purchaser
11.	MSLD seat leakage test	Valve in closed position	Leakage rate across seat	100 %	25% of MRWP as per ASME, Section V, Article 10	Purchase order specification	Test certificate	Vendor	TPIA/ Supplier	Purchaser
12.	MSLD jacket leakage test	Vacuum jacket	Leakage rate across jacket	100 %	ASME, Section V, Article 10	Purchase order specification	Test certificate	Vendor	TPIA/ Supplier	Purchaser

Table 2B
QUALITY ASSURANCE PLAN FOR EP/MANUAL EVBG & EBG VALVES

S No	Test	Object tested	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Pre-Delivery Inspection (PDI)		
								Test performed by	Test witnessed by	Record reviewed by
13.	Pneumatic seat pressure test	Valve in closed position	Structural integrity of seat under stress	100 %	Water displacement method (0.7 MPa(g)	ISO 5208(EN 12266-1)/ API 598/ ASME B 16.34	Test certificate	Vendor	TPIA/ Supplier	Purchaser
14.	Reverse flow shut off test	Valve in closed position	Reverse seat leakage	100%	Water displacement method (0.7 MPa(g)	Purchase order specification	Test certificate	Vendor	TPIA/ Supplier	Purchaser
15.	Functional test (Manual valves)	Valve	Valve function (manual full opening and closing)	100%	Supplier norms	Purchase order specification	Certificate	Vendor	TPIA	Purchaser
16.	Response time test (EP valves)	Valve	Response time	100 %	bidder's standard	Purchase order specification	Test certificate	Vendor	TPIA	Purchaser
17.	Cleanliness	Valve	Cleanliness for Oxygen service	100 %	CGA G-4.1/ ASTM G 93	CGA G-4.1/ ASTM G 93	Certificate	Vendor	—	Purchaser

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 for review. **2.** Purchaser – IPRC. **3.** TPIA – Third Party Inspection Agency

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

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

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

Notes 1. TPIA: 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.

Annexure 4

QUALITY ASSURANCE PLAN (QAP) FOR SENSOR BOOM ASSEMBLY									
S No	Test	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Pre-Delivery Inspection (PDI)		
							Test performed by	Test witnessed by	Record reviewed by
1.	Approval of fabrications drawings	Verification & Approval of dwgs.	100 %	• As per specifications		Fabrication dwg.	Vendor	-	Purchaser
2.	Review of WPS/PQR/WPQ	Mechanical tests as per ASME SEC IX	As per ASME SEC IX	• As per ASME SEC IX • As per ASME SEC V		Inspection report	Vendor	TPIA	TPIA & Purchaser
3.	Fit-up check	Root gap, straightness	100%	Relevant standards		Fabrication record	Vendor	TPIA	Purchaser
4.	Dye Penetrant Test (DPT)	Surface defects of weld joints	100%	As per specifications & Relevant standards		Test certificate	Vendor	TPIA	Purchaser
5.	Radiography Test	• Absence of defects (for butt weld joints) • Review of Radiography films	100%	• As per Article 10 of ASME SEC V • As per ASME SEC IX		Test certificate	Vendor	TPIA	Purchaser
6.	Leak Test (Hood technique)	Leakage detection using MSLD	100%	As per ASME SEC V	As per specifications (finer than 1E–7 Pa.m^3/s)	Test certificate	Vendor	TPIA & Purchaser	Purchaser
7.	Location of Sensors	• Dimensional check • Weld Visual	100%	As per approved fabrication dwgs. & specifications		Inspection report	Vendor	TPIA	Purchaser

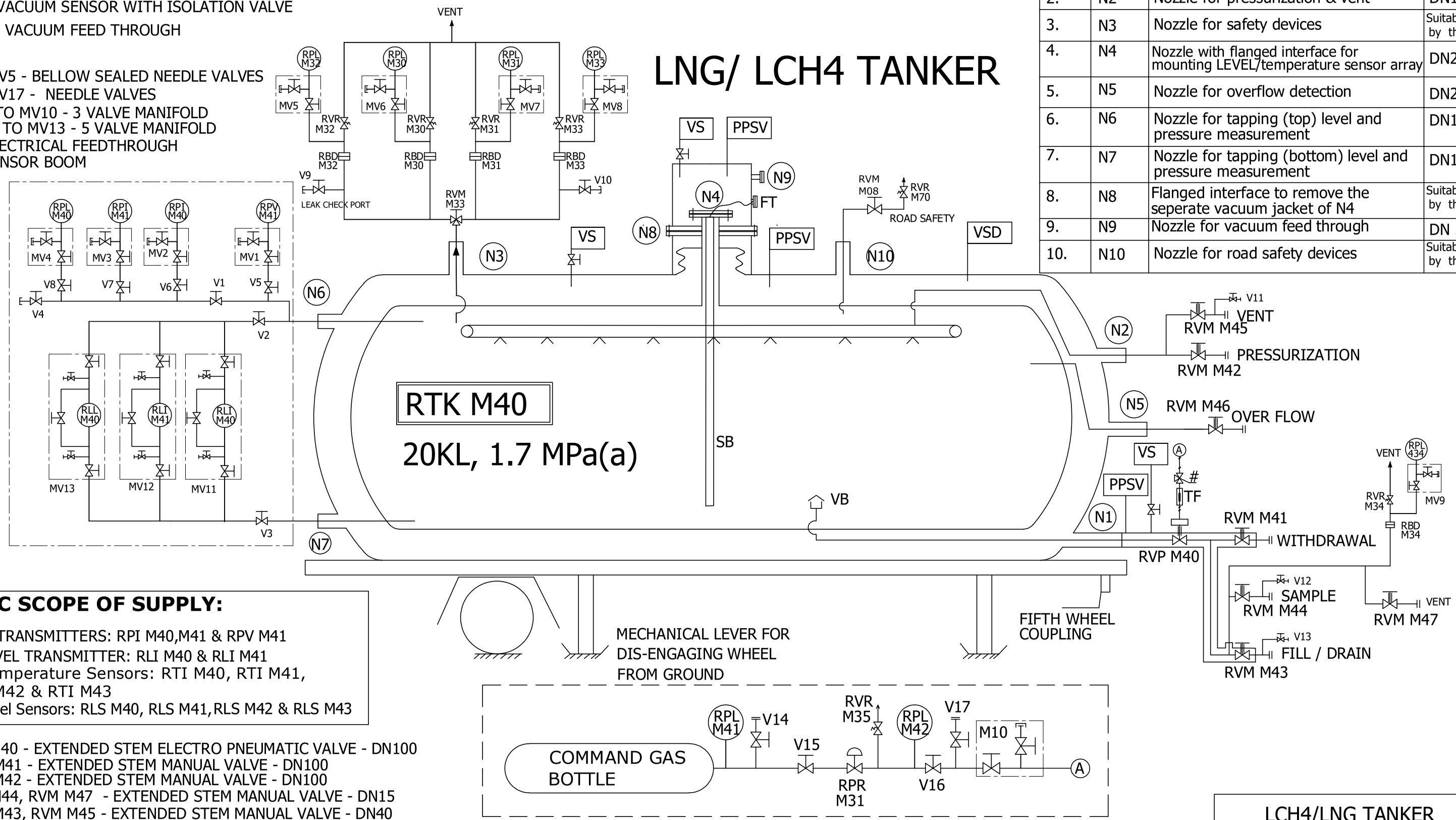
QUALITY ASSURANCE PLAN (QAP) FOR SENSOR BOOM ASSEMBLY									
S No	Test	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Pre-Delivery Inspection (PDI)		
							Test performed by	Test witnessed by	Record reviewed by
		inspection							
8.	Pickling & Passivation of sensor pipe & cover pipe (Without adaptors & sensors)	cleanliness	100%	As per specifications		Fabrication record	Vendor	-	TPIA & Purchaser
9.	Temperature controlled welding for sensors	To avoid damage of sensors while welding with its adaptors	100%	Approved procedure		Inspection report	Vendor	TPIA	Purchaser
10.	Health check of sensors (Fluid temperature sensors & level sensors)	To ensure integrity of sensors	100%	• Approved procedure • Monitor current & voltage	As per specifications	Inspection report	Vendor	TPIA & Purchaser	Purchaser
11.	Dimensional check	Dimensions (final product)	100%	Metrology	As per approved fabrication dwgs.	Report	Vendor	TPIA	Purchaser
12.	Cleanliness	Cleanliness for Oxygen service	100 %	CGA G-4.1/ ASTM G 93	CGA G-4.1/ ASTM G 93	Report	Vendor	TPIA	Purchaser

QUALITY ASSURANCE PLAN (QAP) FOR SENSOR BOOM ASSEMBLY									
S No	Test	Characteristic sought for	Sample size	Test procedure	Acceptance criterion	Form of record	Pre-Delivery Inspection (PDI)		
							Test performed by	Test witnessed by	Record reviewed by
13.	Final assembly of sensor boom (before installing in the tank)	• Weld Visual inspection • Dimensional check	100 %	As per specifications & Approved fabrication dwgs.		Report	Vendor	TPIA & Purchaser	Purchaser
14.	Final documentation & Issue of Inspection Release Note (IRN)	Review of test reports & certificates	100%	As per specifications, approved fabrication dwgs. & relevant standards		IRN	TPIA	TPIA	Purchaser
Notes			TPIA: Third party inspection agency						

FIGURE-1

VB - VORTEX BREAKER
VSD - VACUUM SAFETY DEVICE
PPSV - PUMP OUT PORT CUM SEAL OFF VALVE
VS - VACUUM SENSOR WITH ISOLATION VALVE
VFT - VACUUM FEED THROUGH

V1 to V5 - BELLOW SEALED NEEDLE VALVES
V6 to V17 - NEEDLE VALVES
MV1 TO MV10 - 3 VALVE MANIFOLD
MV11 TO MV13 - 5 VALVE MANIFOLD
FT-ELECTRICAL FEEDTHROUGH
SB-SENSOR BOOM



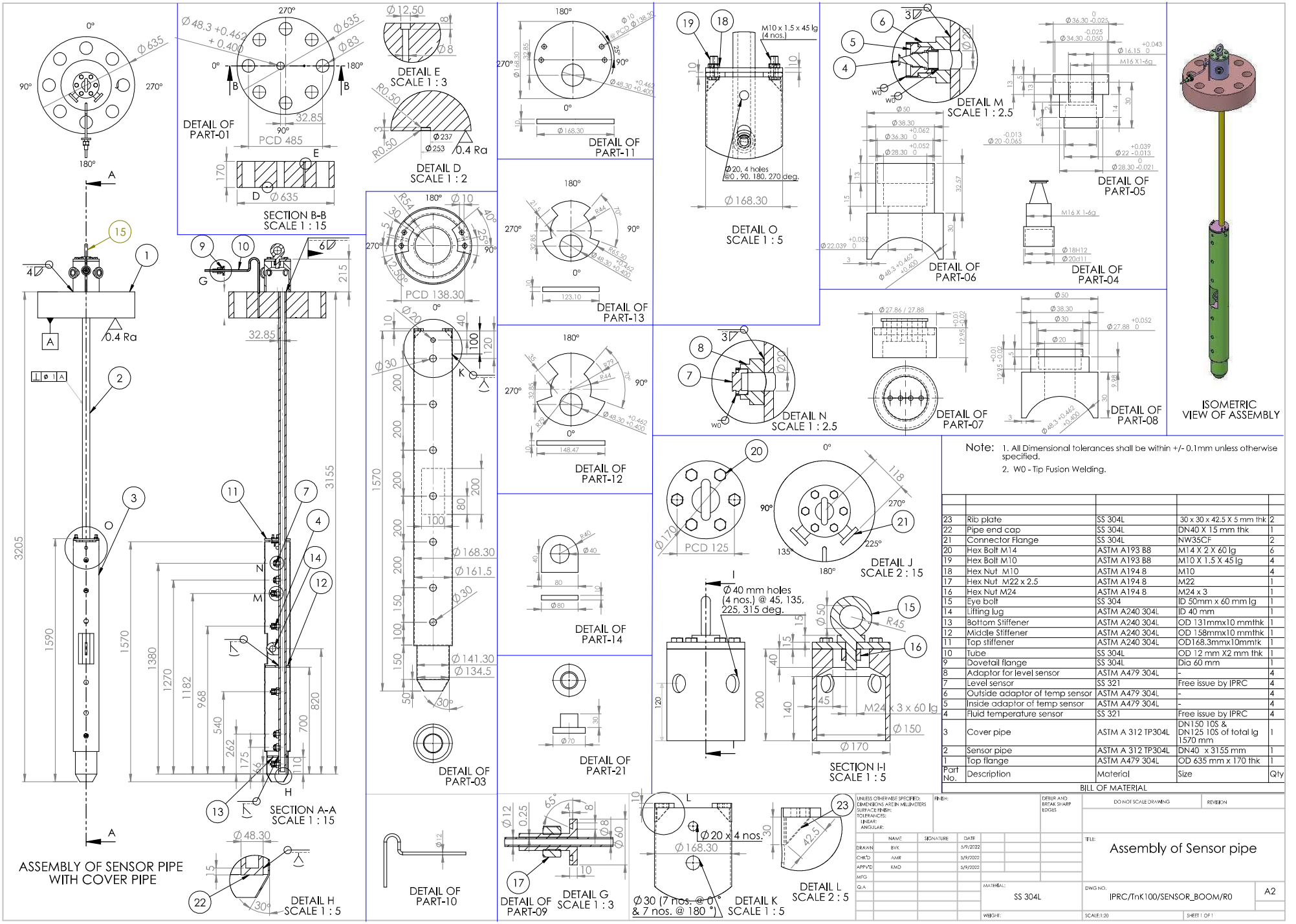
Sl.No	Nozzle	Description	Pipe nominal size & schedule
1.	N1	Nozzle for fluid filling / withdrawal	DN100, 10 S
2.	N2	Nozzle for pressurization & vent	DN100, 10 S
3.	N3	Nozzle for safety devices	Suitably sized by the Supplier
4.	N4	Nozzle with flanged interface for mounting LEVEL/temperature sensor array	DN200, 10 S
5.	N5	Nozzle for overflow detection	DN25, 40 S
6.	N6	Nozzle for tapping (top) level and pressure measurement	DN15, 40 S
7.	N7	Nozzle for tapping (bottom) level and pressure measurement	DN15, 40 S
8.	N8	Flanged interface to remove the seperate vacuum jacket of N4	Suitably sized by the Supplier
9.	N9	Nozzle for vacuum feed through	DN 50
10.	N10	Nozzle for road safety devices	Suitably sized by the Supplier

IPRC SCOPE OF SUPPLY:

1. Pr.TRANSMITTERS: RPI M40,M41 & RPV M41
2. LEVEL TRANSMITTER: RLI M40 & RLI M41
3. Temperature Sensors: RTI M40, RTI M41, RTI M42 & RTI M43
4. Level Sensors: RLS M40, RLS M41,RLS M42 & RLS M43

RVP M40 - EXTENDED STEM ELECTRO PNEUMATIC VALVE - DN100
RVM M41 - EXTENDED STEM MANUAL VALVE - DN100
RVM M42 - EXTENDED STEM MANUAL VALVE - DN100
RVM M44, RVM M47 - EXTENDED STEM MANUAL VALVE - DN15
RVM M43, RVM M45 - EXTENDED STEM MANUAL VALVE - DN40
RVM M46- EXTENDED STEM MANUAL VALVE - DN25
Lever operated $\frac{3}{2}$ way hand lever pneumatic spool valve to be installed.

LCH4/LNG TANKER
TAG NO.-RTK M40
VOLUME-20M3
MAWP-1.7 MPa(a)



Note: 1. All Dimensional tolerances shall be within +/- 0.1mm unless otherwise specified.
2. W0 - Tip Fusion Welding.

Part No.	Description	Material	Size	Qty
23	Rib plate	SS 304L	30 x 30 x 42.5 X 5 mm thk	2
22	Pipe end cap	SS 304L	DN40 X 15 mm thk	1
21	Connector Flange	SS 304L	NW35CF	2
20	Hex Bolt M14	ASTM A193 B8	M14 X 2 X 60 lg	6
19	Hex Bolt M10	ASTM A193 B8	M10 X 1.5 X 45 lg	4
18	Hex Nut M10	ASTM A194 8	M10	4
17	Hex Nut M22 x 2.5	ASTM A194 8	M22	1
16	Hex Nut M24	ASTM A194 8	M24 x 3	1
15	Eye bolt	SS 304	ID 50mm x 60 mm lg	1
14	Lifting lug	ASTM A240 304L	ID 40 mm	1
13	Bottom Stiffener	ASTM A240 304L	OD 131mmx10 mmthk	1
12	Middle Stiffener	ASTM A240 304L	OD 158mmx10 mmthk	1
11	Top stiffener	ASTM A240 304L	OD168.3mmx10mmtk	1
10	Tube	SS 304L	OD 12 mm X2 mm thk	1
9	Dovetail flange	SS 304L	Dia 60 mm	1
8	Adaptor for level sensor	ASTM A479 304L	-	4
7	Level sensor	SS 321	Free issue by IPRC	4
6	Outside adaptor of temp sensor	ASTM A479 304L	-	4
5	Inside adaptor of temp sensor	ASTM A479 304L	-	4
4	Fluid temperature sensor	SS 321	Free issue by IPRC	4
3	Cover pipe	ASTM A 312 TP304L	DN150 10S & DN125 10S of total lg 1570 mm	1
2	Sensor pipe	ASTM A 312 TP304L	DN40 x 3155 mm	1
1	Top flange	ASTM A479 304L	OD 635 mm x 170 thk	1

BILL OF MATERIAL

	NAME	SIGNATURE	DATE
DRAWN	BVK		5/9/2022
CHK'D	AMR		5/9/2022
APPV'D	KMD		5/9/2022
MFG			
Q.A			

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS; SURFACE FINISH:; TOLERANCES: LINEAR: ANGULAR:
FINISH:
DEBUR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
REVISION
TITLE: Assembly of Sensor pipe
MATERIAL: SS 304L
WEIGHT:
DWG NO. IPRC/TnK100/SENSOR_BOOM/R0
A2
SCALE:1:20
SHEET 1 OF 1