

Ref: Public Tender Notice No.PR/BER/TMT/RFP/CAP/92

ANNOUNCEMENT OF OPPORTUNITY
FOR
PROTOTYPING OF EDGE SENSOR
FOR THE
THIRTY METER TELESCOPE (TMT) PROJECT

June 30, 2011

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1 BRIEF STATEMENT OF THE WORK

The primary mirror (M1) of the Thirty Meter Telescope (TMT) telescope is comprised of 492 hexagonal mirror segments. Tip, tilt and piston of each of these segments with a size of 1.44 m across is controlled by three actuators to maintain the overall shape of M1. Contractor has to manufacture prototype edge sensor, for the purpose of technology demonstration. This announcement of opportunity is for manufacture of twenty five edge sensor, meeting the design specifications detailed in the Scope of Works in Section A, following the methodology in Section B and terms and conditions in Section C.

2 BACKGROUND INFORMATION

The optical and infra-red (IR) astronomical community in India, under the umbrella name TMT-India, had made a strong case to the Department of Science and Technology, Government of India for participation in upcoming international, 30-m class telescope project. The proposal effort is led by the Indian Institute of Astrophysics (IIA), Bangalore, the Inter-University Center for Astronomy and Astrophysics (IUCAA), Pune and the Aryabhata Research Institute for Observational Sciences, (ARIES), Nainital. The Department of Science and Technology (DST), Govt. of India, made a decision, on July 24th, 2010, to join the TMT project as an observer with a strong intention of becoming a full partner in due course of time. The TMT project is led by the California Institute of Technology, University of California and Association of Canadian Universities for Research in Astronomy (ACURA) to build a 30-m diameter optical-IR telescope at Mauna Kea in Hawaii, USA. Other partners in the consortium are Japan and China. The TMT construction work is scheduled to start by the middle of 2012 on the summit of Mauna Kea at an altitude of 4200m from sea level. Hereafter, TMT or TMT project refers to the TMT consortium of international members with headquarter at Pasadena, USA, and TMT-India refers to consortium of various institutes in India.

As part of India's contribution to the TMT, TMT-India intends to develop, within the country, various sub-systems needed for the telescope and deliver to the TMT project. Towards this, TMT-India in consultation with the TMT project, has identified various sub-systems. As a first step towards demonstrating the technical capabilities available in India, TMT-India proposes to develop the technology, by manufacturing prototypes of these sub-systems. In pursuance of the above, the Director Indian Institute of Astrophysics, Bangalore, on behalf of TMT India, invites proposals from potential industries to prototype edge sensor for the TMT.

3 SUBMISSION OF THE PROPOSAL

Proposals are invited from industries with proven technical expertise, track record and experience in executing precision fabrication and experience in developing sub-systems for optical-infrared telescopes and/or executing large astronomical projects. Submission of proposal has to be done in two stages. In the first stage, contractors willing to submit proposals are invited to submit a letter

of **Expression of Interest (EOI)**. In the next stage, contractors short listed by the expert committee will be provided design for manufacturing diagrams as well as other relevant information and requested to put a detailed proposal divided into Technical Bid and Price Bid.

Guidelines for submission, including the details of documents required, are provided in Section B.

4 PROCESS SCHEDULE

Date of this Announcement	30 th June,2011
Deadline for receiving Expressions of Interest	22 nd July, 3:30 PM
Opening of EOI	22 nd July 2011 4:00PM
Qualification of contractors	19 th August2011
Signing on NDA, circulation of DFM	26 th August, 2011
Pre bid Technical discussion	9 th September, 2011 11.0AM
Deadline for receiving Proposals	4 th October, 2011, 3:30 PM
Opening of Technical Bids	4 th October, 2011, 4:00 PM
Technical Qualification	25 nd October., 2011
Opening of Price Bids	1 st November. 2011
Award of Contract	11 th November. 2011
Delivery	August 2012

Note: These dates may be revised by IIA through notification on its website.

5 CONTACTS:

Technical Clarifications:

1. Dr. PadmakarParihar(psp@iiap.res.in),IIA, Bangalore
2. Mr. P.K. Mahesh, Engineer (pkmahesh@iiap.res.in), IIA, Bangalore

Administrative Clarifications:

1. Shri Y.K Raja Iyengar, (ykri@iiap.res.in) Purchase Officer, IIA

I. Section A

STATEMENT OF WORK

A brief description of the TMT and the role of edge sensor is provided in the subsequent section. However, additional technical background can be found on the TMT website <http://www.TMT.org/documents>.

This Statement of Work (SOW) is split into two parts. The first part (“Statement of Work – Prototype Sensor”) (See [item 7](#) and subsections) is for manufacture, initial test and delivery of twenty five prototype sensor based on the existing sensor design with a report for possible improvement in the design, cost cutting, and efficient production. The second part (Statement of Work – Production Sensor Cost Estimate) (See [item 7.5](#) and subsections) is for the development of a detailed cost estimate for the Production Sensor based on the experience gained by manufacturing of the Prototype Sensor. A draft of the Production Sensor SOW (“Draft Statement of Work – Production Sensor”) is included (see [item 8](#)) to be used as guidance for the development of a Production Sensor cost estimate.

6 TECHNICAL BACKGROUND

6.1 THE TMT TELESCOPE

The TMT is a Ritchey Chrétien system. Both the primary and the secondary mirrors are hyperboloid. The focal length of the primary mirror is 30-m and the final F-ratio of telescope system is F/15. A tertiary mirror is used to fold and steer the light path to any of the eight instruments that will be mounted on the two main Nasmyth platforms. The telescope has an unvignetted field of view of 15 arc-minute. The primary mirror is segmented giving an effective aperture of 30-m. There are 492 hexagonal segments, each having a size of 1.44 m across corners. The segments are closely placed with nominal gaps of 2.5 mm between the segments. The Primary Mirror Control System (MICS) is responsible for maintaining the overall shape of the segmented M1 mirror despite structural deformations of the telescope structure caused by temperature and gravity and disturbances from wind and vibrations (observatory generated and seismic).

6.2 THE EDGE SENSOR

6.2.1 INTRODUCTION:

In order to achieve very high spatial resolution as well as sensitivity, the 492 hexagonal mirror segments of the TMT must be precisely positioned with respect to each other to form a 30-meter hyperboloid primary mirror. Each mirror segment, supported by a Segment Support Assembly (SSA) will have six degrees of freedom which include the relative displacements along the axes (δx , δy , δz) and rotations about the axes (θx , θy , θz). Three in plane degrees of

freedom (shear δx , δy and clocking θz) will be controlled by passive SSA, primarily by making use of warping harnesses. The remaining three out of plane degrees of freedom, tip, tilt (θx , θy), and piston (δz), will be actively controlled via three actuators per segment. Once mirror segments are aligned based on information from the Alignment and Phasing System, any subsequent deformations due to gravity, thermal changes and wind-induced pressure distributions, will be taken care of by M1 control system (M1CS). The M1CS performs this task, with the help of actuators that move segments in tip, tilt and piston relative to the mirror support structure. These movements are based on error signals generated from edge sensors that are exquisitely sensitive to the relative height and tilt of neighboring segments. One segmented mirror mounted on SSA along with actuator and edge sensor is shown in Figure 1.

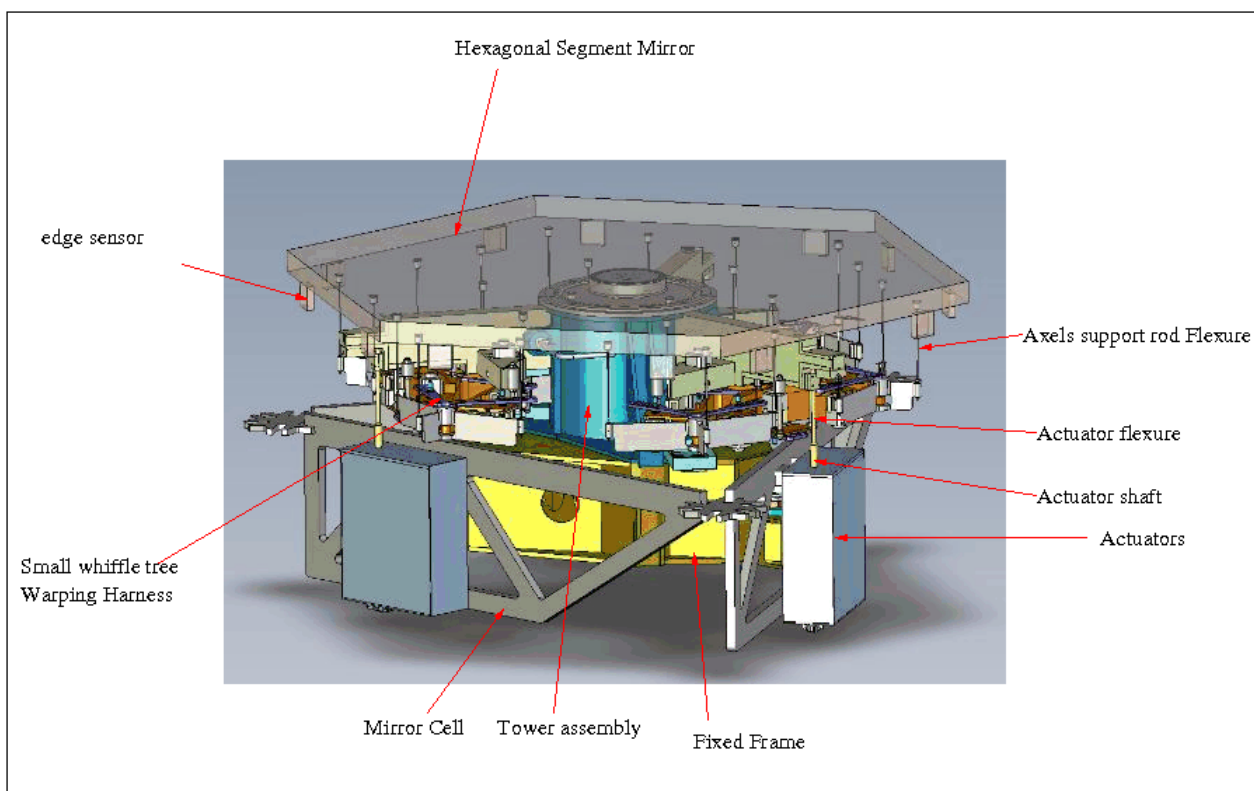


Figure 1 The design of a segmented mirror mounted on SSA along with actuator and edge sensor.

The Sensors are an extremely important component of the TMT and TMT has developed and tested the design of Prototype Sensor in collaboration of the Jet Propulsion Laboratory, USA (P2). After evaluating the performance, reliability, cost, etc., the sensor design was further revised. The revised design will now be used for the prototype manufacturing. A prototype sensor meeting the detailed design requirement will then be considered for mass production

by the TMT partners. In total, the M1CS requires 3234 sensors. Additional sensors are required as spares. The M1CS sensors are the subject of this Scope of Work (SOW). The next section briefly describes the TMT sensor, however, more elaborate details can be found in the TMT documents.

6.2.2 THE PROPOSED CAPACITIVE EDGE SENSOR:

The sensor: The TMT edge sensors will be based on capacitive technology which allows high precision contact-less measurement, on large operational ranges. The TMT edge sensors have a drive half, or transmitter, mounted on one segment edge, and a mating sense half, or receiver, mounted on a neighboring segment edge. The capacitance is that of a simple capacitor in air. Putting a drive half and a sense half on each edge of segmented mirror, allows the tilt (dihedral) component to be separated from the piston component in the control algorithm.

Each half of sensor is a rectangular block of glass having extremely low thermal expansion. The substrate made of Zerodur Expansion class I or equivalent is preferred. All sides are polished to relieve stress and all edges are beveled. The side which hold the capacitor electrode and opposite of it, need to be polished with surface finish 60/40 scratch/dig. Whereas, 0.01 RMS or better, surface finish are required for remaining surfaces. Each block (drive or sense), weighing about 120gms, will have dimension of about 50mm x 62mm x 20mm. The dimension of drive and sense electrodes are, 39mmx23.5mm and 29mmx44mm respectively (see Figure 2). The sides, plated with electrode, will have very thin cross hairs made on the block, prior to coating and will be used as a reference by the coater. The bottom of the each half will have three feet made from same substrate. The sensor blocks would be attached to the back of a mirror segment by a threaded puck and the rod (stud). The threaded puck will be bonded to the back of mirror segment.

The polished sensor blocks will be coated with 0.5 micron gold (99.99% pure or better) over 0.05 micron chromium coating. The coating of front (side with electrode) and back sides, need to be done very precisely and tolerance in coating thickness is $\pm 10\%$. Whereas, tolerance in coating thickness for other sides are little relaxed. The capacitor electrodes are plated on drive and sense block by forming rectangular pattern on sides, facing toward other mirror segment, using any etching technique. Since very precision is involved in forming and placing the rectangular pattern on the blocks, therefore, photolithographic technique is preferred.

Three holes through the block thickness provide paths for wires to connect to the sense and driver electrodes (see Figure 2). Electrical wires will be connected to the electrodes and the ground planes, using Indium soldering. Indium is used to make a stable mechanical connection as well as to insure that the sensor blocks are not damaged if the cables are pulled for some reason. In addition to this the low melting point of Indium avoids overheating the Zerodur substrate, which can have detrimental effects on its thermal expansion coefficients. The coating planes isolated from the electrodes will be connected to the ground, for the purpose

of electro-magnetic shielding as well as to increase the sensor capacitance. For the current electrode geometry (39mmx18.5mm electrode overlapping area) and 2.5mm gap, the capacitance of one drive and sense pair is about 2.5553 pF.

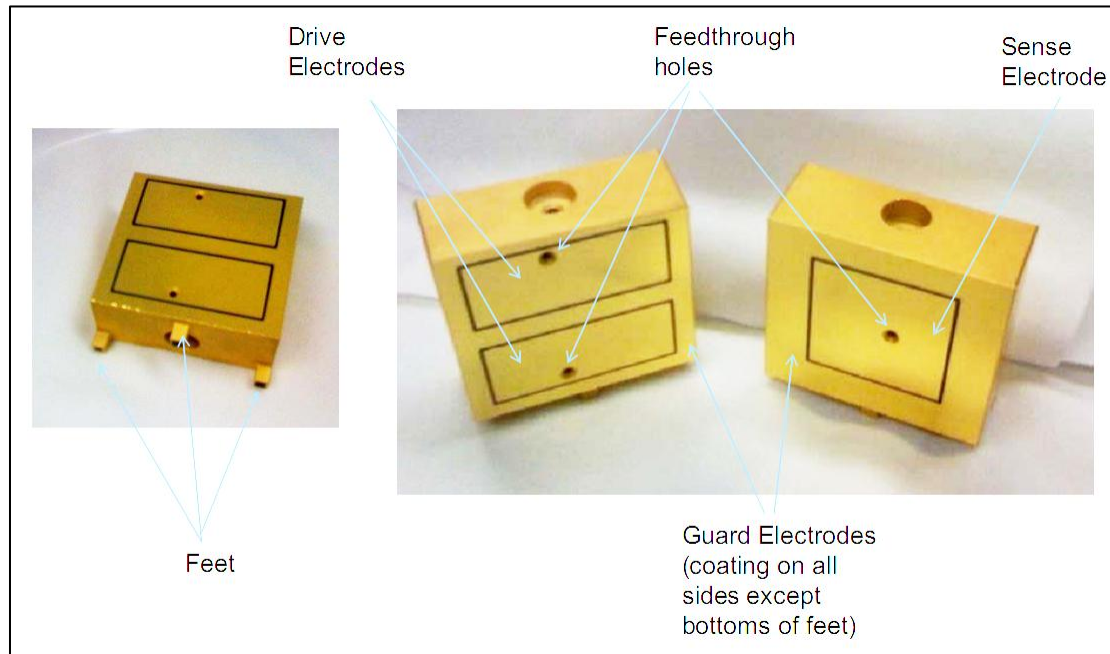


Figure 2: TMT Capacitive Edge Sensor

Each sensor uses a change in the charge on a capacitor to measure a linear combination of a change in the relative height (δz) of the two adjacent segments and a change in the dihedral angle ($\delta \omega$) between the two adjacent segments. The shape and the dimension of the sense and drive plates are chosen in such way that the height sensitivity arises from varying the effective plate area, and tilt sensitivity arises from varying the effective plate spacing.

The Electronics: The sensor electronics are part of the Segment Controller and Cabling (SCC) system which is a separate work package and does not fall under scope of this RFP. Only for reference purposes a brief description of the sensor electronics is given here.

The TMT capacitive edge sensor electronics have two outputs; one output reports the combination of relative height plus the tilt (dihedral angle) between segments. The other output reports the gap between adjacent primary mirror segments. The measurement of the gap between adjacent segments enables the determination of the in-plane position of all segments. The gap and in-plane position of the segments is utilized as part of the sensor calibration process.

The edge sensors are in two parts, a drive side and a sense side, attached on each side of the gap between neighboring mirror segments. Figure 2 shows the drive (left) and sense (right) Zerodur blocks separated to show the gold-plated electrodes. In operation, the electrodes face each other across a 4.5 ± 1.2 mm gap.

Each sensor side has its own small electronics board that provides all analog electronics and a 50M baud digital serial interface. Figure 3 shows the prototype drive board (left) and the sense board (right).

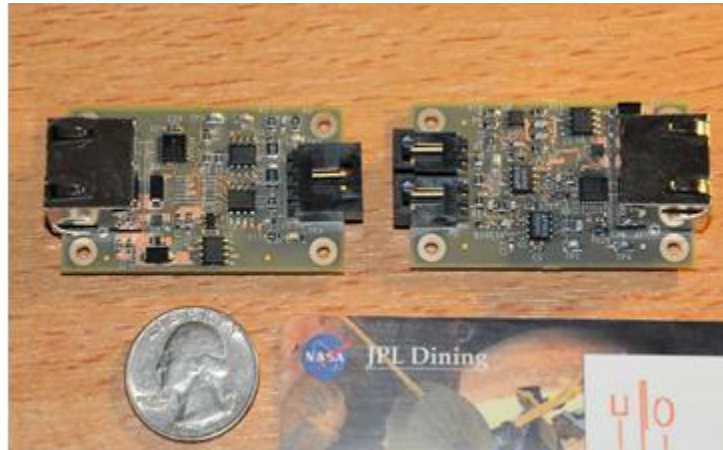


Figure 3: TMT Prototype Edge Sensor Electronics. The drive board (left) contains two 16-bit D/A converters and analog drive amplifiers. The sense board (right) contains a low-noise amplifier chain and an 18-bit A/D converter. These boards are intended to be local to the drive and sense blocks, and dissipate 109 mW and 74 mW respectively. They are controlled by a digital interface board (not shown).

The drive side electronics has a dual 16 bit DAC, a resistor matrix and two $\pm 5V$ output amplifiers for each of the two drive-side electrodes. The first DAC-1 is used to create opposing signals in the two electrode outputs, and the second DAC-2 is used to create common-mode signals in the two electrode outputs. This is done with the resistor matrix and a precision inverter.

DAC-1, making opposing signals, creates a 100KHz sine wave sampled at 800 KHz. This is for height measurement. DAC-2, making common-mode signals, generates a 50KHz sine wave, also sampled at 800 KHz. This is for gap measurement. DAC-2 also outputs a small 100KHz component which functions as a zero-point trim for the height signal.

The sense side electronics connects to the one sense electrode. The Sense side electronics include a low-noise precision amplifier and an 18 bit A/D which samples at 800 KHz. Concurrent phase-sensitive demodulation at both the height and gap carrier frequencies is performed in firmware, in a digital interface board which is not shown. Internal to the firmware, height and gap readings are computed at a 50 KHz rate. These are averaged, also in firmware, to provide 40 bit height and gap outputs at a 400 or 20 Hz rate.

7.0 STATEMENT OF WORK – PROTOTYPE SENSOR BUILD AND TEST AND PRODUCTION SENSOR COST ESTIMATE

7.1 SERVICES: PROTOTYPE SENSOR BUILD AND TEST

The Contractor shall procure, manufacture, assemble, test and deliver twenty five (25) Prototype Sensors per the design provided by TMT-India. In addition the Contractor shall manufacture and deliver one uncoated sensor (Drive and Sense Blocks) without cables. The Contractor shall supply all parts (procured or fabricated), tooling required for assembly, and test equipment necessary to build and test the Prototype Sensors. The following is also included,

- 7.1.1 Review the P2 Sensor Drawings and Models ([Ref. 1](#)), M1 Control System Sensor Design Requirements Document ([Ref. 2](#)), P2Edge Sensor Overview([Ref. 3](#)), and P2Edge Sensor Test Procedure ([Ref. 4](#)). Identify and communicate to TMT-India any missing or incomplete information.
- 7.1.2 After the Pre-Build Meeting (described below) and receipt of written TMT-India authorization to proceed, the Contractor shall procure off-the-shelf parts per the provided parts list ([Ref.1](#)). Substitute parts shall only be allowed with TMT-India written approval.
- 7.1.3 Manufacture sensor blocks, coat sensor blocks, and assemble and install sensor cables.([Ref.1](#)).
- 7.1.4 Test the Prototype Sensors per the provided test procedure (Ref 4).
- 7.1.5 Pack and ship the Prototype Sensors to TMT-India.

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- 7.1.6 The Contractor shall manufacture, assemble, test, and ship five Prototype Sensors prior to manufacturing the blocks for Prototype Sensors six (6) through twenty five (25). The Contractor shall proceed with the manufacture, assembly, and test of Prototype Sensors six (6) through twenty five (25) only after written TMT-India approval.

7.2 MEETINGS: PROTOTYPE SENSORS

The Contractor shall participate in the following meetings. The meetings may be via phone or video. TMT-India reserves the right to meet at the Contractor's facility.

- 7.2.1 A kickoff meeting after the award of contract. The meeting shall be used to answer any Contractor questions and to review the Prototype Sensor drawings, assembly and test procedures.
- 7.2.2 A Pre-Build meeting where the Contractor shall request TMT-India approval for any necessary Prototype Sensor drawing changes. TMT-India shall respond within ten(10) working days. TMT-India will provide the Contractor updated drawings as appropriate within this ten (10) day period.
- 7.2.3 A meeting after the assembly and test of the first five (5) Prototype Sensors. The Contractor shall convey to TMT-India any as-built changes to the Prototype Sensors and test results shall be reviewed. The TMT Project, in collaboration with the TMT-India, shall incorporate the as-built changes into the drawings at its sole discretion. The Contractor shall ship the five (5) Sensors to TMT-India after the successful completion of this meeting.
- 7.2.4 The Contractor shall request written approval to proceed with the procurement, manufacture, assembly and test of Prototype Sensors six (6) through twenty five (25). TMT-India shall respond within thirty (30) working days. This will allow adequate time for the TMT Project to complete an in depth evaluation of the five (5) Prototype Sensors prior to the build of the remaining Sensors.
- 7.2.5 A Pre-Ship meeting prior to the shipment of Prototype Sensors six (6) through twenty five (25) to TMT-India. Test reports for all Prototype Sensors shall be discussed.
- 7.2.6 Any other informal meetings as required or requested by TMT-India to complete the build and test of the Prototype Sensors.

7.3 DELIVERABLES: PROTOTYPE SENSORS

The Contractor shall deliver the following.

- 7.3.1 Twenty five (25) Prototype Sensors. At any time upon TMT-India's request in writing the Contractor shall deliver any completed and tested Prototype Sensors.
- 7.3.2 One uncoated Prototype Sensor Drive Block and Sense Block without cables.
- 7.3.3 All jigs or tooling built for the manufacture, assembly, and test of the Sensors.

- 7.3.4 A written test report for each Prototype Sensor. The written test reports shall include, but shall not be limited to, the results of assembled Sensor testing via the P2Edge Sensor Test Procedure ([Ref. 4](#)) as well as all inspection reports for raw material, the machined sense and drive paddles, the coated sense and drive paddles, and the cable assembly.
- 7.3.5 Redlines/corrections on the documentation as a result of documentation errors.

7.4 INSPECTION AND ACCEPTENCE PROCEDURE

- 7.4.1 At various stages of the prototyping of the Sensors, the Contractor is expected to work very closely with the technical team designated by TMT India and TMT project.
- 7.4.2 Each custom manufactured part will be inspected by technical team authorized by TMT-India at Contractor premises prior to assembly procedures. The dimensionality and the quality of raw material used will be verified. .
- 7.4.3 The first five (5) assembled Prototype Sensors will go through simple functional tests as described in the document [Ref 4](#) at the Contractor premises. Once passed through this test, the five Sensors will be accepted and go through a comprehensive testing procedure at TMT head-quarter.
- 7.4.4 Based on comprehensive testing of the first five (5) Sensors any necessary feedback will be provided on piece part manufacturing, assembly procedures, and test procedures to be utilized for the build and test of the remaining twenty (20) Sensors. The expectation is that the simple functional tests, with possible slight modifications, would be adequate to constitute full acceptance of the remaining twenty Sensors.

7.5 SCHEDULE – PROTOTYPE SENSORS

Meetings and deliverable shall be per the following schedule. All dates are from Effective Date of Contract.

Item	Description	Completion Date from Effective Date
1	Kick-Off Meeting	Week 1
2	Pre-Build Meeting	Week 3
3	Prototype Sensor 1 to5: Build and Test	Week 14
4	Prototype Sensor1to 5: Meeting	Week 15
5	Prototype Sensor6 to25:Build and Test	Week 30
6	Pre-Ship Meeting	Week 31
7	Delivery of all Prototype Sensors, one uncoated Sensor Drive and Sense Blocks without cables, Sensor test reports, corrected drawings and documentation, jigs and tooling	Week 34

Table 1

7.6 SERVICES – PRODUCTION SENSOR COST ESTIMATE

- 7.6.1 Provide a cost estimate, assuming a firm fixed price contract, for the manufacture of thirty three hundred and thirty four (3334) Pre-Production and Production Sensors per the *Draft Statement of Work – Production Sensors (item 8.0)* and any sub-sections). The cost estimate should be broken out into the categories listed below.
- 7.6.1.1 Total cost for thirty two hundred and thirty four (3234) Production Sensors. In addition, the Contractor shall break-out the following costs:
1. Cost of all recurring manufacturing labor. Breakout the cost for quality control, assembly, test, reporting, and any other significant recurring costs.
 2. Cost of off-the-shelf components
 3. Cost of custom fabricated components
 4. Total cost for the delivery of assembly and test hardware
 5. All taxes and duties
 6. Packing and shipping
 7. Overhead and profit
- 7.6.1.2 Total Cost of non-recurring engineering labor for services
- 7.6.1.3 Total Cost for the one hundred (100) Pre-Production Sensors
- 7.6.2 Provide feedback on any aspect of Sensor design, manufacturing, assembly, or test that if modified, without compromising performance, would decrease cost. If possible, estimate any potential cost savings.
- 7.6.3 Provide feedback on the Production Sensor delivery schedule. Is the schedule driving cost? Would a more relaxed or a more ambitious schedule reduce cost? If possible, estimate any potential cost savings.

8.0 DRAFT STATEMENT OF WORK – PRODUCTION SENSORS (FOR REFERENCE ONLY)

8.1 SCOPE

The Contractor shall build and test a total of thirty three hundred and thirty four (3334) Pre-Production and Production Sensors. Of the thirty three hundred and thirty four Sensors thirty two hundred and eighty four (3284) shall be delivered to the TMT Project as “working” Sensors. The additional fifty Sensors shall be appropriately selected during Pre-Production and Production and used for extensive testing to near destruction. These fifty Sensors shall be delivered to TMT-India after testing is complete. The Contractor may choose to build and extensively test more than fifty Sensors. Sensors that are extensively tested shall not count towards the thirty two hundred and eighty four “working ”Sensors that are delivered to TMT-India. All Sensors built by the Contractor shall be delivered to TMT-India.

TMT-India will loan the Contractor the required number of test stations required for Sensor acceptance testing of continuity and isolation. The Contractor is responsible for providing any equipment necessary for validation of the sensor paddle and coating geometry and surface characteristics.

The SOW tasks for the Production Sensors fall into three phases.

- 8.1.1 Planning: The first phase is focused on planning and the completion of a Sensor Manufacturing Plan.
- 8.1.2 Pre-Production: The second phase is the build and test of the first one hundred (100) Production Sensors. This phase will be used to validate the Sensor Manufacturing Plan and processes and to make any adjustments and modifications prior to the build and test of the remaining thirty two hundred and thirty four (3234) Production Sensors. Data from testing the one hundred pre-production Sensors will also be used to detail the quality assurance process.
- 8.1.3 Production: The final phase is the build and test of the remaining thirty two hundred and thirty four (3234) Production Sensors. Also included is packing and shipping the Sensors to the TMT-India.

8.2 SERVICES: PRODUCTION SENSORS – PLANNING

8.2.1 REVIEW OF DRAWINGS AND DATA PACKAGE

TMT - India shall provide a data package documenting the Production Sensors design which includes, but is not limited to, the following:

- 8.2.1.1 Design review packages

8.2.1.2 Analysis reports

8.2.1.3 Assembly and test procedures

1. *For the purposes of this RFP, assume the assembly procedure described in Ref 1.*
2. *For the purposes of this RFP, assume that TMT- India will loan the contractor multiple test stations and that 20 minutes per Sensor is required to run the tests.*

8.2.1.4 Test reports from prototype testing

8.2.1.5 Test station documentation

8.2.1.6 TMT –India shall provide engineering drawings of the Production Sensors including assembly drawings (assume [Ref. 1](#) for the purposes of the RFP). These drawings shall have the following attributes:

- 1 Drawings shall be in English.
- 2 Drawing units shall be in millimeters
- 3 Drawings shall be GDT compliant

8.2.1.7 The Contractor shall review the drawings and formulate a Sensor Manufacturing Plan (as further described in [item 8.2.2](#)). The Contractor shall identify any design or drawing changes required or desired to facilitate the manufacturing process. The recommended design changes should not significantly affect the design or performance of the Sensor, nor increase its cost. The TMT Project, in collaboration with TMT-India, shall incorporate the suggested design changes at its sole discretion.

8.2.1.8 Design changes may include, but are not limited to, the following:

1. Changes to improve manufacturability (DFM)
2. Changes to accommodate alternate manufacturing processes
3. Changes to incorporate tooling that will facilitate subsequent assembly operations.

8.2.1.9 Drawing changes may include, but are not limited to, the following:

1. Drawing changes to incorporate corrections, clarifications, or design changes as described above.
2. Drawing changes to include text in languages other than English. Drawings that contain text in a language other than English shall display the English translation in the same location on the drawing

8.2.1.10 TMT-India shall provide the Contractor any and all updated drawings.

8.2.2 MANUFACTURING, TEST AND QUALITY CONTROL PLANS

Contractor shall develop a “Sensor Manufacturing Plan” that:

- 8.2.2.1 Defines the Contractor’s manufacturing approach for the Production Sensors.
- 8.2.2.2 Defines the procedure that will be used to assemble the Production Sensors based on a Sensor Assembly Procedure provided by TMT – India.
- 8.2.2.3 Defines the procurement strategy that will be used for material and off-the-shelf components for the Production Sensors.
- 8.2.2.4 Defines the facilities and fixtures that will be required to assemble and test the Production Sensors.
- 8.2.2.5 Includes a capacity analysis demonstrating the ability to achieve the required production rates.
- 8.2.2.6 Describes plans for data management for the Production Sensors.
- 8.2.2.7 Describes plans for maintenance of assembly and test equipment.
- 8.2.2.8 Describes plans for re-working Production Sensors, assemblies, or piece-parts that don’t pass either final acceptance tests or quality control inspections.
- 8.2.2.9 Includes a detail schedule of the fabrication and procurement of Production Sensor material and manufactured items, Production Sensor assembly, Production Sensor test, and Production Sensor packing and shipping.
- 8.2.2.10 Contractor shall submit the Sensor Manufacturing Plan to TMT-India. Contractor must receive advance, written approval of the Sensor Manufacturing Plan from TMT-India before beginning manufacturing of the Production Sensors.
- 8.2.2.11 Contractor shall develop a “Sensor Test Plan” based on the “Draft Sensor Test Plan” provided by TMT - India. The Sensor Test Plan shall utilize automated test equipment provided by TMT - India. Contractor shall provide input to TMT - India on the design of the automated test equipment that will make testing more efficient and thorough. Contactor shall determine the number of automated test sets required to meet manufacturing schedules. TMT-India will loan the Contractor the required number of test stations

required for Sensor acceptance testing of continuity and isolation. The Contractor is responsible for providing any equipment necessary for validation of the sensor paddle and coating geometry and surface characteristics.. The Contractor must receive advance, written approval of the final Sensor Test Plan from TMT - India before beginning manufacture of the Production Sensors.

8.2.2.12 Contractor shall develop a “Sensor Quality Control Plan” that covers every phase of manufacturing. The Sensor Quality Control Plan shall contain, but is not limited to, the following:

1. Plans for inspection control of procured material and parts.
2. Plans for inspection and verification of manufactured parts.
3. Plans for calibration of assembly and test equipment
4. Identification of operations to be witnessed by a quality control representative
5. Plans for conducting in-process and final inspections, including pass/fail criteria
6. Plans for conducting intermittent in-process and final inspections by TMT-India quality control personnel.
7. Plans for appropriately selecting and testing fifty or more Sensors from the Production run to be used for extensive testing to near destruction.
8. All results of inspections and test reports associated with a particular MICS Sensor shall be contained in a single electronic file.

8.2.3 SENSOR RISK MANAGEMENT PLAN

The Contractor shall devise and implement a “Sensor Risk Management Plan” that identifies the risk areas that could threaten the delivery schedule of the Production Sensors. Contractor shall conduct an ongoing risk management program that mitigates these risks and actively reduces TMT - India vulnerability to the risks. Risk areas that should be addressed include at a minimum:

8.2.3.1 Supply chain problems or delays

8.2.3.2 Assembly and testing ramp-up (equipment and labor)

8.2.3.3 Prevention, survival, and recovery from events such as facility fires or natural disasters.

8.2.4 SENSOR MANUFACTURING PLAN REVIEW

Contractor shall present a summary of the Sensor Manufacturing, Test, Quality Control and Risk Management Plans, and a summary of any changes made as part of [item 8.2.1](#) at a Sensor Manufacturing Plan Review meeting. The meeting will be face-to-face and held, at TMT-India's discretion, either the Contractor's facility or an alternative location selected by TMT-India.

8.2.5 ASSEMBLY FACILITY PREPARATION

Contractor shall prepare a facility to conduct procurement, manufacture, assembly, inspection, and test operations detailed in the Sensor Manufacturing, Test, and Quality Assurance Plans. Contractor activities during the planning phase include, but are not limited to, the following:

8.2.5.1 Preparing the facility

8.2.5.2 Installing and verifying all manufacturing equipment

8.2.5.3 Recruiting and training personnel

8.2.5.4 Implementing all provisions of the Sensor Manufacturing, Test, and Quality Assurance Plans

8.3 SERVICES: BUILD AND TEST OF PRE-PRODUCTION SENSORS

Contractor shall build and test a total of one-hundred (100) Pre-Production Sensors using the Sensor Manufacturing, Test, and Quality Assurance Plans and the facilities as described in [items 8.2.2, 8.2.3, and 8.2.5](#). Contractor shall procure the minimum amount of material and quantity of off-the shelf parts necessary to support the production of five hundred (500) Production Sensors. Contractor shall fabricate the minimum number of custom parts necessary to support the production of one hundred (100) Production Sensors. A larger quantity of material and off-the-shelf and custom parts may be procured with advance; written approval from TMT-India if doing so would reduce overall production costs or schedule duration.

Contractor shall pack and ship the one hundred (100) Pre-Production Sensors to TMT-India after the completion of the Production Readiness Review meeting.

8.4 PRODUCTION READINESS REVIEW MEETING

Contractor shall present a summary of the Quality Control and Test results from the fabrication run of one hundred (100) Pre- Production Sensors at a Production Readiness Review meeting. Contractor shall propose any improvements in the design of the Production Sensors or the Sensor Manufacturing, Test, and Quality Assurance Plans that are required or desired to facilitate the manufacturing process. Contractor shall implement proposed changes only with advance, written TMT – India approval.

8.5 SERVICES: BUILD, TEST, AND DELIVERY OF PRODUCTION SENSORS AND DATA

Contractor shall build and test an additional thirty two hundred and thirty four (3234) Production Sensors per the Sensor Manufacturing and Quality Control Plans. Contractor shall procure the minimum quantity of material and off-the-shelf parts to support the build of the Production Sensors and the delivery of the required spare parts. Contractor shall fabricate the minimum quantity of custom parts to support the build of the Production Sensors.

Contractor shall appropriately select fifty (50) or more Sensors during Production for extensive testing. A total of thirty two hundred and eighty four (3284) working Sensors (Pre-Production and Production) shall be delivered to the TMT Project. Sensors that are extensively tested shall not count towards the 3284 working Sensors.

The Contractor shall supply all material, procured and/or fabricated parts and tooling required for Sensor assembly. TMT-India will loan the Contractor the required number of test stations required for Sensor acceptance testing of continuity and isolation. The Contractor is responsible for providing any equipment necessary for validation of sensor paddle and coating geometry and surface characteristics. Contractor shall deliver all Sensor Quality Control and Test reports to TMT-India within 10 days of completion of the Contractor's final test on that Production Sensor. The Contractor shall pack and ship the Production Sensors and spare parts to TMT-India after TMT-India review and approval of all Quality Control and Test reports.

8.6 SERVICES: ASSEMBLY AND TEST HARDWARE DELIVERY

Contractor shall compile a "Sensor Equipment Inventory," listing all hardware and software required to assemble and test the Production Sensors. The Sensor Equipment Inventory shall include, but is not limited to, the following:

- 8.6.1 Commercial off-the-shelf tools and equipment procured and used to assemble and test the Production Sensors.
- 8.6.2 Custom made tools, fixtures, instruments or equipment used to assemble and/or test the Production Sensors
- 8.6.3 Contractor shall pack and ship all Sensor Equipment to TMT-India.

8.7 MEETINGS

Contractor shall hold bi-weekly (every two weeks) status meetings with TMT-India where Contractor shall present and discuss technical, schedule, and program status of the Sensor build effort with TMT-India. The bi-weekly status meetings can be a videoconference or similar

mode of communication. The bi-weekly status meetings may be held at the Contractor's facility at TMT-India's sole discretion. Contractor shall provide a proposed agenda and any meeting material 2 days prior to the bi-weekly status meetings. TMT-India can add items to the agenda at its sole discretion. Contractor shall submit a Meeting Summary Report, including a list of any open Action Items, to TMT-India after each meeting.

TMT-India may elect to locate one or more representatives of TMT-India at the Contractor's facility during any stage of the work. Contractor shall provide the TMT- India representative(s) with access to English-language translators, a work area, telephone, fax, and the internet while they are at the Contractor's facility.

8.8 REPORTS AND DATA ARCHIVING

Contractor shall prepare written plans and reports as listed throughout this SOW. All of the prepared documents and any other relevant information/data shall be archived electronically and transmitted electronically to TMT-India. All reports shall be in English.

8.9 DELIVERABLES

The Contractor shall deliver the following.

- 8.9.1 Production Sensor Fabrication drawings
- 8.9.2 Production Sensor Manufacturing, Test, and Quality Control Plans
- 8.9.3 Production Sensor Risk Management Plan
- 8.9.4 Material for the Sensor Manufacturing Plan Review
- 8.9.5 Material for the Production Readiness Review
- 8.9.6 A total of Thirty Two Hundred and Eighty Four (3284) working Pre -Production and Production Sensors.
- 8.9.7 Fifty or more Sensors that have been extensively tested.
- 8.9.8 Assembly and test hardware
- 8.9.9 Inspection and Test Reports for each Pre-Production and Production Sensors

8.10 SCHEDULE

Contractor shall adhere to the following schedule. All dates are from the Effective Date of the Contract.

Item	Description	Completion from Effective Date of Contract
1	Updated Production Sensor Drawings: item 8.2.1	Week 8
2	Sensor Manufacturing, Test, and Quality Control Plans: item 8.2.2	Week 8
3	Production Sensor Manufacturing Plan Review: item 8.2.4	Week 12
4	Complete build of Pre-Production Sensors: item 8.3	Week 26
5	Production Readiness Review: item 8.4	Week 28
6	Completion of Production Sensors: item 8.5	Week 80
7	Sensor Quality Control and Test Reports: item 8.9.9	Through week 82
8	Pack and Ship Production Sensors: item 8.5	Week 84
9	Pack and Ship Assembly and Test Hardware: item 8.6	Week 86

Table 2

8.11 REFERENCES

Reference 1: [P2 Edge Sensors Drawings and Assembly](#)

Reference 2: [Edge Sensor Design Requirements](#)

Reference 3: [P2 Edge Sensor Overview with Drawings](#)

Reference 4: [Prototype Sensor Test Procedure](#)

II. SECTION B

METHODOLOGY OF SUBMISSION AND QUALIFICATION

9 EXPRESSION OF INTEREST (EOI)-PART 1

- 9.1 Sealed EOI shall be submitted in the format specified in the Appendix, enclosing documents listed below and any other documents that would help in the evaluation of the EOI.
- a) The profile of the company
 - b) The management structure and brief bio-data of top most technical personnel
 - c) Technical staff strength in all categories
 - d) Manufacturing plants and equipment of the company
 - e) Financial position of the contractor
 - f) Audited balance sheets for the last three years
 - g) Solvency certificates (not older than 12 months) issued by scheduled/nationalized bank with which the Contractor holds the current account
 - h) Copy of Registration, LST/CST/WCT No., PAN No., and TIN No. allotted by concerned authorities
 - i) Details of past experience of the company in executing precision work, including projects related to astronomical or other sciences if any (including photographs)
 - j) Appreciation/Reward letters from clients
- 9.2 The EOI should be printed on company stationery and the authorized person who signs the offer is required to indicate his/her e-mail ID, mobile no. and also general e-mail ID for easy and fast communication.
- 9.3 The envelopes for EOI shall bear the following: “Prototyping of the Primary Mirror Control System Sensors for the Thirty Meter Telescope Project; Expression of Interest”, name and address of the contractor. It shall be addressed to:

**THE DIRECTOR,
INDIAN INSTITUTE OF ASTROPHYSICS (IIA),
SARJAPUR ROAD, KORAMANGALA,
BANGALORE – 560 034
KARNATAKA**

10 SUBMISSION OF TECHNICAL AND PRICE BIDS – PART 2: GENERAL TERMS

- 10.1 The Contractor shall prepare original and two copies of the Bid, clearly marking each as

"Original Bid" and "Copy of Bid," as appropriate. In the event of any discrepancy between them, the Original shall govern.

- 10.2 Both the Original and Copies of the Bid shall be signed by the Contractor or a person or persons duly authorized by the Contractor. The latter's authorization shall be indicated by written Power of Attorney accompanying the Bid.
- 10.3 The bid must be submitted in an organized and structured manner. No brochures/leaflets etc. should be submitted in loose form. Please indicate page nos. on your quotations. For e.g., if the quotation is containing 25 pages, please indicate as 1/25, 2/25, 3/25,.... 25/25.
- 10.4 The contents must be clearly typed without any cancellation/corrections or overwriting. Each page of the bid and cutting/corrections (if any) shall be duly signed and stamped by the Contractor. Failure to comply with this requirement may result in the bid being rejected.
- 10.5 All pages of the Bid (except for un-amended printed literature) shall be initialed by the person or persons signing the Bid. The Contractor's name stated on the proposal shall be the exact legal name of the firm.
- 10.6 The Technical and Price Bids shall be sealed in separate envelopes. The envelopes shall bear the following: "Prototyping of the Edge Sensor for the Thirty Meter Telescope Project", and "Technical Bid" or "Price Bid" as appropriate.
- 10.7 Both the envelopes shall bear the name and address of the contractor.
- 10.8 The two sealed envelopes shall be enclosed in a third sealed envelope. The envelopes shall bear the following: "Prototyping of the Edge Sensor for the Thirty Meter Telescope Project: Technical and Commercial Bids", bear the name and address of the contractor, and shall be addressed to:

THE DIRECTOR,
INDIAN INSTITUTE OF ASTROPHYSICS (IIA),
SARJAPUR ROAD, KORAMANGALA,
BANGALORE – 560 034
KARNATAKA

If the envelopes are not sealed and marked as required, IIA will not take any responsibility for misplacement or loss Bid's or premature opening whatsoever the reason may be.

- 10.9 The Contractor has the option of sending the Bid by registered post or submitting the Bid in person so as to reach IIA by the date and time indicated. IIA will not be responsible for late, delayed Bids and loss of Bids in transit whatsoever the reason may be.
- 10.10 IIA, on behalf of TMT-India, reserves the right to accept/reject any or all bids without assigning any reasons.
- 10.11 Any other condition or guideline for submission of the bids shall be notified by IIA if it finds necessary.
- 10.12 IIA, on behalf of TMT-India, may, at its discretion, extend the deadline for the submission of Bids by amending the Bidding Documents, in which case all rights and obligations of IIA and Contractor previously subject to the deadline will thereafter be subject to the deadline as extended.
- 10.13 At any time prior to the deadline for submission of Bids, IIA, on behalf of TMT-India, may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective Contractor, notify changes in the Bidding documents through an amendment.
- 10.14 In order to allow reasonable time for the prospective Contractors for taking the amendment into account in preparation of their Bids, IIA, on behalf of TMT India, may, at its discretion, extend the deadline for the submission of the Bids.
- 10.15 The amendments, if any, shall be notified in writing at IIA's website and the amendments shall be binding on all the Contractors. Hence the Contractors shall view the notification in complete before submitting their Bids.
- 10.16 The Contractor responding to announcement shall be deemed to have read and understood the documents in complete. Where counter terms and conditions have been offered by the Contractor, the same shall not be deemed to have been accepted by IIA, unless a specific written acceptance thereof is obtained.
- 10.17 Any effort by a Contractor to influence IIA in the Bid Evaluation, Bid Comparison or Contract Award decisions may result in the rejection of its Bid.
- 10.18 Any clarifications pertaining to this document may be obtained from IIA by the Contractors by writing at the following address at least fifteen days prior to the due date for submission of bids.

THE DIRECTOR

INDIAN INSTITUTE OF ASTROPHYSICS

BANGALORE 560034, KARNATAKA

Contact for Technical Queries: Mr. P.K. Mahesh (pkmahesh@iiap.res.in)

Dr. PadmakarParihar (psp@iiap.res.in)

Contact for Commercial Queries: Shri Y.K. Raja Iyengar (ykri@iiap.res.in)

11 TECHNICAL BID - PART2A: DETAILS

11.1 A compliance sheet clearly indicating any deviation with reference to the terms and specifications shall be included. Limitations and assumptions, if any, should be clearly mentioned. Scope description may explicitly state anything which is not covered.

11.2 The Technical Bid shall include but not limited to the following items:

- a) Description of the proposed technological approach to be followed for making the product
- b) Strategy to be followed for the execution of the project including tools and technologies to be used
- c) Project execution and management details, including details of the project team, escalation paths etc
- d) Details of the resources, infrastructure or data expected to be provided by IIA, on behalf of TMT-India, to the successful Contractor for undertaking the project
- e) Risk identification and mitigation plans
- f) Quality audit, control and assurance plans
- g) Change control process
- h) Detailed time schedule for the project
- i) Commercial terms and conditions
- j) Acceptance criteria and test plans in the factory and on-site
- k) A copy of the Price Bid without indicating the quoted Price
- l) Earnest money deposit for only prototyping of Rs.3,00,000/- (Rupees Three Lakhs only) by way of Demand Draft drawn on a Nationalized Bank only in favour of Director, Indian Institute of Astrophysics.

12 PRICE BID – PART 2B: DETAILS

12.1 The Price Bids shall include the following:

- a) An item wise break-up of the cost in Indian Rupees, clearly indicating any free-issue material, imports etc.
- b) Applicable taxes, duties or other statutory payments
- c) Any other cost such as for tooling, packaging, travel etc.
- d) Total cost along with proposed payment stages, schedule and percentage to be paid at each stage.

12.2 The offer should be complete to indicate that all products and services asked for are quoted.

12.3 Price Bids shall be valid for a period of 90 days from the date of opening of bids. IIA, on behalf of TMT-India, may ask for the Contractor's consent to extend the period of validity. Such request and the response shall be made in writing only. A Contractor agreeing to the request of IIA for extension of the bid will not be permitted to modify the bid.

13 ELIGIBILITY CRITERIA AND QUALIFICATION PROCESS

13.1 First only the EOI envelopes shall be opened on the date specified by IIA. Contractors or their authorized agents can be present at their own interest when the EOI are being opened.

13.2 The EOI will be evaluated by an Expert Committee. Mere submission of EOI will not entitle a Contractor to get selected to the tendering stage. The criteria for qualifying for the tender evaluation stage shall include, but are not limited to the following :

- a) The Contractor should be registered in India for the last 10 years.
- b) The Contractor should have a minimum average annual turnover of Rs. 30 crores during the last five years and should be of sound financial status (supporting documents must be included).
- c) The Contractor should have executed at least two projects involving similar precision fabrication costing above Rs. 5 crores in the past three years (supporting documents must be included).
- d) The Contractor must have the necessary infrastructure, in-house facilities and experience for design, manufacture, integration, testing and packaging the product.
- e) The Contractor must have well defined quality policy and assurance program.
- f) The Contractor should have a well defined plan for the manufacturing the product and organizational structure for project planning, monitoring, schedule tracking, corrective measures etc.
- g) Prior experience working with Government, Semi Government, Government Undertaking and Government Autonomous Bodies will be an added advantage (supporting documents must be included).
- h) EOI submitted by the Contractor shall be complete in all respects and shall include all details asked for in item 9.1 of Section B.

13.3 The parties shortlisted through the evaluation of the Expression of Interest will be intimated and invited for a meeting to sign a Non-disclosure Agreement and receive additional documents.

13.4 Technical Bids from only those parties who have responded to this EOI notice and short-listed by the Expert Committee will be qualified for the tendering process.

- 13.5 IIA may organize a pre-bid meeting, approximately two weeks prior to the last date of submission of the bids. All the parties who have been shortlisted during the EOI stage, may attend the meeting and obtain clarifications regarding the technical and commercial terms and conditions.
- 13.6 Technical Bid shall be opened on the date specified by IIA. Contractors or their authorized agents may be present at their own interest when the Bids are being opened.
- 13.7 The Technical Bids shall be evaluated by an Expert Committee and the shortlisted Contractors may have to make presentations on their detailed proposals to the Committee. The following points should be covered in the presentation.
- a) Contractor's over all profile.
 - b) Contractor's strengths in dealing with the specific requirements in hand.
 - c) Contractor's experience in manufacturing products of similar nature and specification. List of projects executed to be presented and few will be discussed in detail.
 - d) Contractor will discuss few challenging cases where it made specific efforts to manufacture the product using non-conventional and innovative fabrication techniques and approach for schedule and cost control.
 - e) Contractor's understanding about over all scope of work and responsibility for this project. Please identify all activities involved in this job and discuss them in detail.
 - f) Critical areas identified by the Contractor having serious impact on delivery schedule and cost of the product. Contractor's proposed solutions for these problems.
 - g) Any special packing and shipment requirements for product foreseen by the Contractor.
 - h) Contractor will justify his manufacturing and financial capabilities to manufacture and deliver the product in given cost and time schedule.
 - i) Codes and standards regularly followed by the Contractor, especially international ones.
 - j) Details of Contractor's Quality Policy and Program, organizational set-up for Quality Surveillance and Quality Assurance, Quality Audit program, non-conformity control and reporting and testing and inspection facilities.
 - k) If some manufacturing, testing and inspection facilities are not available with the Contractor, it should mention about their access to such required facilities at other places.
 - l) Project planning and Execution methodology followed by the Contractor, with specific emphasis on schedule and cost control.
 - m) Contractor's views if any, on the need to form a consortium to meet quality, cost and time schedule.
 - n) Last five years track record of the Contractor in terms of projected and actual delivery schedule and cost for projects above Rs. 5 crores.
 - o) Commitments and loading of the Contractor in terms of projects costing 10% or more of annual turnover.
 - p) Commitment from Contractor's highest authority for complete and credible involvement of the Contractor till completion of the deliveries.
- 13.8 To assist in the evaluation of Bids, IIA, on behalf of TMT-India, may, at its discretion, ask the Contractor for a clarification of its Bid. IIA may call for meetings with Contractors to seek

clarification at appropriate times in its premises in Bangalore. The Contractors shall attend the meeting at their own cost. The request for clarification and the response shall be in writing.

- 13.9 Following the evaluation of Technical Bids, the Price Bids of qualified Contractors shall be opened to choose the Contractor to execute the Project.
- 13.10 The evaluation committee may hold techno-commercial discussion with short listed and selected the contractor or contractors or consortium to manufacture and deliver the product as per drawings, technical specifications and delivery schedule given in the tender document. The order(s) may be placed with one contractor or more than one contractors or a consortium.
- 13.11 During the assessment of the bids, specific weightage will be given to the contractors for innovative suggestions on fabrication feasibility, cost optimization and schedule control. Selection of the successful contractor will be mainly based on procurement optimization from an integrated point of view, involving optimization of manufacturing, shipping, assembly, schedule and cost. Prior experience with similar projects, commitment and risk evaluation will also play an important role in the selection process.

III. SECTION C

14 TERMS AND CONDITIONS

The successful Contractor who is awarded the Contract as the Contractor shall be subjected to the Terms and Conditions that include, but not limited to the following. A detailed Contract Agreement (MOU) will be drawn and signed by both the parties before the award of the contract.

14.1 SUBCONTRACTS

- a. The Contractor is an independent contractor.
- b. The Contractor shall provide as an independent contractor, and not an agent of IIA, all necessary personnel, materials, equipment and facilities to perform the Work.
- c. The Contractor shall not assign its rights or obligations to a third party without the prior written approval of IIA.
- d. Notwithstanding any subcontract under this Agreement, whether approved by IIA or not, the Contractor shall remain fully liable and responsible to IIA for the satisfactory and timely completion of the Work.

14.2 PAYMENT

- a. Payment shall be made by IIA Bangalore on behalf of TMT India.
- b. IIA shall pay the Contractor the Price in accordance with a Milestone Schedule.
- c. Upon completion of each Milestone, the Contractor shall submit to IIA an Invoice for the amount corresponding to that Milestone in Schedule.
- d. The Contractor shall submit reasonable documentary evidence, including but not limited to photographs and illustrations, as verification of completion of each Milestone. IIA, on behalf of TMT-India, may at its own discretion verify and substantiate that the Milestone has indeed been performed or completed as invoiced by the Contractor. Such verification may require Contractor to submit to IIA, additional documentation with regard to quality control normally expected during process of manufacture, and/or inspection by IIA representatives. Any

request for substantiation under this clause shall be made by IIA within fourteen (14) days of its receipt of the corresponding Invoice.

14.3 VESTING OF TITLE AND ASSUMPTION OF RISK

- a. On each item to be delivered by the Contractor, including an item of work in progress, in respect of which payments have been made in accordance with item 14.2 of Sec B above, IIA shall have a security interest in such items which shall be deemed to be released only at the time when the applicable Deliverable Item is finally delivered to and accepted by IIA, on behalf of TMT-India.
- b. Risk for loss or damage to Deliverable Items provided by the Contractor shall rest with the Contractor, until final acceptance by IIA, on behalf of TMT India.
- c. Title to all Deliverable Items provided by the Contractor shall pass from the Contractor to IIA upon final acceptance or the final payment under item 14.2 of Sec B above, whichever last occurs.
- d. TMT-India shall not accept any liability for the Contractor and its subcontractors, their subsidiaries and/or their officers, employees or agents, servants, and assignees, or any of them or for their property. The Contractor shall indemnify and keep harmless TMT-India, its officers, employees consultants, servants, agents and assignees, or any of them, against any loss or liability, costs or claims, action or proceedings which they or any of them may incur by reasons of damage to property or injury, including death, caused to the employees of the Contractor, its subsidiaries and/or their officers, employees or agents, servants and assignees, or any of them in connection with the performance of Work under this Agreement, and caused by an act of commission or omission by the Contractor, its subsidiaries and/or their officers, employees or agents, servants and assignees, or all or any of them.

14.4 INTELLECTUAL PROPERTY RIGHTS

- a. All Intellectual Property Rights existing in a party prior to the Contract (“**Existing Intellectual Property Rights**”) shall remain with that party. Except to the extent necessary to complete the Work or expressly stated otherwise, neither party grants any rights in its Existing Intellectual Property Rights to the other party.
- b. All Intellectual Property Rights arising directly from the Work (“**Work Intellectual Property Rights**”) shall, upon completion of the Work, vest in TMT India and TMT project.

14.5 CONFIDENTIAL INFORMATION

- a. The Receiving Party shall protect the Confidential Information and keep it secure, and shall not at any time (except with the prior written consent of the Disclosing Party):
- b. directly or indirectly disclose or distribute the Confidential Information to any person other than a representative, employee, agent or advisor of the Receiving Party; or
- c. directly or indirectly disclose or distribute the Confidential Information to a representative, employee, agent or advisor of the Receiving Party except where such disclosure is necessary for the purpose of the Work; or
- d. use or copy the Confidential Information except for the purpose of the Work.
- e. Where the Receiving Party discloses Confidential Information to a representative, employee, agent or advisor, the Receiving Party shall ensure that such person is aware of the confidential nature of that Confidential Information and is bound by suitable obligations of confidentiality to ensure that that person protects and keeps secure that Confidential Information and does not use the Confidential Information for any reason other than the purpose of the Work.
- f. The Receiving Party shall, on demand by the Disclosing Party, or where the purpose of this Agreement has been served, promptly return to the Disclosing Party all Confidential Information (including copies or reproductions of the same) which is reasonably capable of being returned which is in the possession or control of the Receiving Party.
- g. This Agreement is not intended to restrict the use or disclosure of Confidential Information by the Receiving Party to the extent that it is required to be disclosed by law provided that the Receiving Party has taken such steps as are available under law (but not the institution of legal action) to protect such Confidential Information and notifies the Disclosing Party hereunder of its obligation to make such disclosure prior to the time such disclosure is made.
- h. The provisions of this item 14. 5 are subject to the provisions of item 14.4.

14.6 SETTLEMENT OF DISPUTES

- a. All disputes arising in connection with the interpretation or implementation of the Contract shall be amicably settled by IIA, on behalf of TMT-India, and the Contractor, by direct discussion.
- b. If IIA and the Contractor are unable to resolve a Dispute within 30 working days of the

Dispute being referred to them, the parties may agree to refer the Dispute to mediation.

- c. IIA and the Contractor appoint a Mediation Committee comprising of two nominees by IIA and two nominees by the Contractor. IIA and the Contractor will seek the opinion of this Mediation Committee to amicably settle the disputes.
- d. In the event of a dispute or difference which cannot be resolved by mediation, the same shall be referred to an Arbitration Tribunal consisting of three members. Either party shall give notice to the other regarding its decision to refer the matter to arbitration. Within 30 days of such notice, one Arbitrator shall be nominated by each Party and the third Arbitrator shall be nominated by agreement between the Parties to this Agreement. The venue of the arbitration will be Bangalore. Subject to the aforesaid, the Indian Arbitration and Conciliation Act, 1996 and the rules there under and any statutory modification thereof for the time being in force shall be deemed to apply to the Arbitration proceedings.

14.7 FORCE MAJEURE

- a. Neither party shall be held responsible for any losses, if the fulfillment of any terms and conditions of this Contract are delayed or prevented by acts of lawful Government, revolutions and other disorders, wars (declared or undeclared), acts of enemies, strikes, fires, floods, acts of God and, without limiting the foregoing, any other cause not within the control of the party whose performance is interfered with and which, by the exercise of reasonable diligence, he is unable to prevent.
- b. Each party will promptly notify the other in writing when a condition of Force Majeure described in item 14.7 (a) arises. Neither party will be liable for any failure to perform its obligations hereunder if prevented from doing so by reason of Force Majeure, provided that it will have used all reasonable endeavours to perform its obligations notwithstanding such situation or event.
- c. As soon as practicable after the lodging of such notice the Contractor and IIA shall jointly determine whether the situation constitutes Force Majeure and if so the appropriate measures to meet the situation. Either party shall not be liable for any penalty or damage resulting in delays to perform its obligations as a consequence of Force Majeure.

14.8 TERMINATION

- a. IIA, on behalf of TMT-India, may terminate the Work with sixty (60) days prior written notice any time without assigning any reason or cause by notifying the Contractor in writing. In the event that the Work is so terminated by IIA then IIA shall pay the Contractor total amount of the costs and liabilities incurred by the Contractor up to the date of termination.

- b. IIA may at any time terminate the Contract by giving written notice with immediate effect in any of the following cases.
- c. If the Contractor is adjudged insolvent or if its financial position is such that within the framework of its national law, legal action leading towards bankruptcy is taken against it by its creditors or its Government, or
- d. If it is determined through appropriate proceedings that the Contractor has resorted to fraudulent or corrupt practices in connection with its securing or implementation of this Agreement.

14.9 PACKAGING, TRANSPORTATION AND INSURANCE

- a. The packing of the product for shipment shall be appropriate depending upon the nature of transportation and handling hazards. The stores shall be packed securely to avoid any damage to the consignment in transit, loading, unloading and storage. The package shall contain a Packing Note quoting Contract number and date, Copy of Shipping Release and one set of test certificates. The Package shall be marked with name and address of the Contractor, lifting points and special handling instructions, if any.
- b. The Contractor is responsible for its delivery to TMT-India or TMT, USA or any other place designated by TMT-India, including transportation charges and transit insurance.

14.10 ACCEPTANCE PROCEDURE: Please refer to item 7.5 of Section A.

14.11 PATENTS, COPYRIGHTS AND OTHER PROPRIETARY RIGHTS

- a. The Contractor warrants that any Deliverable Item provided to IIA on behalf of TMT India shall to the best of its knowledge and belief be free of any rightful claim of any third party for infringement of patent, copyright, or other proprietary right.

14.12 ACCESS TO WORK

- a. Work in progress and data and documentation related to the Work, including design and test data necessary to understand the ability of the Work to meet the specifications are subject to examination, evaluation, and inspection by IIA, on behalf of TMT-India, at reasonable times and with reasonable notice to the Contractor.
- b. The Contractor shall provide IIA, access to such documentation and to those of its premises where Work on or in connection with the subject of this contract is being performed during normal business hours and subject to prior arrangement.

- c. IIA may depute engineers/scientists of its choice from time to time who will be allowed by the Contractor to participate in the Work in respect of the disciplines in which they are specialized.

14.13 WARRANTY

- a. The Contractor warrants that all Deliverable Items shall be free and clear of all liens and encumbrances pertaining to title at the time of delivery to TMT India or TMT USA. The Contractor's liability and IIA's sole remedy under this Warranty shall be limited to the Contractor procuring the removal of any such lien or encumbrance or the replacement of the goods and parts thereof that has been identified as defective of title. The Contractor will provide a one year warranty from date of acceptance of the Deliverables by IIA.

And the Contractor warrants that:

- b. all Deliverable Items that are procured or furnished by the Contractor or its subcontractors or suppliers shall be new and shall conform in grade and quality to all the requirements of the Contract; where the grade or quality is not specifically defined therein, they shall be of a grade or quality suitable for their intended use;
- c. all workmanship employed in the manufacture of Deliverable Items shall be of good quality, free from faults and defects, and shall conform to the relevant specifications applicable to the said manufacture; and
- d. all Deliverable Items shall be free from defects arising out of the use of defective equipment or materials that would result in a total or partial failure of any Deliverable Item or which would render a Deliverable Item unsafe for its intended use.

14.14 DELIVERABLE DOCUMENTATION AND STANDARDS

The Deliverable Documentation shall include the Design reports, Concept drawings, Final drawings, Manufacture drawings of all components, and Manuals (user handbooks). All documentation shall be in the English Language.

14.15 PROGRESS REPORTS

The Contractor shall provide IIA with detailed reports on progress of the Work and notify any deviations on the schedule, at least monthly highlights and bi-monthly detailed reports on the progress of the Work, up to the Delivery Date.

14.16 PERFORMANCE GUARANTEE

IIA shall withhold 5% part of each Milestone Payment towards Performance Guarantee and pay the total sum on completion of 6 months since delivery, subject to the Deliverable Items meeting the Final Acceptance Tests.

14.17 GOVERNING LAW

This Agreement shall be governed by, and construed in accordance with, the law for the time being in force in India.

IV. APPENDIX

APPENDIX A: FORMAT FOR SUBMISSION OF “EXPRESSION OF INTEREST”

IIA RFP No (to be Inserted)

Bidder’s Offer No. -----

Dated -----

FROM

M/s -----

To

The Director,

Indian Institute of Astrophysics (IIA),

Sarjapur Road, Koramangala,

Bangalore, Karnataka – 560 034,

India

Dear Sir,

We have gone through the conditions pertaining to the Announcement of Opportunity and by accepting the same, we are submitting herewith our Expression of Interest.

We hereby agree to supply the Stores conforming to the specifications incorporated in Section – A.

Yours faithfully,

Stamp and Signature of the Contractor

APPENDIX B: ABBREVIATIONS

DFM	Design for Manufacturing
EOI	Expression of Interest
GDT	Geometric Dimensioning and Tolerancing
IIA	Indian Institute of Astrophysics
M1CS	Primary Mirror Control System
MOU	Memorandum of Understanding
NDA	Non-Disclosure Agreement
RFP	Request for Proposal
SOW	Statement of Work
TMT	Thirty Meter Telescope