

भारत सरकार/GOVERNMENT OF INDIA
अंतरिक्ष विभाग/DEPARTMENT OF SPACE
द्रव नोदन प्रणाली केंद्र/LIQUID PROPULSION SYSTEMS CENTRE
भारतीय अंतरिक्ष अनुसंधान संगठन/INDIAN SPACE RESEARCH ORGANISATION
THIRUVANANTHAPURAM – 695547, KERALA

सं./No.TM40 2018 031709 01

दिनांक: /Date:18.09.2018

अभिरुचि की अभिव्यक्ति के लिए आमंत्रण/INVITATION FOR EXPRESSION-OF-INTEREST

Liquid Propulsion Systems Centre (LPSC), invites **Expression-of-Interest (EOI)** for End-to-End production of Launch Vehicle Aluminium alloy Tankages of various ISRO programs.

LPSC proposes to develop an additional source to meet increased demand and establish industry partners for fabrication, inspection and supply of Aluminium alloy Tankages. The INDUSTRY would be responsible for the procurement of raw materials & standard parts, establishment of dedicated integrated facilities and realization of Tankages. It is proposed to utilize the expertise, experience and dedicated facilities of Indian industries who are in the field of Pressure vessel manufacturing and who possess prior experience in production of Precision components for production and delivery of Tankages at an annual rate of 48 Nos. (approx). The size of tank varies from Ø2.8 to 4.0m, thickness varying 3 to 10mm and length upto 6.5m which depends on propellant loading requirement of various launch vehicles.

From the Aluminium alloy sheets and Forgings, bare tank is being realized. The realization of tanks requires various manufacturing facilities (at party's works) for machining of parts upto Ø5m, special purpose duty auto-TIG welding stations with trimming/boring head for performing longitudinal/facial/meridian/angular/circeamwelding, press/forming facility, chemical process facilities for chemical milling & surface treatment, Heat-treatment furnaces, full-fledged dimensional inspection, Non-destructive equipments viz X-ray radiography, Ultrasonic, Dye Penetrant setup for evaluation of welds, test & evaluation (T&E). It is estimated that about 60 technical personnel comprising Graduate engineers, Diploma engineers & Technicians along with the above facilities under single roof is essential to achieve the targeted throughput.

The operating personnel shall be conversant with relevant fabrication techniques, handling heavy duty welding machines, machining centers, special tools & space qualified welding techniques. Exceptional skill-sets and temperament is essential for technicians engaged in assembly welding & NDE operations. Additionally, several tests like leak testing, pressure testing and calibration are to be carried out under single roof as part of the production process. Finally, knowledge and ability is essential on the part of Quality Control (QC) personnel to assess/evaluate performance parameters and adhere to stringent quality stipulations. The final product shall be delivered within the stipulated schedules with full complement of test and evaluation documents and stipulated delivery documentation. The company / industry should be conversant with safety practices and shall ensure compliance to safety regulations.

Interested companies/industries having adequate know-how, qualified & skilled technical personnel, expertise, experience, ISO/AS accreditation, sound financial background, commitment and desirous of long-term partnership with ISRO, are invited to participate in the Expression-of-Interest. On receipt of EOI, LPSC shall evaluate and assess suitability prior to empanelment. This assessment may include capability evaluation of your company/industry by our own experts. This call for EOI does not carry with it, any guarantee for allotment of work. This EOI is issued as a "Pre-Bid Qualification". Inadequate, incorrect or incomplete information will attract rejection. LPSC reserves the right to accept or reject all or any EOI. Mere compliance to the EOI terms does not guarantee further consideration for qualification.

Interested companies/industries may submit their "Expression of Interest" in a sealed envelope superscribing the "Reference number of this advertisement and EOI No.TM40 2018 031709 01 (End-to-End production of Launch Vehicle Aluminium alloy Tankages of various ISRO programs) due on 22.10.2018,1600hrs " **so as to reach LPSC on or before 22.10.2018,1600 hrs to the following address**

**Sr.Head, Purchase & Stores,
Liquid Propulsion Systems Centre
Valiamala, Thiruvananthapuram 695 547,
Kerala, India**

Opening of EOI is on 25.10.2018,1030Hrs

-s/d-

**Sr. Head, Purchase & Stores
For & on behalf of the President of India
(The Purchaser)
Phone # 0471 2567867/2567540
Fax # 0472 2800712
e-mail: senior_hps@lpsc.gov.in**

Brief description and scope of work of EOI is attached as Annexure herewith

LIQUID PROPUSLION SYSTEMS CENTRE

Indian Space Research Organisation

Valiamala, Thiruvananthapuram– 695 547, Kerala

Advt. Ref. No: LPSC/PT/ADVT/68/2018 Dtd. 18/09/2018

Invitation for “Expression of Interest”

“Expression-of-Interest for End-to-End production of Launch Vehicle light alloy Tankages”

1. Preamble:

Liquid Propulsion Systems Centre (LPSC) of the Indian Space Research Organisation has been developing liquid stages for launch vehicles and propulsion systems for spacecraft projects. Based on the profile drawn-up for various Launch Vehicle programme, LPSC intends to develop an additional source for realization of Aluminium alloy Tankages for various Launch Vehicle programmes of ISRO.

LPSC proposes to effectively utilise the expertise, experience and capabilities of Indian industries who are in the field of Pressure vessel manufacturing and who possess prior experience in production of similar products for ISRO/ Defence/ Aerospace sector. Accordingly, it is proposed to invite Expression-of-Interest (EOI) for End-to-End production of Launch Vehicle Aluminium alloy Tankages from capable Indian industries. Typical variants of propellant tanks & water tanks are given in Enclosure-1A to ID.

2. Scope of work:

The scope is to develop/entrust an INDUSTRY for End-to-End realization of Aluminium alloy Tankages. This includes procurement of raw materials /standard parts, creation /establishment of facilities, realization and delivery Aluminium alloy Tankages using various manufacturing facilities (at party's works).

Table-1

Sl.	Tanks	Qty, Nos/ annum	Remarks
A	Dia 2.8m class Aluminium alloy Tankages		
1	PS2 Propellant Tank	06	Single tank with two compartments, One common bulk head separating top & bottom.
2	PS2 Water Tanks	06	Toroidal tank with circular section
B	Dia 4.0m class Aluminium alloy Tankages		
3	Mk-III Tankages (Four variants)	12	Single tank with two end domes
4	L110 water tanks	03	Toroidal tank with circular section
5	L110 feedlines (7 types)	21	
	Total	48	
C	Requirement of future Launch vehicles with Dia 5.0m class Tanks may also be considered while planning the facilities - 2 tanks per annum is envisaged.		

It is envisaged that the production contract will be operated for an initial tenure of 7 years. This includes first 18 Months for establishment of facilities & development of processes, delivery of 1 set of qualification tankages in 24 Months and subsequently, staggered annual delivery as per above table. For the first three set of deliveries, material & standard parts will be provided by LPSC and subsequent deliveries INDUSTRY shall procure materials for realization which ultimately culminating to End-to-End production.

3. Description of hardware:

The size of tank varies from Ø 2.8m to Ø 4.0m, thickness varying from 3mm to 10 mm and length upto 6.5m which depends on propellant loading requirement of various launch vehicles. Tanks of these sizes are built from Aluminium alloy sheets & forgings. Typical bare propellant tank mainly has two end domes (Fore & Aft), cylindrical Shell compartment & Feed line sub-assemblies. However, depends upon variant of tank, there may be additional dome in the middle making single tank with two compartments (Ref: schematic in enclosures1A to ID)

Realization process of end domes involves stretch forming of petals, heat treatment, chemical milling of petals, welding of Nozzle to petals, TIG welding of petals (Meridian welding) and Dome to ring welding. Shell sub-assemblies involve chemical/mechanical step milling of shell panel sheets, rolling and L-seam welding of shell panels. Further, end dome & shell sub-assemblies are cir-seam welded to form bare propellant tank. Brackets for mounting internals, wire tunnel/destructive system are welded at various locations inside & outside the tank. Welding process adopted is double pass DCSP (Direct Current Straight Polarity) TIG for all the joints of domes, single pass DCSP TIG for Nozzle/bi-metal adapters to petal welding and fillet TIG welding for brackets. Further, aluminium alloy baffles, feed lines, level sensors lines etc., will be mounted/assembled inside the tank as part of internal system.

The operating personnel shall be conversant with relevant fabrication techniques, handling heavy duty welding machines, machining centres, special tools & space qualified welding techniques.

Exceptional skill-sets and temperament is essential for technicians engaged in assembly welding & NDE operations. Additionally, several tests like leak testing, pressure testing, and calibration are to be carried out under single roof as part of the production process. It is also essential to perform inspection using high-end metrology equipment. Finally, knowledge and ability is essential on the part of Quality Control (QC) personnel to assess/evaluate performance parameters and adhere to stringent quality stipulations. The final product shall be delivered within the stipulated schedules with full complement of test and evaluation documents and stipulated delivery documentation. The company / industry should be conversant with safety practices and shall ensure compliance to safety regulations.

4. List of equipment / facilities required.

The dedicated facilities shall be established at INDUSTRY and should include full complement of manufacturing, assembly, testing and evaluation equipment / machinery at the manufacturing site under single roof. The facility should also include captive power supply and utilities of gas bank, pneumatic supply, LN2 supply, UPS backup etc.

It is preferred setting up of dedicated facilities near SDSC-SHAR, Sullurpetta, AndraPradesh, considering the size of the tank (4m to 5m dia) for ease of transportation and for further integration/testing. INDUSTRY shall submit their opinion on the same.

Essentially, following are the equipment / facilities required:

4.1 Receipt and storage of raw materials, standard parts and consumables issued as FIM at bonded stores.

4.2 Machining:

- Turning centers upto dia 700, Precision turning/ milling / drilling, surface grinding and polishing.
- 3Axis CNC router 9m x 3m
- CNC 4-axis Vertical machining centers (Ø3.0 m & Ø5.0 m).
- General purpose precision machineries (Lathe, milling, drilling etc.)

4.3 Chemical process facility

- Chemical milling bath (L8m x H2.5m x W4 m)
- Maskant bath (W1 m x H3.0m x L8m)
- DM water bath (W3m x D3m x L6m)
- Vapour degreasing bath (W1 m x H1.5m x L2.5m)
- Anodisation bath -Chromic acid (H3.0m x W3.5m x L6.4m)
- Anodisation bath-sulphuric acid (L1.6m x W1.0m x D1.3m)

4.4 Heat treatment facility:

- Solutionizing/Drop bottom furnace. (W2.0m x L6m xH4m, 1500kW)
- Annealing/Ageing furnace. (W5.5m x L9m x H5m, 400kW)
- Solutionizing-Drop bottom/Annealing/Ageing furnace for small parts.
- Sub Zero treatment furnace (W0.5m x L0.5m x H0.5m)

4.5 Press/Forming facility:

- Shearing machine (15mm thk Al.)
- Stretch forming machine (1500T)
- Tube bending machine/ Rubber forming/Press
- Three Roll Al. plate bending machine (Thk: 15 mm)
- Riveting facility for Aluminium baffles.

4.6 Auto TIG welding machines with trimming/boring head: (600A, AC/DC)

- L-seam welding machine. (Length 3.5m)
- Facial/Rotary welding machining.

- Column & Boom manipulator machine with tilt positioner (upto Dia 5.0m)
 - Cirseam weld lathe. (Dia 5.0m x 10m)
- 4.7** Manual TIG welding machine (500A, AC/DC).
- 4.8** Clean room for welding (100000 class including Particle counter, Humidity recorder & Temperature monitor)
- 4.9** Material handling equipments. EOT Crane, Jumbo, etc
- 4.10** Painting facility.
- 4.11** Crack detection facility.
- 4.12** Finished parts/sub-assy storage facility.
- 4.13 Inspection & NDT equipments required**
- Full fledged metrology lab (Height master, Profile Projector, Hardness tester, Surface roughness tester)
 - Co-ordinate Measuring Machine. (Size 5000mm X 5000mm X 9000mm)
 - UT thickness gauge
 - UT flaw detector(4MHz, 70deg angle probe)
 - X-Ray machine (160kVA, Dual Focus: 0.4 x 0.4 & 1.5 x 1.5)
 - Auto film processor
 - UV lamp
 - Theodilite measuring instrument
 - LASER tracker instrument with T-probe/V-probe
 - LASER engraver
 - Weighing machine
 - Mass Spectrometer (MSLD) Leak Detector
 - Pressure test facility with strain gauge & AE monitoring.
 - XRF analyzer, Material testing etc.,
 - Conductivity Measuring Instrument
 - Eddy Current Instrument
 - Viscosity Measuring Instrument
 - Air Particle Counter
 - Humidity Measuring Instrument
- 4.14 Pre-assembly operation:**
- Dry fit up area: since size of tank varies from dia 2.8m to dia 4.0m x 6.5mlength, generally vertical assembly is preferred for which separate hanger inside welding shop area with roof height of 17m is required.
- 4.15 Sub-assembly level testing viz:** proof pressure test, MSLD leak test, etc.
- 4.16** On-line quality surveillance at all stages of assembly & testing operations.

4.17 Documentation, packing, containerization & delivery to ISRO centres.

5. Delivery schedule:

The company/industry shall assimilate realization technology within 18 months from the date of placement of contract, establish necessary facilities and shall roll out the first batch of qualification tanks within 24 months. Subsequently, staggered annual delivery as per Table-1.

6. Human resource and HR policy:

6.1 The company / industry shall have all the required workforce (Technical and skilled) for executing the production contract.

6.2 Company / industry workforce should be qualified, experienced and possess requisite skill-sets for operation of the dedicated facilities and to perform production work as specified.

6.3 It is anticipated that a work-force of about 60 personnel comprising of Graduate Engineers, Diploma Engineers & Technicians/ may be required to be deployed by the company / industry for the production task.

- Qualified welders (for aluminium alloy welding)
- Experienced Supervisors
- Qualified welding Engineers
- Certified NDT Technicians (Preferably from ISNT/ASNT)
- Qualified (Level 2) NDT supervisor/Engineer

6.4 The company / industry shall have a HR policy to retain the trained workforce. This is very essential since attrition would lead to derailment of production activities, affect quality, result in inordinate delay in delivery schedule and lead to uncertainty in contract execution.

7. Other requirements:

- **Safety:**

Company / industry workforce shall follow all safety stipulations.

- **Secrecy:**

The company / industry and all their workforce shall abide by INDIAN OFFICIAL SECRET ACT in vogue and shall provide information of awareness of the above in writing.

8. Following are the criteria for scrutiny of EOI proposals:

8.1 General:

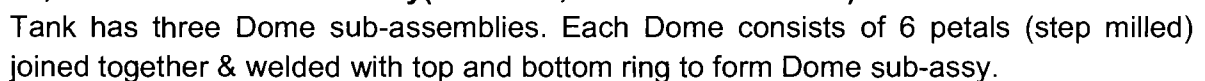
The EOI shall contain complete information of the company / industry, human resource, infrastructure, assets, financial standing, line of business and credentials.

8.2 Essential criteria for evaluation of EOI:

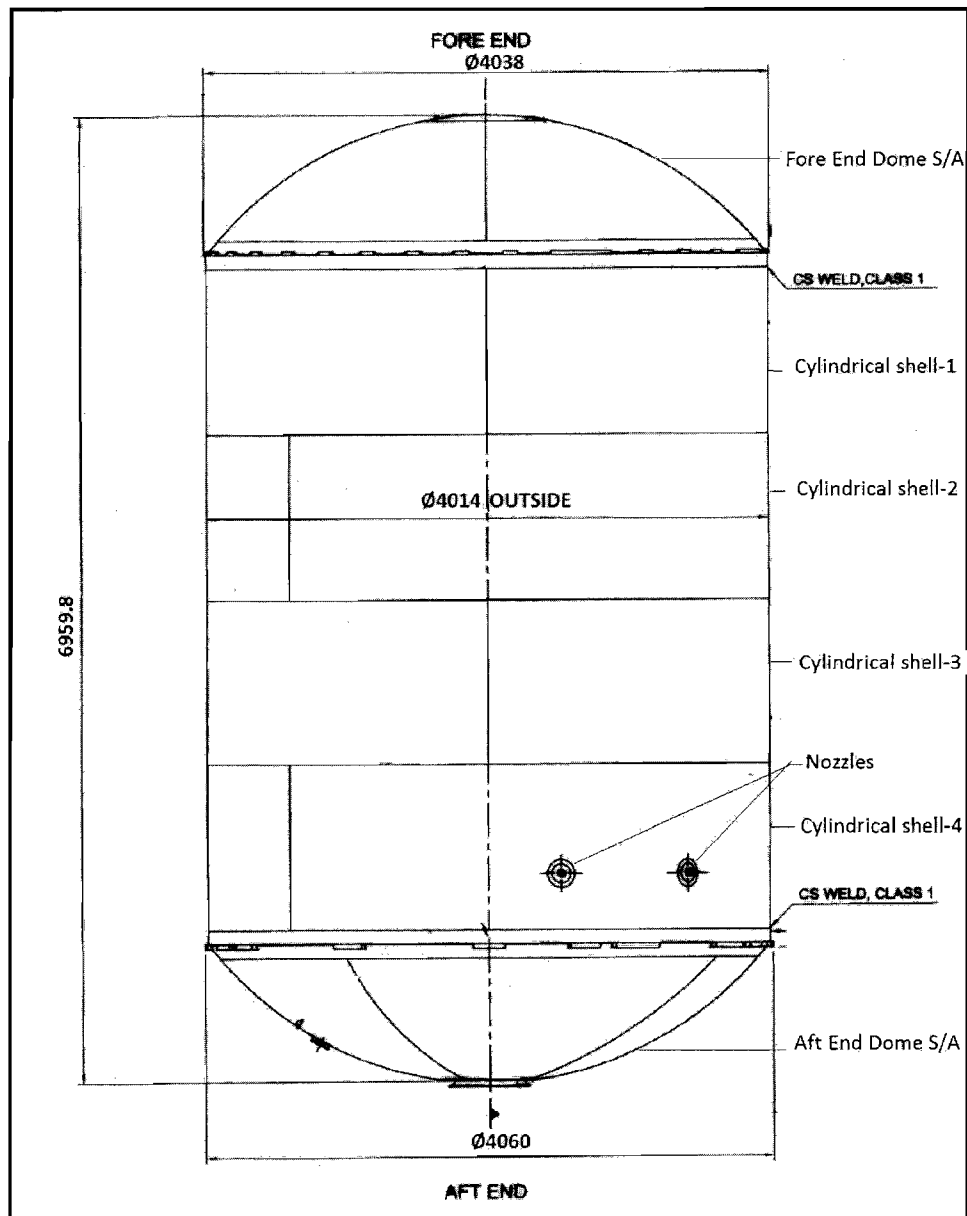
- 8.2.1** The companies / industries desirous of submitting EOI proposals shall mandatorily be accredited with ISO/AS standard for the last 3 years for the company's / industry's existing operations.
- 8.2.2** Prior experience of last 2 years is essential in working in manufacturing, assembly, testing, evaluation and production of pressure vessels to a tune of minimum 250.00 Crores per annum.
- 8.2.3** The company / industry shall possess human resource with adequate knowledge, skill and experience in the areas of programme planning, Tooling, manufacturing, metrology, assembly / testing, non-destructive inspection and quality control.
- 8.2.4** Party shall also submit the details of facilities and manpower (with qualification) existing at present for product realisation and quality control.
- 8.2.5** The companies / industries shall possess machining, manufacturing, metrology / NDI and assembly & test facilities suitable for production of similar aerospace components.
- 8.2.6** Annual turnover of the company / industry for similar nature of work for the last 5 financial years (FY: 2013-14, 2014-15, 2015-16, 2016-17 & 2017-18) ending 31st March of corresponding year shall be furnished.
- 8.2.7** The company / industry should not have incurred any loss in more than 2 years during the last 5 financial years (FY: 2013-14 to 2017-18) ending 31st March of corresponding year. Certified copies from Chartered Accountant for the annual financial turnover and balance sheet showing profit / loss & IT returns to be furnished.
- 8.2.8** In the event of response from companies / industries already executing ISRO contracts, past performance will be considered.
- 8.2.9** Party shall fill & submit questioner attached as Enclosure-2 and shall clearly spell out whether facility is available/ready to augment/any other plan for the facility.

Note:

- 1.** For clause 8, all information provided by the companies / industries shall be backed by documentary evidences. Printed brochure of the company / industry may also be provided.
- 2.** The final evaluation of the response will be based on inputs furnished against our criteria, assessment based on facility visit, if required; feedback from customers and overall assessment.



Schematic diagram of Mk-III Tank (Typical variant)



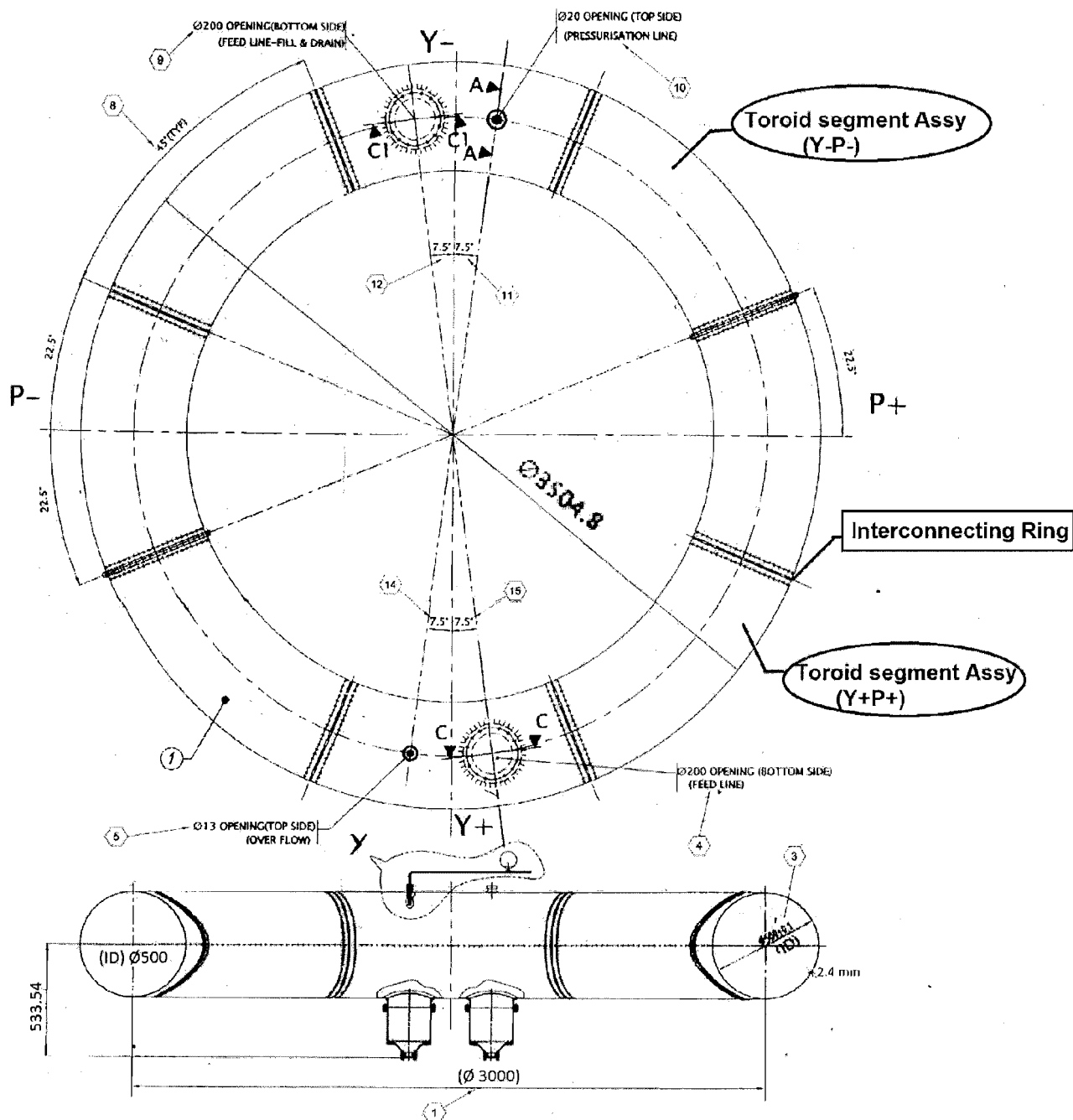
Note:

Mk-III Propellant tanks are cylindrical in shape with tori-spherical dome at both the ends. There are four variants. Overall length, thickness of the shells and dome petals are different for each variant.

The above tank has 4 shells assy. Each shell assy consists of 2 shell panels (step milled: 7.0/4.5/2.2), joined by LS weld.

Fore end dome assy consists of 4 petals (step milled: 4.4/2.8/1.4) & welded with top and bottom ring by TIG welding.

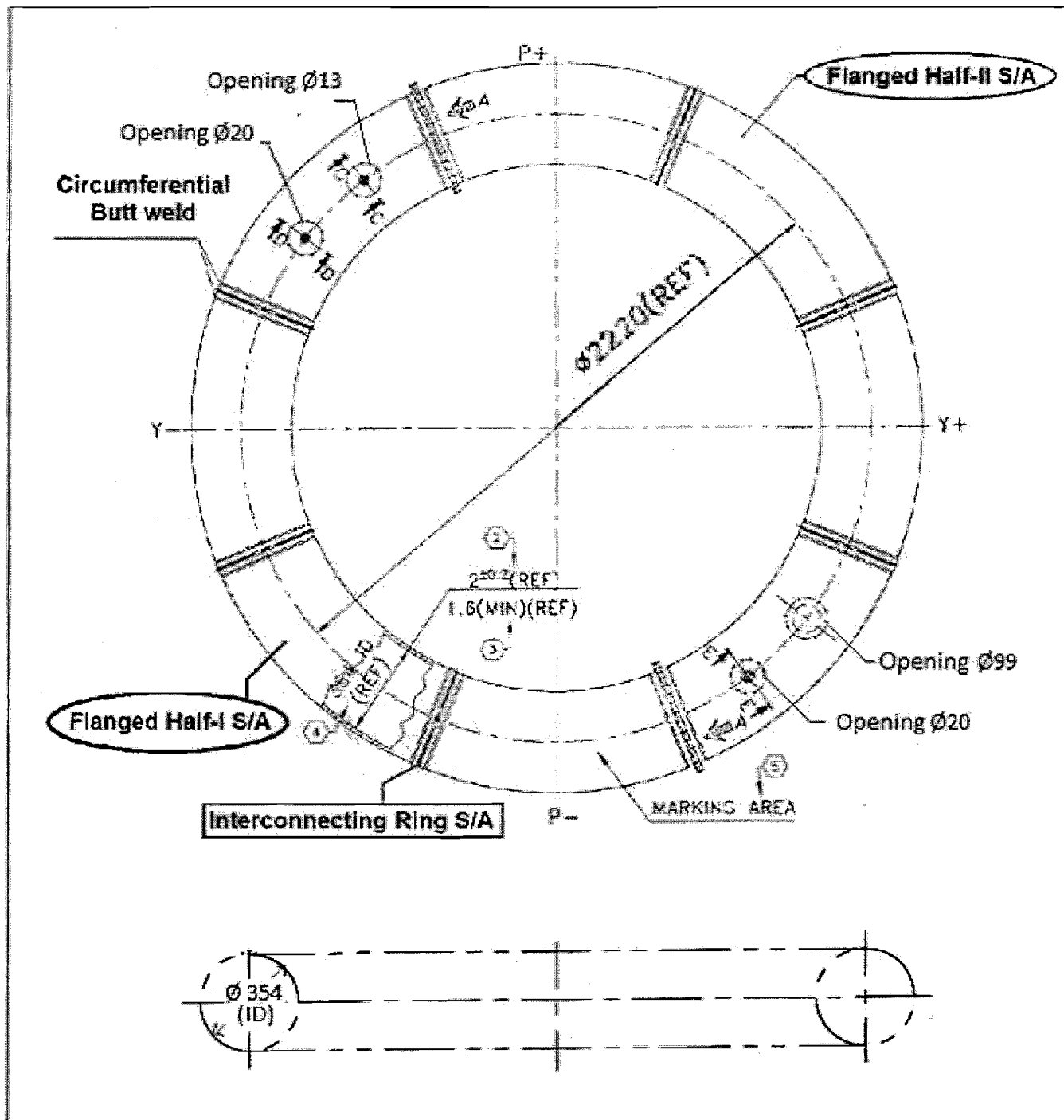
Schematic diagram of L110 Water tank



Note:

L110 water tank is in toroidal in shape. Mean diameter of the tank is 3000 mm and toroidal diameter is 500 mm and shell thickness is 2.4mm. The tank is of two flanged half configurations with 4 toroidal shells in each half. Flanged halves are bolted together to make the full tank. 4 numbers of openings are provided on the tank for different purposes.

Schematic diagram of PS2 Water tank



Note:

PS2 water tank is in toroidal in shape. Mean diameter of the tank is 2220 mm and toroidal diameter is 354 mm and shell thickness is 1.6mm. The tank is of two flanged half configurations with 4 toroidal shells in each half. Flanged halves are bolted together to make the full tank. 4 numbers of openings with adaptors are provided on the tank for different purposes.

QUESTIONNAIR / MATRIX				
SL. NO	DESCRIPTION	AVAILABILITY		
		YES	NO	READY TO AUGMENT
I	FACILITY			
1	Machining center			
1.1	CNC 4-axis Vertical machining centers (Ø3.0m & Ø5 m)			
1.2	3 Axis CNC router 9m x 3m			
1.3	Turning centers upto dia 700			
1.4	Precision turning/ milling / drilling, surface grinding and polishing			
2	Chemical process facility			
2.1	Chemical milling bath (L8m x H2.5m x W4 m)			
2.2	Maskant bath (W1 m x H3.0m x L8m)			
2.3	DM water bath (W3m x D3m x L6m)			
2.4	Vapour degreasing bath (W1 m x H1.5m x L2.5m)			
2.5	Anodisation bath -Chromic acid (H3.0mxW3.5mx L6m)			
2.6	Anodisation bath -Sulphuric acid (L1.6m x W1.0m x D1.3m)			
3	Heat treatment facility:			
3.1	Solutionizing/Drop bottom furnace(W2.0mxL6mxH4m, 1500kW)			
3.2	Annealing/Ageing furnace. (W5.5m x L9m x H5m, 400kW)			
3.3	Solutionizing-Drop bottom/Annealing/Ageing furnace for small parts.			
3.4	Sub Zero treatment furnace (W0.5m x L0.5m x H0.5m)			
4	Press/Forming facility:			
4.1	Shearing machine (15mm thk Al.)			
4.2	Stretch forming machine (1500T)			
4.3	Tube Bending machine			
4.4	Rubber forming/Press			

4.5	Three Roll Al. plate bending machine (Thk: 15mm)			
4.6	Riveting facility for baffles.			
5	Auto TIG welding machines with trimming/boring head: (600A, AC/DC)			
5.1	L-seam welding machine. (Length 3.5m)			
5.2	Facial/Rotary welding machining.			
5.3	Column & Boom manipulator machine with tilt positioner. (upto Dia 5m)			
5.4	Cirseam weld lathe. (Dia 5m x 10m)			
6	Manual TIG welding machine (500A, AC/DC).			
7	Material handling equipments. EOT Crane, Jumbo,			
8	Painting facility.			
9	Crack detection facility.			
10	Finished parts/sub-assy storage facility.			
11	Clean room for welding (100000 class including Particle counter, Humidity recorder & Temperature monitor)			
12	Inspection & NDT equipments required			
12.1	Full fledged metrology lab (Height master, Profile Projector, Hardness tester, Surface roughness tester)			
12.2	Co-ordinate Measuring Machine. (Size 5000 X 5000 X 9000)			
12.3	UT thickness gauge			
12.4	UT flaw detector(4MHz, 45deg angle probe)			
12.5	X-Ray machine (160kVA, Dual Focus: 0.4 x 0.4 & 1.5 x 1.5)			
12.6	Auto film processor			
12.7	UV lamp			
12.8	Theodilite measuring instrument			
12.9	LASER tracker instrument with T-probe/V-probe			
12.10	LASER engraver			
12.11	Weighing machine			
12.12	Mass Spectrometer (MSLD) Leak Detector			

12.13	Pressure test facility with strain gauge & AE monitoring			
12.14	XRF analyzer, Material testing etc.,			
12.15	Conductivity Measuring Instrument			
12.16	Eddy Current Instrument			
12.17	Viscosity Measuring Instrument			
12.18	Air Particle Counter			
12.19	Humidity Measuring Instrument			
II	MAN POWER			
13.1	Qualified welders (for aluminium alloy welding)			
13.2	Experienced Supervisors			
13.3	Qualified welding Engineers			
13.4	Qualified electroplaters			
13.5	Certified NDT Technicians (Preferably from ISNT/ASNT)			
13.6	Qualified (Level 3) NDT supervisor/Engineer			
III	GENERAL			
14.1	Do you have a tool design dept.?			
14.2	If not , how are you going to realise the tooling?			
14.3	Do you have methods/planning dept.?			
14.4	Do you have any prior experience in Al. welding?			
14.5	Previous experience in Aerospace manufacturing?			
14.6	Do you have ISO or AS certification?			
14.7	Major clients			
IV	ORGANISATION			
15.1	Partnership			
15.2	Pvt. Ltd			
15.3	Public Ltd.			
15.5	Public Sector			
15.6	Financial Strength (Refer clause 8.2.8 & submit documents)			
15.7	Turn over (Refer clause 8.2.7 & submit documents)			
15.8	Willing to establish facilities nearby SDSC-SHAR, Sullurpeta, Andrapradesh (details shall be provided)			