

**General Terms for Expression of Interest for Setting up and operation of Additive Manufacturing,
Metal 3D printing Facility at LPSC Valiamala on BOOT model**

1. Introduction

Liquid Propulsion Systems Centre, Valiamala, Thiruvananthapuram, India is established under the Indian Space Research Organization for the design and development of liquid rocket engines and stages for its Launch Vehicles and Spacecrafts.

To keep up with the developing manufacturing trends and also to fast track realisation of developmental hardware, LPSC needs to move into vistas hitherto unexplored. Through this EOI, LPSC intends to leapfrog the application of additive manufacturing technology by riding piggy back on an experienced vendor who will setup and operate an AM facility for LPSC at its premises on the BOOT model.

Attention of reputed OEMs and service providers in the additive manufacturing field is solicited to respond to this EOI.

2. Scope of supply and terms and conditions

The scope of supply and the terms and conditions are laid out in the EOI document titled for "Setting up and operation of Additive Manufacturing, Metal 3D printing Facility at LPSC Valiamala on BOOT model" which is appended herewith.

3. Technical details of proposal

The vendors shall submit their concurrence/response to each and every clause of the EOI. In case they have an alternate suggestion, the same can also be brought out.

4. Commercial details of the proposal

The vendors shall also submit necessary documents in support of their meeting the qualification criteria mentioned at clause 7 of the EOI. In addition vendors shall also submit

- 4.1 The full history of the company, financial status,
- 4.2 Past experience, major tasks undertaken in the Aerospace/Aviation and other precision industries in similar areas
- 4.3 Case study of AM parts realized, technical manpower availability with their competence etc.

5. Mode of operation of tender

- 5.1. In the first stage the companies have to respond to this Expression of Interest giving all details sought for above. **No price is to be quoted now.**
- 5.2. Companies who fulfill the financial and technical criterion may be called for a technical presentation within 3 weeks of submission of the Expression of Interest.
- 5.3. Based on the discussions so held, one or more acceptable solutions shall be decided upon.
- 5.4. Detailed technical specification and evaluation criterion will be generated for each solution.
- 5.5. In the second stage, techno-commercial and price bids will be invited from the shortlisted vendors on two part bid basis.
- 5.6. The final selection will be based upon the techno-commercial evaluation matrix, and the price bid.

6. This call for EOI does not carry with it any guarantee for allotment of work.

7. Interested vendors may submit their Expression of Interest quoting the reference number -**TM20 2017 030283 01** and description as **“TM20 2017 030283 01 - Expression of Interest for Setting up and operation of Additive Manufacturing, Metal 3D printing Facility at LPSC Valiamala on BOOT model”** in an envelope so as to reach LPSC on or before **30.11.2017 at 16.30 hrs** to the following address:

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

8. **Technical details of EOI – TM20 2017 030283 01 are attached as Annexure**

The following document forms part of this Expression of Interest.

“EOI for Setting up and operation of Additive Manufacturing, Metal 3D printing Facility at LPSC Valiamala on BOOT model”

(sd)

**Sr.Head, Purchase and Stores
For and on behalf of the President of India
(The Purchaser)**

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Request for Proposal

for

**“Setting up and operation of Additive Manufacturing,
Metal 3D printing Facility
at LPSC Valiamala on BOOT model”**

CE20EF, MME

Liquid Propulsion Systems Centre

Valiamala, Thiruvananthapuram 695 547

September 2017

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Distribution List

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1. Abbreviations

AM	Additive manufacturing
DMLS	Direct Metal Laser Sintering
JRB	Joint Review Board
Vendor	Technology or service provider
BOOT	Build Own Operate& Transfer mode of project execution

2. Executive summary

The scope of this RFP is to design, set up, commission and operate an Additive Manufacturing, Metal 3D printing Facility at LPSC Valiamala for realization of identified components and bring them into mainstream usage.

In addition, the RFP looks for consulting services in adapting chosen components to Additive Engineering Design. This will include joint discussions on potential design changes, Topology Optimization, Analysis, Simulation, Validations and Post processing.

Further the RFP looks towards to seek research services for adaption of new metal alloys and geometries to support LPSC programs.

The facility shall be commissioned within 12 months of finalisation of the contract. The vendor shall also be responsible for operating the facility for a period of 3 years from date of commissioning of the facility and at the same time shall train LPSC personnel in operation of facility.

3. Introduction

ISRO has ambitious programmes lined up to achieve self reliance in low cost access to space. While the work horse, PSLV takes care of the requirement of launching remote sensing satellites in the polar orbit, GSLV MkIII will launch the communication satellites. LPSC is tasked with the realisation of engines powered by liquid fuels.

The realisation of Cryogenic engine and stage in large numbers is the immediate challenge faced by LPSC towards operationalising GSLV MkIII launch vehicle. Also, the semi cryogenic engine (SE2000), the work horse for future generation launch vehicles, proposed to be developed, needs to go through an extensive process development cycle for realisation. The development of the semi cryogenic stage is also an immediate requirement.

In addition, LPSC has to cater to the demand of supplying propulsion systems for the GEOSAT programme. Further there are the hardware demands for the next generation Electric propulsion as well as LOX Methane Engines.

To keep up with the manufacturing trends adopted by space faring nations and also to fast track realisation of developmental hardware, LPSC needs to move into vistas hither though unexplored.

Through this RFP, LPSC intends to leap frog the application of this technology by riding piggy back on an experienced vendor who will setup and operate an AM facility for LPSC at its premises.

4. Background

Metal Additive Manufacturing holds tremendous promise, as a manufacturing technique for Indian space systems and it combines the advantage of short production volumes, weight reduction, short time from design to realisation and faster design iterations.

While a systematic and scientific approach is required to be able to discover appropriate metal AM use cases, the world over, most organizations have achieved success in the application of this technology by working in a collaborative mode with technology or service providers.

Further, this collaboration will also complement the development of skill sets, competencies and talents within LPSC, on a sustainable basis.

5. Scope of the RFP

This RFP envisages that the selected technology/service provider shall ultimately be responsible for the lay out design, Procurement, Deployment, Commissioning, Maintenance and Operation of the AM facility at LPSC Valiamala in the Build Own Operate and Transfer mode to meet the demand of AM components for LPSC.

The technology/service provider shall also train the LPSC team to operate the facility independently after the end of the term of this contract.

In addition, the RFP looks for consulting services in adapting chosen components to Additive Engineering Design. This will include joint discussions on potential design changes, Topology Optimization, Analysis, Simulation, validations and Post processing.

Further, the RFP looks towards to provide research services for adaption of new metal alloys and geometries for support of LPSC programs.

6. Location

The AM facility shall be located at the premises of LPSC at Valiamala, Trivandrum 695547, Kerala

7. Qualification criteria

Prospective vendors shall meet any of the criteria below for qualifying to participate in this bid:

1. They shall be a AM technology provider (OEM) with minimum 3 years of experience and with a group business turnover of Rs 500 lakhs for 2016
2. They shall be an AM service provider with minimum two years of experience.
3. They can be a consortium of both AM technology provider (OEM) & AM service provider, both meeting the individual criteria above

8. Responsibilities of the vendor

8.1. AM Facility build up

The vendor shall be responsible to design and locate the LPSC AM facility within its premises, choose required equipment, oversee the commissioning of equipment, and make the AM facility operational after necessary trials

The vendor shall be responsible for:

1. Designing the layout of the AM facility
2. Choose required equipments in discussion with LPSC
3. Oversee the commissioning of equipment in the AM center
4. Procurement of powder, replacement tools, repairs and consumables and related services

Equipments to be supplied include

1. DMLS AM Machine of 400 mm³ build volume with twin lasers and related systems including powder handling
2. Gas evacuation mechanism
3. Material handling equipment for shop floor
4. Powder storage, heating and handling equipment
5. Custom Designed Inert gas furnace
6. Surface Grinding Machine
7. Shot peening equipment
8. Tumbling equipment
9. Requisite tooling and quality instruments
10. Microscope
11. Powder and Coupon Characterization equipment
12. Server/ Desktops for related equipment and data back up
13. Trolleys, Tables, working surfaces
14. Requisite set of spares and AMC as applicable for all above equipment
15. Protective equipments
16. Related software for modeling, AM and monitoring
17. Dehumidifiers
18. Establish an Argon Gas bank and piping
19. Establish a compressed air system and piping
20. Design hazardous waste storage area

The above list is not exhaustive and the vendors can add or optimize the configuration of any equipment for executing the contract.

8.2. Consultancy in AM Process Development & Production

The vendor shall be responsible for providing consultancy for development of the AM process which include.

1. Data Preparation
2. Build Strategy
3. Parameter Selection
4. Post Processing and Prove out considerations,

Towards this, necessary test coupons shall be printed and tested. The parts shall also be subjected to functional tests as well as destructive and non-destructive testing (by LPSC). Additional print and testing iterations shall be carried out as required on mutually agreed terms till the process package is finalized and the parts qualified. To ensure repeatability in production, the parameters shall be fine tuned if found necessary.

This exercise will be a continuing activity throughout the period of the contract can also be carried out at the vendors' technology centre before implementing the same at the LPSCs' AM facility.

In addition the vendor shall also be responsible for production of identified components at the facility. In the production stage, the vendor shall be responsible for:

1. Operating the facility by co-location of two experts at LPSC premises as well as two AM Machine operators
2. Training the LPSC team to operate the facility independently after the end of the term of this contract

In the eventuality of the capacity at the facility not being able to meet the demand, then the facility shall be augmented.

8.3. Consultancy services in Design & Engineering for AM

The vendor shall provide consultancy services in design & engineering for AM. For this the vendor shall jointly work with LPSC teams in Design, Engineering, Quality and Production to adapt chosen components for Additive Engineering Design. This will include joint discussions on potential design changes, topology optimization, simulation and validation where applicable and post processing. The design alterations approved will be implemented for AM.

This exercise will be a continuing activity throughout the period of the contract and will draw experts from the vendor's technology centre too.

8.4. Consultancy services in Advanced R&D

The vendor shall also be responsible for providing consultancy services towards supporting R&D initiatives such as new parameter development, new alloy adaption, new powder qualification etc

9. Responsibilities of LPSC

9.1. AM Facility build up

LPSC shall be responsible for rendering all necessary help and approvals for locating the LPSC AM facility within its premises.

LPSC shall be responsible for

1. Identifying an AM core team for internal liaison and program execution
2. Providing an independent air conditioned area measuring 75 sqm in its premises
3. Providing all utilities like water, power, and other allied consumables as well as housekeeping services
4. Providing network as well as secure internet connection.

5. Be responsible for the safety and security of the site , equipments and personnel
6. Involvement in the installation, commissioning and trials of equipments

9.2. AM Process Development & Production

LPSC, through its coordination team, shall be responsible for rendering all necessary help and providing necessary approvals during the development and deployment of the AM process.

LPSC shall be responsible for

1. Identifying parts for AM
2. Carrying out functional tests as well as destructive and non-destructive tests during the development process at its facilities
3. Providing material characterization support at its facilities
4. Providing post processing services of Wire EDM, Machining and Vacuum heat treatment
5. Providing dimensional inspection support
6. Providing canteen facilities at prescribed rates
7. Providing necessary logistics for working beyond regular hours and on holidays
8. Providing a hazardous waste storage area as per the vendor's design
9. Providing two AM machine operators who are to be trained by the vendor

9.3. Design & Engineering for AM

LPSC team shall jointly work with the vendor to adapt chosen components for Additive Engineering Design. This will include participating in joint discussions on potential design changes, topology optimization, simulation and validation where applicable and post processing.

LPSC shall be responsible for

1. Identifying parts for implementing Design & Engineering for AM
2. Identifying a team for working with the vendor's team
3. Approving the design changes as well as analysis and validation results
4. Coordinating the implementation of the design change into its system

9.4. Advanced R&D

LPSC team shall propose and jointly work with the vendor for R&D initiatives such as new parameter development, new alloy adaption, new powder qualification etc

10. Absolute responsibility

Throughout the currency of the contract, the vendor shall be solely responsible for the adequacy of the equipments as at clause 8.1. Any clearance given by LPSC shall not absolve the vendor of their responsibility in executing the Contract in full conformity with the specifications.

11. Facility Maintenance

As far as possible, the equipments in the AM facility shall be covered by AMC with the OEM. In other cases, the repairs shall be assigned to experienced companies on per call or per incident basis. The maintenance cost of the AM facility shall be borne by LPSC.

12. Consumables

The vendor shall maintain a minimum approved stock of powders at the AM facility. All necessary certification shall also be maintained for the stock of powder. Powders shall be sourced only from OEM or approved vendors.

LPSC shall be responsible for replenishing Argon cylinders. A minimum stock of other consumables shall be maintained by the vendor.

13. Duration

The vendor shall commission the AM facility within 12 Months from date of placement of order.

The vendor shall be responsible for operating the facility for a period of 3 years from the date of commissioning.

14. Timelines

The time lines for the project shall be as below

Id No	Activity	Schedule
T0	Date of placement of order	Start
T1	Finalisation of equipments	T0 + 4 weeks
T2	Layout design of facility	T1 + 2 weeks
T3	Readiness of building	T2 + 6 weeks
T4	Commissioning of facility	T0 + 12 months
T5	Consultancy for AM process development	T0 + 4 weeks (start time, will continue till end of project)
T6	Consultancy for Design & engineering for AM	T0 + 8 weeks (start time, will continue till end of project)
T7	Consultancy for advanced R&D	T0 + 12 weeks (start time, will continue till end of project)

Table 1 : Time lines

15. Working hours

The normal working hours of the facility under this contract shall be from 08.45 hours to 17.15 hrs from Monday to Saturday. However necessary work arrangement shall have to be made to run the DMLS AM machine on 24hrs basis based on the requirements arising from time to time.

In addition, work in support and consultancy activities shall have to be organised on extended hours as well as on holidays depending on the nature and schedule of requirement.

16. Safety, Security & Hazard mitigation

The layout of the facility as well as organization of work shall be based on sound and safe practices for additive manufacturing with special focus on powder handling and laser operation. The vendor shall endeavour to inform the AM machine operators regarding the hazards involved as well as to train them on safe operating practices. Necessary personnel protection equipments shall be provided. Immediate first aid like eyewash etc shall form part of the facility layout.

LPSC shall be responsible for the security of the equipments as well as personnel in its campus.

Under no circumstances will LPSC be liable to pay for damages arising out of wrong operations or unsafe operations carried out by the employees of the vendor or due to the mal functioning of the equipment in the facility.

17. Administering authorities

LPSC and the vendor shall identify the following administering authorities for specific functions as mentioned against each.

17.1. Contract Managers

The Contract Manager of the LPSC and the Contract Manager of the Vendor shall execute the contract effectively. A suitable organizational structure shall be put in place to support the Contract managers.

The Contract Manager for the vendor shall not be changed without prior approval of LPSC. In case LPSC desires to change its Contract Manager, it shall be intimated to the CONTRACTOR in time.

The Contract Manager of LPSC or his authorised representative only shall execute the clauses, terms and conditions viz., technical clearances, approvals, decisions and other authentic technical information of the Contract. Any decision involving additional expenditure shall be communicated in writing to LPSC. The Contract Manager of the vendor shall execute the clauses and terms and conditions of the Contract on behalf of the vendor.

17.2. Joint Review Board

A Joint Review Board (JRB) consisting of key management personnel from both LPSC and the vendor shall be constituted to co-ordinate the technology transfer, establishment of facilities, procurement of consumables and all other activities for smooth execution of the Contract.

The JRB shall address among other things:

- Proper co-ordination between all individual agencies
- Periodic review of Contract implementation status
- Review the progress of facility establishment at LPSC site and the adequacy of manpower deployed.

The JRB shall co-opt specialists for specific issues. The board shall meet as frequently as possible but at least once in two months.

18. Documentation

The vendor shall:

1. Prepare all documentation in a manner that meets the needs of LPSC, in content and quality of material as well as reproduction.
2. Present the documents in their customary formats provided such formats meet the requirements stated above and are acceptable to LPSC.
3. The documentation as agreed to shall form the basic document governing the procedure for manufacturing in respect of the supply of any or all of the items to LPSC under the Contract. No amendment to the procedure laid down therein shall be made or implemented without the specific written approval of LPSC.

19. Material Traceability Procedure

The vendor shall maintain a proper material traceability procedure for all the consumables being used in the facility. These include the details of materials, such as material grade, size, certificate No/ Heat No/ Melt No, identification No, inspection report sent by material suppliers, batch numbers, quantity and details of job for which the materials are used along with drawing No.

The vendor shall maintain an Inward Register for materials received

The vendor shall also maintain a material issue register, giving details of job orders; quantity of materials issued, its identification no. and the part for which the material is issued.

20. Technology Transfer

The vendor shall transfer the technology for additive manufacturing by way of documents, person-to-person interaction and training of the LPSC personnel at the captive AM facility/ vendor's technology centre

21. Ownership & Custody

All equipments established under this contract, and provided by the vendor, shall be the property of the vendor during the currency of the contract. A consolidated list of such items indicating quantity shall be prepared by the vendor and certified by the respective contract managers shall be made available to LPSC. The ownership of the facility shall automatically be transferred to LPSC on expiry/termination of the contract.

All tooling realized as per this contract shall be the exclusive property of LPSC. The vendor shall be the custodian of all the tooling and shall be responsible for preservation and up keeping of the tooling with proper identification till the completion of the contract

All parts, designs and processes realized/ developed under this contract shall be the exclusive property of LPSC and LPSC shall have free hold rights on their usage.

22. Intellectual Property

The ownership of intellectual property whether statutorily protected or not and generated in the course of or resulting from work undertaken for the purpose of this contract shall rest with LPSC.

The vendor/sub-contractors are strictly forbidden to transfer the technology gained in the course of executing the contract to any third party without written approval from LPSC

23. Prices

The prices shall be quoted in the following pattern

Sl no	Description	Unit	Qty	Rate	Amount
1	Consultancy in design iteration and, topology optimization	Hr		No prices to be quoted	
2	Consultancy in Analysis & Simulation	Hr			
3	Fixed monthly cost for capex recovery	Rs			
4	Generation of 3D models from 2D drawing by modeling	Hr			
5	Additive Manufacturing, costs for pre-processing,	Hr			
6	Additive Manufacturing, costs for 3D printing by DMLS including printing of necessary test coupons	Hr			
7	Additive Manufacturing, costs for post processing	Hr			

Table 2: Pattern for quote

The powder cost will be accounted based on consumption, and will be made on prorata basis at landed costs.

24. Breakeven terms (no prices to be quoted now)

The vendor shall indicate an anticipated turnover for each year, during the production phase, to achieve a break even.

25. Rework and rejection

Any rework that may be required to maintain the specified quality level shall be carried out by the vendor free of cost. After rework, the relevant dimensions shall be re-inspected. Hardware with unacceptable deviations shall be rejected.

During production phase a maximum rejection allowance of 10% will be permitted. Rejections beyond this will be to the account of the vendor. In case the rejections are not attributable to poor workmanship then the same will be put to the JRB for decision

26. Correspondence

All correspondences in regard to this Contract shall be addressed to the Senior Purchase & Stores Officer (Purchase), LPSC, Valiamala, Trivandrum- 695 547. All correspondences shall quote our Contract No. number and date.

27. Payment

Payment shall be regulated as below

1. Payment for consultancy services shall be made on prorata basis within 30 days of completion of the activity duly signed off by the contract manager
2. Payment for production services shall be made on prorata basis within 30 days of completion and acceptance of each job duly certified by the contract manager
3. Fixed monthly cost towards capex recovery shall be made within 30 days of submission of invoice duly certified by the contract manager. Capex recovery shall start only after the facility has been fully commissioned.
4. In case of facility augmentation as at clause 8.2, the payments shall be made on prorata basis for the additional capacity.

The vendor can also specify his payment terms which will be discussed and finalised.

28. Taxes and duties

Taxes and duties, as applicable will be reimbursed by LPSC.

29. Addition/deletion

LPSC reserve the right to delete part of the work during the currency of Contract.
.Additional work shall be incorporated after obtaining quote from contractor on mutual consent.

30. Force Majeure

Should a part or whole of this Contract be delayed in delivery due to reasons of force majeure which shall include lock-outs, strikes, riots, civil commotions, fire accidents, acts of god and war, stoppage of deliveries by Government, refusal of or non-receipt of import license for raw-materials, non-availability and/or delay in receipt of inputs from LPSC, the delivery period referred in this Contract shall be extended by a period (s) not in excess of duration of such force majeure.

Each party undertakes to advise the other as soon as it becomes aware of the circumstances of such force majeure, so that actions under the provisions of this Contract can be mutually reviewed and agreed upon between the vendor and the department. If the force majeure condition extends over a period of six months both the parties of the Contract shall mutually discuss and arrive at an agreement for the continuation or the termination of the Contract.

31. Subletting of the contract

The contractor shall not sublet, transfer or assign the Contract or any part thereof without prior written approval from LPSC

32. Liquidated damages

In case supplies are not made within the delivery period as stated above or any extension thereof, Liquidated Damage @ 0.5% (zero point five percent) of the order value or part there of the undelivered portion for each calendar week of delay or part there of shall be recovered from your bill. However, total Liquidated Damage shall not exceed 10% (ten percent) of the total value of each job.

33. Arbitration

Dispute, if any, shall be settled mutually, failing which it shall be referred to a One-Man-Arbitrator appointed by Director, LPSC in accordance with Arbitration & Conciliation Act 1996, whose decision shall be final and binding on both the parties.

34. Parallel/ adhoc contract

LPSC reserves the right to enter into parallel/adhoc contract(s) simultaneously or at any time during the currency of contract with one or more agencies.

35. Short Closing/Termination of Contract

Under normal circumstances, short-closing/termination of the Contract is not foreseen. However, in case of continued non-performance of the Contract resulting in inordinate delays in the delivery dates in spite of repeated written requests for meeting the delivery schedule as provided in the Contract, LPSC reserves the right to terminate wholly or partly the Contract, by giving a notice of not less than one month.

In case of major changes in the policies of the Government of India, as a result of which LPSC is compelled to curtail its requirements wholly or partly, the LPSC and the vendor shall enter into negotiations to mutually agree to terminate this contract wholly or partly.

In the event of short-closing/termination of this Contract, the following procedure shall be followed.

1. LPSC shall give a notice of not less than one month.
2. On receipt of the notice the vendor shall take all necessary steps for winding up of the Contract in line with the notice within a reasonable period, but in any case not exceeding three months from the date of posting the notice.
3. The compensation to be paid to the vendor shall be agreed to by mutual negotiations. LPSC shall in no circumstances be liable to pay any sum which, when added to the other sums paid, due or becoming due to the CONTRACTOR under this Contract, exceeds the amount specified in Clause 23 of this Contract.

36. Secrecy

The drawing and documents sent along with the order form part of the vital documents and same should be kept on top secret. Under any situations, the vendor should not part with or transfer the technology/contents of drawings and documents whatsoever to any third party/agency/without our prior consent. If at any time, it is brought to our notice that the secrecy has been transferred by the vendor intentionally, or otherwise to any third party/agency, the vendor shall be liable to identify the loss/damage to Government of India.