

Joint Dark Energy Mission (JDEM)

Project

Code 448

**Telescope Concept Study
Statement of Work (SOW)**

JDEM-TELE-LEGL-0008

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**National Aeronautics and
Space Administration**

**Goddard Space Flight Center
Greenbelt, Maryland**

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1.0 Introduction

This Statement of Work specifies what is to be performed by the contractor in support of the JDEM Telescope Study. This study activity is intended to determine feasible telescope concepts for the preliminary JDEM science requirements and assess the critical thermal, optical, mechanical and dynamic environments that drive the JDEM telescope design. The study will also assess the critical cost, schedule, technical performance and risk drivers and develop cost and schedule estimates for the design, build and test of the telescope.

2.0 Reference Documents

At the website <http://jdem.gsfc.nasa.gov>, documents relating to this study are available for review and download.

JDEM-TELE-LIST-0002	JDEM Project Telescope Concept Study DILS
JDEM-TELE-REF-0010	JDEM Project Telescope Concept Study Payload Description
JDEM-TELE-REQ-0001	JDEM Project Telescope Concept Study Interface and Constraints Document
JDEM-SE-REF-0011	JDEM Project Math Models Guidelines Document
JDEM-SMA-REQ-0002	JDEM Project Mission Assurance Requirements
GEVS-STD-7000	General Environmental Verification Standard (GEVS)
	http://msc-docsrv.gsfc.nasa.gov/cmdata/170/STD/GEVS-STD-7000.pdf

3.0 Study Assumptions

During the course of the study, the contractor shall assume:

- a. A telescope pre-ship review date of March 2015.
- b. An instrument integration date of April 2015.
- c. A spacecraft integration date of July 2015.
- d. Instrument integration will be performed at GSFC. The telescope must be delivered to GSFC and ready to support the above instrument integration date.
- e. The Draft JDEM MAR and GEVS are provided for the purpose of supporting the development of the baseline cost and schedule.
- f. Telescope personnel are required to support the instrument and spacecraft integration activities at GSFC.
- g. The spacecraft will accommodate a prime and redundant electronics box for the telescope, if required.

4.0 Work to be performed

The contractor shall perform a study that results in at least one feasible telescope concept using the assumptions above and the JDEM Telescope Study Payload Description. The design of the instrument and Fine Guidance Sensor (FGS) are the responsibility of the JDEM Project and the optical prescription for both are provided to allow the selected vendors to package the FGS and instrument optical trains.

4.1 Study Content

At a minimum the contractor shall address and provide information on the following to a degree of accuracy that is commensurate with a conceptual design:

4.1.1 Telescope Physical Description

- Provide figures of the on-orbit configuration showing physical layout of the primary components.
- Provide a detailed master equipment list for the proposed concept.

4.1.2 Telescope Design Description

- Provide detailed descriptions of the mechanical structure, thermal control, optical design and any mechanisms used, including an assessment of the heritage and performance history of the mission critical components.
- Provide a summary of the mass properties and electrical resources for the telescope.

4.1.3 Systems Engineering

4.1.3.1 Design

- Provide results of trade studies performed in the development of the proposed concept to show that the proposed concept balances technical risk and cost while meeting the general design requirements, as specified in Table 5-1 of Section 5.0 of the Telescope Concept Study Payload Description Document, with adequate margins. Provide analysis of significant break points in cost, schedule, technical performance and risk for the telescope design determined as a result of trade studies performed.
- Provide an analysis of break points in your manufacturing and testing process that could impose a technical, schedule or cost risk for the following design parameters:
 - Aperture diameter (0.8 m – 1.5 m)
 - Wave front error (30 nm – 60 (TBR) nm) (imaging channel only)
 - Telescope temperature (243 K \pm 50 K)
 - System f/# (5 to 14)
- Provide and substantiate error budgets for all relevant portions of the telescope, including mechanical, optical and thermal.
- Provide mechanical envelopes and tolerances for the telescope.

- Assess the external interfaces to the spacecraft and instrument and provide a recommended set of interface designs. Identify any aspects of the instrument and spacecraft that must accommodate the proposed concept, using the Telescope Study Interface and Constraints Document as a starting point.
- Substantiate the verifiability of the telescope design.
- Describe any technology development required to meet the proposed concept and provide an assessment of the current technology readiness levels for the telescope components.
- At the completion of the study, participants are encouraged to identify areas for further investigation to advance the objectives of the telescope design for JDEM.

4.1.3.2 Validation

- Provide validation of the design and performance.
- Provide dynamic Zernike decomposition of the wavefront error.

4.1.3.3 Integrated Modeling

- Perform integrated modeling to assess the performance of the vendor's telescope design at the instrument interfaces, based on the observatory (spacecraft, telescope and instrument) dynamic environment. Provide the results of integrated modeling performed for the proposed design concept. NASA will provide mathematical models of the spacecraft and instrument conceptual design for use by the study participants in the development of integrated models for their telescope conceptual designs. The NASA provided models will provide preliminary information on spacecraft and instrument interfaces and forcing functions, including mechanical, thermal, optical, and dynamic considerations. The JDEM Project Math Models Guidelines Document provides requirements and guidelines for file formats, coordinates and node numbering, benchmarks, and other details designed to facilitate successful transfer and integration of models.
- Additionally, provide recommendations/lessons learned for future iterations as a result of this analysis.

4.1.4 Cost and Schedule

- Provide the cost and schedule for developing and testing the proposed concept, including details of the design, fabrication and test phases. The cost of the optical train for the FGS should be included in the telescope cost estimate.
- Identify any long lead items and provide a schedule for procurement of those items.
- Provide a delta cost, schedule and risk impact to the above if a Zerodur boule, sufficient in size to build the primary, secondary, tertiary and a fold mirror and with $CTE(0,50) < 0 \pm 5 \text{ppb/C}$, were provided by the Government.

4.1.5 Integration and Test

- Describe the telescope integration and test flow, including the optical test flow at temperature, as well as an instrument integration and test flow, that is technically and cost credible. Assume that instrument integration and test is performed at the Goddard Space Flight Center (GSFC). Include any recommendations to reduce cost, schedule and technical risks.

- Describe all of the major assembly and test facilities and ground support equipment (GSE) required to build and test the telescope, including optical test equipment, and associated logistics such as shipment of hardware between facilities.

4.2 Additional Trades

The following items represent trades that could be beneficial to the mission.

4.2.1 Integral Field Unit Accommodations

- Study the accommodation of an Integral Field Unit (IFU) for spectroscopy in place of the on-axis fine guider and describe the changes to the baseline design. An IFU design description will be provided at award.

4.3 Meeting Support

The contractor shall provide status on the progress of the study at the meetings specified in the JDEM Telescope Concept Study Deliverable Items List and Schedule.