

# Tender Details For Turn-Key Supply Of A Solar Optical Telescope Starting With Design, Manufacture And Eventual Installation At Site.

## 1. SCOPE OF ACTIVITY

- a. Design Validation (Vendor to provide evidence of feasibility of matching with user requirements)
- b. Manufacture
- c. Testing at Factory
- d. Installation & testing at site
- e. AMC for 5 years including spare parts

## 2. MAJOR MILESTONES OF THE PROJECT

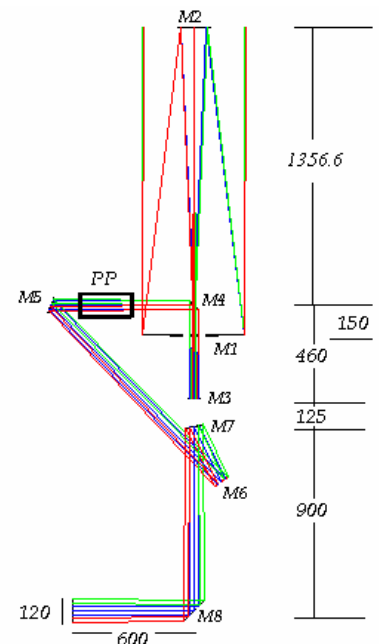
- a. Selection of vendor
- b. Procurement Plan including list of deliverables, site requirements, interface documents, site handling tools and fixtures
- c. Signing of contract
- d. Preliminary Design Review
- e. Critical Design Review
- f. Acceptance tests at factory
- g. Site preparation (by PRL) and inspection (by vendor)
- h. Installation and testing at site
- i. Commissioning
- j. Training
- k. Acceptance

## 3. TECHNICAL SPECIFICATIONS

The aim of the telescope is to deflect 6 arc-min portion of the sun into a stationary collimated horizontal beam of about 10 cm diameter. The nominal optical layout is as given in the accompanying figure.

### 3.1 System Specifications:

- a. Input beam size: 50 cm dia (clear aperture)
- b. Output beam size: 10 to 12 cm dia corresponding to 6 arcmin FOV
- c. Output wave-front error @632.8 nm:  $\lambda/12$  rms on axis,  $\lambda/10$  rms over FOV,  $\lambda/4$  ptv
- d. Output beam Stray light irradiance (after baffling, etc): not more than 0.2 % of solar flux (allowance for twice sky brightness)
- e. Stationarity of FOV in output beam: max movement less than 0.01 arc-sec per minute maintained by image rotator to be located anywhere after M4



- f. Vibration of output beam (seeing excluded): less than 1 arc-sec rms in 0 Hz to 1 Hz bandwidth; < 0.5 arc-sec rms in 1Hz to 10 Hz bandwidth; < .05 arc-sec rms for freq > 10 Hz
- g. System length (M2 to M3): less than 2.0 m
- h. System height (elevation axis to output beam): less than 2 m
- i. Total transmission : more than 50% in wavelength range 400 nm to 900 nm

### 3.2 Subsystems:

#### 3.2.1 Intermediate collimated horizontal output beam after M4:

- a. size: not more than 5 cm dia
- b. wave-front accuracy @632.8 nm:  $\lambda/12$  rms on axis,  $\lambda/10$  rms over FOV,  $\lambda/4$  ptv
- c. Mueller matrix of M4 (in the range of 400- 900 nm) with reference to plane of reflection:

$$\begin{bmatrix} 0.95_{-0.01}^{+0.05} & 0.03_{-0.03}^{+0.01} & 0 & 0 \\ 0.03_{-0.03}^{+0.01} & 0.95_{-0.01}^{+0.05} & 0 & 0 \\ 0 & 0 & -0.93_{-0.07}^{+0.01} & -0.17_{-0.01}^{+0.01} \\ 0 & 0 & 0.17_{-0.01}^{+0.01} & -0.93_{-0.07}^{+0.01} \end{bmatrix}$$

- d. Stray light irradiance (after baffling, etc): not more than 0.2 % of solar flux (allowance for twice the sky brightness)
- e. Space to be provided (15 cm length, 10 cm diameter) for polarimeter package PP co-axial within 10 arc-min tilt with and 10 micron decentre from elevation axis

#### 3.2.2 Optical Components:

- a. Mirror M1 of ULE
- b. All other mirrors of SiC
- c. All mirrors with surface accuracy of  $\lambda/50$  rms,  $\lambda/4$  ptv (@632.8 nm), not more than 2 nm rms microroughness
- d. All mirror coatings with reflectivity 95% or better in 400 nm to 900 nm range, not more than 2 nm microroughness
- e. All mirror coatings to absorb less than 10% of incident solar flux.
- f. M1 front surface to be maintained at temperature of 1<sup>0</sup> C within ambient
- g. M1 must have airflow of 1 m/s to 1.5 m/s across front surface
- h. All other mirrors must be maintained at temperatures within 0.5<sup>0</sup> C of ambient

#### 3.2.3 Mechanical Assembly:

- a. Mechanical system to hold together the optics and move the telescope in altitude over azimuth configuration
- b. Azimuth limits: 85<sup>0</sup> to 275<sup>0</sup> reckoned from the North in the sense NESW.
- c. Altitude limits: 5<sup>0</sup> to 88.5<sup>0</sup> (zone of avoidance is 3<sup>0</sup> at zenith)
- d. All mechanical members must be maintained within 1<sup>0</sup> C of ambient

#### 3.2.4 Drive System

- a. Pointing Accuracy: < 10 arc-sec
- b. Differential pointing accuracy: < 0.5 arc-sec

- c. Open loop tracking (tracking using calculated positional reference): better than 0.25 arc-sec rms over 10 minute period and better than 0.05 arc-sec for 1 sec period under all operating conditions
- d. Closed loop (guided tracking using sun as reference): better than 0.1 arc-sec for 1 hour period under all operating conditions.
- e. Tip-tilt secondary mechanism or active optics system for maintaining the specified quality of output beam under all operating conditions

**3.2.5. Environmental Parameters and Operating Conditions:**

- a. Telescope operation between 10 to 50 degrees temperature, 0 to 90% humidity and upto 30 km/hr wind speed
- b. Telescope to be operated with Uninterrupted Power Supply (backup of 30 minutes), 220±20V, 50±2 Hz.
- c. Telescope to be located at USO island site, preferably on existing pier, subject to suitability of pier's mechanical parameters.
- d. Telescope to be operated with vendor supplied telescope control system.

**4. Following details of the vendor must be supplied along with bid:**

- a. Heritage of vendor
- b. Approach to be taken including availability of manpower and expertise
- c. Analysis of performance requirements and commitment to specifications with sufficient details for assessment of vendor's capability for meeting the requirements.

**5. User Requirements Document available at**

<http://www.prl.res.in/~uso/project/mast.html>