Request for Proposal

for

Design, Refurbishment, Performance Testing, Supply, Installation and Commissioning Of Thermo Vacuum Test Facility As Per Specification for VELC Project

at

Prof. MGKML, CREST Hosakote

Indian Institute of Astrophysics
Bangalore

Apr 2019
1. Introduction

Indian Institute of Astrophysics (IIA) is developing Visible Emission Line coronagraph (VELC) to be launched on board Aditya L1 mission, India’s second satellite for Astronomy research. In order to qualify the design and do the performance checks, the payload sub system will be tested in thermo vacuum environment. The payload subsystem includes visible and IR detectors, Mechanism elements, electronic packages etc.,

Keeping in view of complex and technologically demanding inter-disciplinary nature of activities, the executing agency is expected to have or has access to established expertise in design, fabrication and engineering of thermo vacuum chambers, cryogenic and thermal circulation systems. Similarly, total familiarity with practices of automation, control & data dissemination adopted in modern chambers is a pre-requisite.

2. Scope of work

The bidder shall be responsible for Design (base plate, shrouds, sensors, data acquisition system, control panel, ports etc.,), Refurbishment of the existing vacuum chamber, Performance Testing, Supply, Installation and Commissioning of Thermo vacuum Test Facility for VELC Project at Prof.MGKML, CREST Hosakote as per the details mention in the RFP. Bidders with all or maximum facility and technical capability to realize this system will be preferred. Bidder who has realised similar kind of systems will be preferred. Bidder shall provide PO copies of the similar systems supplied, commissioning report, list of customers with contact details etc.,

The items shall be supplied in accordance with the applicable drawings/documents/standards specified herein and the schedules set forth. The following are the objective and scope of work of this RFP in detail.

3. Applicable Codes

i. ASME code sec VIII div 2 for design, fabrication, inspection and testing.

ii. ASME code sec IX for welding, welder qualification and other welding details.

iii. ASME code sec V for testing ASTM/ASME standard for material

4. Location and Environment
The thermo vacuum plant to be installed in a class 10,000/1,00,000 cleanroom at Prof. MGK Menon Lab for Space Sciences at CREST Campus of IIA, Hoskote.

5. Existing Vacuum Chamber

The existing vacuum chamber to be converted as thermo vacuum chamber.

Existing chamber is the part of the vacuum system which was used for our payload testing.

The existing chamber comprises of

a) Cylindrical shell of 2.12 m (L) and inner diameter is 1.0 m. clear length excluding the depth of Dished ends (i.e. Flange to flange length of the shell).

b) Two hinged doors at both sides, Torispherical end dish at one end & flat end at other end of the shell

c) Material of Construction : SS304L

d) Existing Chamber dimensional details:
Ports Name

1. Source Inlet port
2. Hinge
3. Feed Through Port
4. Turbo Pump port
5. Feed Through Port
6. Source Inlet Port
7. Hinge
8. Turbo Pump Port
9. Roughing Pump bellow Port
10. Gauge Sensor Port
6. Existing Evacuation System Details

The existing chamber was reaching 10e-6 in 40 minutes using following pumps. Meets the standard leak rate requirement of 1 e-8 m bar lit/sec. The required Roughing and High Vacuum Pumps are available with IIA. The details of the pumps are

a). Turbo pump: Peiffer Make, ATH2303 M250CF

b). Roughing Pump: Make Alcatel, ACP40

7. Refurbishment of the existing Chamber

A Concept design of the refurbished chamber and internal details (as per IIA requirement) to be made available to IIA for the approval. The chamber accessories shall be fabricated from SS 304L and all the materials inside the chamber shall be vacuum compatible. Adequate ports and fittings shall be provided to meet the requirements of evacuation, purging, venting, sensors, feed through etc.,

The following are required to be incorporated in the refurbished thermo vacuum chamber and the evacuation system design

- Concept Design
- Base plate>Loading platform design & thermal shroud design. SS base plate shall be provided with 100mm grid M6 tapped holes. Base plate shall be capable of taking ~ 100 kg load.
- Clear working space: Bidder shall ensure clear working space of not less than 1800(L) X 850mm (D) above the top plate. Bidder shall clearly mention the clear working space proposed to be made available w.r.t. their system design.
- Valves and gauges from Standard Companies like Pfeiffer, Alcatel etc.,
- All the Plumbing with SS 304L.

8. Thermal system

a) Thermal shrouds of cycling box which are blister or embossed type

b) Thermal Conditioning Units (TCU’s)

c) Accessories: SS pipe lines (grade AISI 304L), gate valves, relief valves, cryogenic valves, super insulated thermal lines etc.
a) Thermal shrouds of cycling box which are blister or embossed type

For heating and cooling the test object kept inside the chamber a thermal shroud shall be mounted around the test object and the shroud is kept inside the vacuum chamber with thermal insulated support systems. The shroud shall consists of 3 segments, viz., a hollow cylindrical shroud and 2 nos. of circular type shroud. Also another rectangular base plate of SS 304L shall be provided to mount the test object (DUT-Device Under Test). The shroud shall be fabricated by sandwiching two SS 304L sheet of 0.6-0.8mm thick, which are embossed to allow flow of fluid through the shroud. Seam welding by roller welding method along the length shall be done at regular interval covering the entire shroud for unobstructed thermic fluid flow and ensures uniformity of temperature within the specified limits. The outer periphery and circular cut-outs (if any) are to be TIG Argon Arc welded. Reinforcement at suitable positions to be provided to prevent warping / distortions of the shroud.

The sequence of fabrication to be as follows:

The sheets are to be embossed independently & jointed together in such a way that channels are formed and seam welding is carried out. Then the joined sheet is to be rolled with appropriate Spacer plates and required cut-outs are made and TIG welded around openings. Inner surface of the shroud to be sand blasted and painted with space qualified low degassing black paint (Aeroglaze Z 306) to achieve thermal emissivity of 0.9 or better and the outer surface is electro polished to achieve thermal emissivity of 0.1 or better. Similarly other shroud segments are to be fabricated and all the shroud segments are to be mounted inside the vacuum chamber. The plate type shrouds/disc type shroud are to be mounted vertically at the ends of the cylindrical shroud. All the shrouds are mounted inside with thermally insulated support like G10 / G11 material from the chamber inside.

A rectangular shroud shall be provided for quick thermal cycling. The rectangular shroud of size 500mm (W) X 500mm (L) is to be fixed from the front opening door and in this rectangular shroud the test object will be mounted.

The shroud embossing to be pressure tested for 8kg/cm2 for 24 hours and therefore is designed for 12kg/cm2. Fluid inlet/outlet ports to be provided and these ports are to be connected to the liquid feed through with the help of metallic flexible hoses.

b) Thermal Conditioning Units (TCU’s)- IIA’s Scope

Standard Heating/ Refrigerating circulator shall be used for temperature cycling of thermal plate kept inside the Chamber. Inlet and out-let pipes for thermal plate shall enter the Chamber through leak proof feed through. The circulation bath will have integrated programmer with real time clock to load, save and execute the temperature cycling. All the
necessary system safely interlocks will be the standard features of the circulator. Circulator shall be located adjacent to the Chamber and flexible lines with good thermal insulation shall be used to connect the bath with thermal plate. No complex electrical circuitry or computer is envisaged for system operation.

Heating/ Refrigerating circulating bath will be supplied by IIA from the standard bidder supplying similar units for different applications. Standard air-cooled heating / Refrigerating circulating bath shall be chosen from the reputed bidders who are supplying similar units. Heating and cooling of thermal plate & shrouds are envisaged by this thermal bath.

Temperature cycling on the thermal plate & shrouds kept inside the Chamber shall be executed by the circulating bath having integrated programmer to execute the profile with all safety interlocks and alarms. Thermal plate & shrouds are to be fabricated from SS material. These components shall be manufactured to remain leak proof after several thermal cycling at high and low temperatures during its usage under high vacuum. Bidder shall explore the possibility to use the plate & shroud available from the different bidders like Lytron, Tranter etc.

The bath will have standard features like – LCD dialog display for convenient interactive operation, key pad for set points and menu functions, self optimizing temperature control, PT-100 external sensor and it’s connection for measurement and control, required safety.

interlocks and alarm system for smooth operation, High temperature cut-off, Rs.232/485 / Ethernet interface for on line communication, active and proportional cooling control, pump of adequate capacity to circulate fluid etc. The bath will have adequate Heating / cooling capacity to achieve and maintain different temperatures in specified time.

Bidder shall provide the details like thermal load to buy the Heating/Cooling system considering appropriate heat load, heat transfer efficiency and heat load generated by circulating pumps of thermal bath. IIA accordingly purchase and supply the bath from standard manufacture with proven heritage like- Julabo, Thermo scientific and Hubber.a.

c) Accessories

SS pipe lines (grade AISI 304L), gate valves, relief valves, cryogenic valves, super insulated thermal lines etc. All components, piping, joints, valves, traps, bellows etc shall have leak tightness better than 1 x 10^-8 mbar-litre/sec.

a) Chamber-vacuum system interfaces should have high conductance through selection of suitable size and placement of the items as close to the chamber port as possible.
b) All components, piping and valves used should be AISI-304L based.

c) Inlet of TMP’s must be fitted with inlet screen/mesh.

d) All purging, ballast, exhaust drains must be led out to designated places.

e) The bidder shall confirm meeting all the vacuum pumping system requirements and submit a Vacuum system schematic showing size and capacity of equipments/pumps, make/model, location on the chamber and all details as per standard nomenclature along with the quote.

8. Temperature Range

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
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<tbody>
<tr>
<td>Chamber inside temperature range</td>
<td>-90deg C to + 150 deg C</td>
</tr>
<tr>
<td>Temperature control required on DUT/Subsystem</td>
<td>-80deg C to + 140 deg C</td>
</tr>
<tr>
<td>Temperature stability</td>
<td>+/-1 deg on the set point</td>
</tr>
<tr>
<td>Rate of heating/Cooling</td>
<td>1.5 deg C per Minute (Minimum)</td>
</tr>
<tr>
<td></td>
<td>5 deg C per Minute (Maximum)</td>
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9. Test of non-vacuum compatible sub systems

The proposed system shall have the provision for testing of non-vacuum compatible instruments/subsystems under the specified temperature range. Condensation issues at sub zero temperatures are to be taken in to account during the design.

10. Material of construction

Chamber components shall be constructed out of Stainless Steel SS 304L and all the materials used inside the chamber are to be high vacuum compatible. The support structures are also to made up of SS 304L. Bidder shall clearly specify the material offered and how the quality of the material and welding is planned to be ensured.

11. Welding

Chamber and sub-assemblies are to be welded using TIG Welding Technique for leak tight joints.
12. Surface finish

After the re-furbishment, the inner surface of the chamber are to be suitable polished (mirror finish) to meet the requirements of Thermal, vacuum & low out-gassing. All the joints and assemblies are welded using TIG welding technique for leak tight joints. All port flanges bright polished and fitted with reputed SS hardwares. Weld joints should be buffed to best possible finish. All finished components shall be protected from scratch and contaminants.

13. O rings and seals:

Viton / OFHC Copper gaskets as required by the system design. Vacuum seals to be provided with edgeless Viton 'O' ring to achieve good vacuum sealing. All surfaces in contact with Viton'O' rings shall be grounded to provide surface finish better than 1.6 micron.

14. Ports

Ports required for Vacuum system, Thermal system & Feed through for temperature sensors may be considered suitably by the bidder in addition to below specified ports.

Bidder shall increase the number of ports if required by IIA.

- Evacuation Ports - (For Turbo pump: 2 Nos & For roughing Pump : 2 Nos)
- Sensor Ports - 2 Nos
- Ports for RGA & TQCM -2
- Electrical Feed through Ports - 2 Nos
- Feed through for penning gauge, pirani gauges & capacitance manometer - 2 Nos
- Door Ports - 2 on each door
- Ports for Gas & Vent - 2 Nos

The type & sizes of the port will be finalised during BDR.

15. Gauges and meters

Bidder shall provide 2 nos of vacuum gauges with accessories to monitor the vacuum pressure. The makes and models as well as the specification sheets of the gauges also to be provided.

16. Leak tightness

Bidder shall ensure better than 1.0E-9 mbar L/sec leak tightness for all welded joints of the Chamber, Vacuum system, base plate, shrouds and its piping inside the Chamber. Leak
tightness of all O-ring joints shall be better than 5.0E-9 mbar l/sec. Bidder shall clearly specify the level of leak tightness offered and the method of measurement proposed.

17. Chamber Venting

Through 5 micron filter in a reasonable time but not more than 15 min. Bidder shall also provide parallel arrangement with needed fittings etc. to fill the Chamber with Nitrogen gas bottle.

18. Temperature sensors

All the temperature sensors used in this system shall have temperature measurement accuracy of +/- 0.7 K considering operational temperature range, total measurement chain including sensor, cables, feedthroughs and measuring instrument. Bidder shall specify the make and type of temperature sensors offered in this system.

Temperature control on base plate and shroud is envisaged by PT-100 of thermal bath and operation of thermal bath to achieve and maintain the temperature as per the preloaded thermal cycle as well as execution of thermal cycle shall be done by Integrated programmer/controller provided in thermal bath.

Bidder shall provide 24 nos. PT100 (Class A, 4 wire) RTD temperature sensors to monitor base plate, shroud & DUT temperatures. These sensors shall have rugged beads with Teflon extension wires of about 1.5m to reach the electrical feedthroughs on the chamber. foil type RTD may also be considered by bidder. Bidder shall provide display and data logging of these 24 temperature channels through standard paperless data recorder available in the market.

19. Data acquisition and recording system

Bidder shall provide a standard paperless data recorder having suitable number of universal type of channels and essential accessories like digital input/Out card, analog input card, CF card etc. In addition to temperature logging, chamber vacuum shall also be displayed and recorded in one of the channel. The data recorder shall have features like TFT LCD display with required no. of universal type of channels, standard adequate memory to store the test data, additional 1GB memory card, various display formats in alphanumeric and graphical form, RS232 / RS 485 / Ethernet interface, infrared detector for protection of monitor’s life etc. Bidder shall select the best suited recorder from the bidders having proven heritage.
20. Operation Modes

Semi automatic as well as manual mode of operation. Bidder shall consider execution of repeated thermal cycling of the package through profile mode of operation executed through internal programmer of thermal bath.

21. Control Console

The PLC based control console unit shall be supplied with the following:

- Auto vacuum controller
- Selector switch for auto/manual/standby mode
- Push button switches for manual over ride
- Failure Indication alarms
- Vacuum gauges control unit
- Temperature monitoring & Recording unit

22. Operation & Safety

Safety protections: System design shall provide adequate safety interlocks and protections to ensure Test package safety, System safety as well as Personnel safety during operation and storage of the system. Manual overrides shall be provided for any automatic operational controls.

As a part of safety and maintenance bidder shall include essential signs, marks, write-up etc.

23. Preliminary Design of the system offered

Bidder shall provide preliminary design calculations of the system offered along with the Technical offer. Summary of the design calculation shall clearly bring out design margins included in the system design.

24. Calibration Certificates

Bidder shall provide calibration test for all the Vacuum gauges and Temperature sensors provided in the system for monitoring as well as for control purpose. These test certificates
shall be valid throughout the period of warranty/guarantee after the completion of installation and handling over of the system to the purchaser site.

25. Electrical Power and other utilities required

Bidder shall clearly specify the estimated connected power as well as estimated peak power consumption of the system offered considering different operation mode described above.

Note: The system expected shall be fully air cooled type requiring no other utilities.

26. Quality control Plan

Bidder shall furnish their standard QC plan used during execution of similar systems.

27. Manuals, Maintenance & Spares

Detailed manuals shall be provided with subsystem descriptions including electrical and mechanical drawings, circuit diagrams, interconnections and layout details.

Operational procedures shall be provided for cleaning, evacuation, purging, testing etc.,

Safety precautions and interlock/alarm recovery procedures shall be provided.

Instruction and maintenance manuals, trouble shooting and fault finding procedures and recovery methods.

28. Demonstration of specifications, Acceptance test and Transportation

Bidder shall assemble the total system at his premises and demonstrate all the specifications to the purchaser prior to dispatch. Bidder shall disassemble the system and transport safely. Bidders shall organize for required loading/unloading shifting of all system components to the place of installation of this system. Bidder shall assemble and integrate the system at CREST campus of IIA, Hosakote. Bidder shall again restore system specifications demonstrated prior to dispatch and demonstrate the same to purchaser as per mutually agreed acceptance test plan. Acceptance test plan shall be generated by bidder during the course of execution in consultation with the purchaser.

29. Training to operators of the purchaser

Bidder shall provide a thorough on job training to at least 10 operation personnel for a period of 7 days at purchaser’s site prior to system acceptance.
30. Guarantee Period

Bidder shall guarantee the failure free operation of the system for a period of not less than 24 months from the date of acceptance of the system at purchaser’s site. This is mandatory requirement and must be complied in the offer.

31. Compliance and Deviation Table

Bidder shall furnish detailed compliance table w.r.t. all the specifications described above. Bidder shall furnish detailed deviation list, if any w.r.t. above specification. Bidder shall give detailed justification for proposed deviation.

32. Bidder’s experience and eligibility criteria

a) It is essential that bidder possess the adequate experience in executing custom designed thermo vacuum chambers. Bidder must mention such experience clearly in their offer.

b) Bidder should have executed at least one such project having ~ 1m diameter (or rectangular shape) thermal vacuum chamber with operational vacuum level of 1.0E(-5) mbar or better in last five years. Bidder shall furnish previous references where similar systems had been fabricated and supplied by him in past with details like contact person, address, PO value and brief specification achieved at the time of system acceptance by the customer.

33. Technical bid

Bidder shall furnish following details / documents in their technical bid

a) Detailed description of the system offered w.r.t. each of the above specification.

b) Detailed drawings showing the dimensions of the system and major components

c) Detailed list of scope of supply included in the offer.

d) List of major items as specified at 7.6 above along with make and model number.

e) Catalogues, leaflets, brochures, application notes etc. for all the major components and equipment’s proposed.

f) Preliminary design calculation made to arrive at sizes of various equipments and components.

g) Compliance table with remarks.

h) Deviation table if any with remarks and detailed justification.
i) Un-priced commercial bid.

j) Any other details relevant to the requirement.

34. Miscellaneous

- Clear Specifications (quality, quantity, fitting or piping specification, rate of supply, pressure etc.) shall be given on any auxiliary requirements which are necessary for the operation of the system such as power, coolant etc., Price shall be quoted for optional items separately. Any other requirement like ventilation, structural support etc shall be clearly specified.

- The company shall provide training about the operation of the system and precautions related to the system.

- Packing and transport of all the components to site is in bidder scope.

- Installation, Alignment and commissioning is in bidder scope.

35. Schedule

- Preliminary design review 2 Weeks after receipt of PO

  During this stage refurbishment drawings, design details & options shall be sent to IIA for comments.

- Critical design Review 1 Week after PDR

  During this stage final drawings and design details shall be sent to IIA for approval.

- Factory Acceptance Test (FAT) 6 Weeks after CDR

- Installation & Commissioning at Site Within 2 Weeks of FAT

36. Factory Acceptance Test

Factory acceptance test will be carried out by competent experts of IIA at bidder’s location.

a) Leak Test

The complete system shall be tested with Mass spectrometer leak detector sensor to achieve 3 e-8 m bar l/s/sec and report shall be generated.
b) Vacuum Hold Test

After the pumps are put off, the pressure should not raise more than 1e-2mbar in 24 hrs.

c) Thermal cycling test

Package size: Two Packages having size of 500mm x 500mm x 250 mm(H) each shall be mounted on the thermal plate inside the Chamber during testing.

Package Weight: Total weight of the package to be ~ 50 Kg

Package Heat dissipation: Total heat dissipation from the test package to be handled by base plate & shrouds shall be ~ 150 Watts.

Package Material: Aluminum alloy 6061 may be considered for estimating cooling load and thermal heat calculation purpose etc.

The temperature of the package up to the design range, uniformity of the temperature inside the chamber, uniformity of the temperature on the package, thermal stability, etc., will be tested to confirm the design.

d) X-ray test on the welded joints. Reports shall be attached during FAT.

37. Final Acceptance Test

All the mentioned factory acceptance tests to be performed at site after commissioning. Final performance matrix shall be generated for final acceptance.

38. Note to the Bidder

1. The technical proposal shall contain the details like tentative sketches of the system with support structure, Internal details of the chamber includes instrument support structure, platform, Drawings of the thermo vacuum chamber with dimensions and the Port locations with sizes, etc.

2. IIA reserves the right to alter, whenever necessary, specifications and drawings. As from the date, the Stores shall be in accordance with the specifications, patterns and drawings so altered, which the contractor is bound to comply with. In the
event of such alteration involving a revision in the cost, or in the delivery period, the same shall be discussed and mutually agreed to, taking into account the unit rates of similar items in the Contract. In case of disagreement, the decision of IIA, in the cost or the delivery period, shall be final and conclusive.

3. **Minor modifications / Additional Scope of Work:** Minor modifications / additional scope of work to the tune of 2% of the total contract value shall be carried out by the contractor without any extra cost to IIA.

4. **Subletting or Assignment of Contract:** The Contractor shall not sublet, transfer or assign the Contract or any part thereof or bills or any other benefits, accruing there from or under the contract without the prior written consent of IIA (All Subcontractors are required to be appraised and approved by IIA before placement of orders by the Contractor/Bidder). However, such consent shall not be unreasonably withheld by IIA, if such stores are not normally manufactured by the Contractor, such assignment or subletting shall not relieve the Contractor from any contractual obligation or responsibility under the Contract.

   Any breach of this condition shall entitle IIA to cancel the Contract or any part thereof and to purchase from other sources at the risk and cost of the Contractor and shall recover from the Contractor damages arising from such cancellations.

   In case the Contractor sublets, transfers or assigns any part of the Contract with the prior written consent of the Purchaser, all payments to the Sub-Contractor shall be the responsibility of the Contractor and any requests from such sub-Contractor shall not be entertained by IIA.

5. **Past performance:** In case the past performance of the tenderer is not found to be satisfactory with regard to quality, delivery, warranty obligation and non-fulfilment of terms and conditions of the contract, their offer is liable to be rejected by IIA.

6. The bidder is required to submit all supporting documents as proof for the compliance. Bids received without valid documents and/or incomplete and irrelevant documents are likely to be rejected.

7. A detailed QAP, drawings documentation and calculation for obtaining necessary approval should be submitted to IIA before taking up chamber fabrication.

8. IIA’s decision to consider as to whether a bidder has met with the eligibility criteria or not is final.
9. **Pre-Bid Meeting**: Pre-bid meeting will be arranged by IIA. Tenderers are requested to go through the tender notice carefully before coming to Pre-Bid meeting. During the Pre-Bid meeting vendors will be allowed to raise any queries and the clarification will be given by IIA. Time and venue will be intimated through IIA website.

10. Payment to the vendor's will be linked with milestones like PDR, CDR, FAT, Delivery at site, installation & commissioning, etc.,

11. Vendor shall visit the project site to evaluate RFP requirements before submitting the quote. Prior permissions shall be obtained from IIA for the visit.

**39. Check list for No. of documents to be enclosed in the offer**

**a) Technical bid**: Bidder shall furnish following details / documents in their technical bid:

Detailed description of the system offered w.r.t. each of the above specification.

i) Detailed list of scope of supply included in the offer.

ii) List of major items along with make and model number.

iii) Catalogues, leaflets, brochures, application notes etc. for all the major components and equipment's proposed.

iv) Preliminary design calculation made to arrive at sizes of various equipments and components.

v) Compliance table with remarks.

vi) Deviation table if any with remarks and detailed justification.

vii) Un-priced commercial bid.

viii) Any other details relevant to the requirement.

**b) Commercial bid**: Bidder shall furnish following details / documents in their commercial bid:

i) Commercial bid with price

ii) Price break up for refurbishment of Vacuum chamber to Thermo vacuum chamber with ports, doors, etc.

iii) Thermal system with base plate, shrouds and associated piping.

iv) Price break up for data acquisition system including temperature sensors and paperless data recorder.

v) Price break up for Miscellaneous items if any (Include all left out elements giving details)