

TMT International Observatory LLC

Draft Request for Proposal ("RFP")

For The

TMT VCAM System Preliminary Design and Prototyping

TMT Document No.: TMT.BUS.MGT.15.081.REL01

Date Issued: June 12, 2015

PROPOSALS DUE: July 31, 2015

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1.0 Description of Request for Proposal

1.1 Introduction

The TMT Project (the “Project”) is a collaboration of the California Institute of Technology, the University of California, the Association of Canadian Universities for Research in Astronomy, the National Astronomical Observatory of Japan, the Department of Science and Technology of India, and the National Astronomical Observatories of China with a mission to design, construct and operate a thirty meter optical/infrared telescope. The TMT International Observatory LLC (“TMT”) is part of the Project and is the legal entity that is issuing this RFP and any resultant contracts.

The first light TMT AO system (“NFIRAOS”) is a Laser Guide Star (LGS) Multi Conjugate AO (MCAO) System. It includes 6 (six) high-order LGS wavefront sensors cameras and one high-order Natural Guide Star (“NGS”) wavefront sensor camera for observations without lasers guide stars. The 6 (six) high-order LGS wavefront sensor cameras and the NGS wavefront sensor camera shall be referenced as the visible cameras (“VCAM”) system in this RFP.

Respondents are requested to submit proposals for the work, price and schedule to develop the preliminary design and prototype for the VCAM System in accordance with the requirements stated in this RFP.

1.2 Background Information and Exhibits

The list of Exhibits for this RFP may be found in Section 7.0 of this RFP

Respondents should submit a written request for any exhibits, applicable or reference documents in the Background Information they wish to review.

If the applicable or reference documentation is available for distribution, it will be distributed using the Caltech Dropbox, which is a service for sharing large files. Once TMT is notified, interested Respondents requesting such documents or drawings should receive an email message from the Caltech Dropbox that the requested documents or drawings are ready for transfer

A sample statement of work for the VCAM System Preliminary Design and Prototyping (“Sample SOW”) is incorporated into the Model Contract in 6.0 of this RFP. Respondents should propose any modifications to the Model Contract in the section designated for RFP deviations.

Please note that a more detailed statement of work for Task 3 (“Task 3 SOW”) shall be provided by TMT after the anticipated Effective Date of the Contract. Respondents shall propose a submission date for TMT to provide the more detailed Task 3 SOW. The submission date for the more detailed Task 3 SOW must provide sufficient time for the Respondent to complete the Work without any delays. Respondents are responsible for proposing a Work schedule that addresses the staggered submission of certain Background Information as specified in this RFP.

Exhibits A through J are referenced collectively as the “Background Information.”

The Offer Submittal Form is attached to this RFP as Exhibit J.

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1.3 Proposal Instructions

The Work described in the Statement of Work and the Deliverables being procured under this RFP are described in Section 6.0 of this RFP. Respondents are directed to use this RFP as their sole reference for understanding and addressing the requirements regarding the Statement of Work and Deliverables in the development of their proposal.

1.3.1. Review of Background Information

Respondents shall review the Background Information for this RFP and review the statement of work for this RFP.

1.4 Proposal Terms

1.4.1 Shipment and Delivery.

Unless specified otherwise in writing, all deliverables shall be submitted electronically to TMT via electronic mail. All deliverables shall be submitted to cboyer@tmt.org and pratheep@tmt.org.

Respondent's proposal must include the cost of shipping all hardware deliverables in accordance with the requirements stated in Section 6.0 of the RFP. Proposed shipping methods and costs shall mitigate all reasonable risks that could damage the deliverable(s). For the purposes of this proposal, shipping terms shall be DDP to the W.M. Keck Observatory in Hawaii.

1.4.2 Contract Type for Proposed Work.

Respondents shall provide a firm fixed price proposal to perform the work described in the Section 6.0 of the RFP. The proposed firm fixed price shall be submitted to TMT by completing the cost matrix attached to this RFP as Exhibit A. Respondents are requested to submit firm fixed price information for all activities defined in the cost matrix.

1.4.3 Validity Period.

The Proposal must be valid for sixty (60) days from the date of its receipt by TMT.

1.4.4 Data Rights.

TMT will own all rights to the work product developed or fabricated pursuant to the resultant contract awarded under this RFP and will have the right to use, reproduce and adapt it for any purpose.

1.4.5 Proposal Schedule

The proposed schedule for the work described in the Section 6.0 of this RFP (Statement of Work) must be completed no later than fifteen (15) months from the Effective Date of the Contract.

The proposal shall include a detailed, resource-loaded schedule to a level showing the tasks to be performed for each activity listed in the SOW such as the NFIRAOS VCAM opto-mechanical preliminary design or the final design of the NFIRAOS VCAM Electronics Prototype as well as the different milestones and reviews. The schedule shall be provided in MS Project format.

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1.4.6 Proposal Cost and Schedule Contingency

The proposal shall include any specific information on the proposal cost and schedule contingency.

1.4.7 Format of Deliverables

For the purposes of this RFP, proposed deliverables shall be provided in MS Word (unless specified otherwise in the RFP).

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2.0 Instructions to the Respondent

2.1 General Instructions

Read the information contained in this RFP, which includes the model contract (the "Model Contract"), and submit a complete response to all requirements, guidelines, specifications, and questions as directed.

The designated letters for the Exhibits in this RFP may be different than in the awarded contract.

2.1.1 Schedule of Events

RFP Issued	June 12, 2015
Submission of RFP Questions	June 26, 2015
Proposal Submittal Date	July 31, 2015
Completion of TMT Proposal Review	August 14, 2015
Estimated Contract Start Date	August 17, 2015

2.1.2 Offer Form

The proposal shall be submitted with the completed and signed Offer Submittal Form attached as Exhibit J to this RFP as the cover page. Additionally, the proposal shall follow the requirements described in Section 5.0.

2.1.3 Proposal Submission Protocol

The required method of submission is in an electronic form. TMT will evaluate the proposal in its electronic form.

The font size of the proposal may not be less than 10 points.

Respondents must submit their proposals to Corinne Boyer (cboyer@tmt.org), Christina Wong (cwong@tmt.org) and Pratheep Eamranond (pratheep@tmt.org) no later than the proposal submission date and time of July 31, 2015, 5:00PM Pacific Time ("Proposal Submittal Date and Time").

All questions, concerns, requests and correspondence regarding the RFP must be submitted by June 26, 2015 to ensure a response. RFP questions submitted after June 26, 2015 may not receive a response. RFP questions shall be directed (only) to cboyer@tmt.org, cwong@tmt.org and pratheep@tmt.org

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3.0 Proposal Evaluation Process

3.1 Proposal Evaluation Guidelines

Proposals will be reviewed by a TMT Project Source Selection Board ("SSB") comprised of reviewers designated by TMT to determine the proposals that provide best value to TMT. The SSB will submit the result of their review to the Source Selection Official. The Source Selection Official will render the final determination of an award, if any, for this RFP.

Each proposal will be evaluated separately. The Source Selection Board's evaluation criteria are listed below in approximate order of importance with the most important criteria listed first:

- A. Respondent Experience.
- B. Proposed activities and deliverables
- C. Qualifications of personnel who will perform the work
- D. Proposed Cost and Schedule to perform the Work.
- E. RFP or contract deviations

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4.0 Contract Award Process

4.1 Contract Award Conditions

Issuance of this RFP does not require TMT to award a contract. TMT reserves the right to reject any or all proposals; to waive any technicalities, informalities, or irregularities in any proposal at its sole discretion. TMT reserves the right to request clarification or additional information at any time. TMT reserves the right to award multiple contracts, a single contract or no contracts. In addition, TMT reserves the right to re-solicit proposals or to temporarily or permanently abandon the procurement. If TMT awards a contract, it will award the contract to the respondent or respondents whose proposal(s) is (are) the most advantageous to TMT as determined by TMT in the exercise of its sole discretion.

TMT also reserves the right to award a contract based (i) on proposals initially submitted, without discussion, clarification or modification, or (ii) on the basis of negotiation with none, any or all of the respondents. Therefore, each respondent should make sure that its proposal is compliant with this RFP.

4.2 Responsible Respondent

TMT will only establish contracts with a responsible respondent. A responsible respondent is defined as an organization or institution that demonstrates the financial ability, resources, skills, capability, willingness, and business integrity necessary to perform on the potential contract resulting from this RFP. TMT's determination of whether a proposal is from a responsible respondent will be made at TMT's sole discretion.

5.0 Proposal Form

5.1 Proposal Form Guidelines

The organization of the proposal shall be as follows:

5.1.1. Offer Submittal Form.

The Offer Submittal Form, attached as Exhibit J to this RFP, shall be used as the cover page for the proposal.

5.1.2. Table of Contents.

Respondents must provide a table of contents with page number references in their proposal. The table of contents should be in sufficient detail to facilitate easy reference to the sections of the proposal and all separate supplemental information.

5.1.3. Introduction.

The Introduction shall include a description of the Respondent organization. The description should include, but is not limited to, stating how long Respondent has been in business, the principal areas of business activity, the number of employees, etc.

5.1.4. Respondent's Experience.

This section should describe the experience and expertise that qualifies the Respondent to perform the work of this RFP for the VCAM System Preliminary Design and Prototyping. Respondents should have experience in designing and manufacturing CCD Cameras with fast pixel data rates and low noise.

5.1.5. Proposed Activities and Deliverables.

This section should describe the activities Respondent proposes to accomplish in return for the proposed firm fixed price. This section should describe how the proposed activities address the work required in Section 6.0 of this RFP.

5.1.6. Qualifications of Personnel.

List the actual, key personnel of Respondent and of any subcontractors who will be performing the work requested by the RFP. A curriculum vita ("CV") must be provided for the key personnel. Indicate the role of the actual and key personnel working on the proposed effort in an org chart form. Proposal must indicate the Project Manager for the proposed effort.

5.1.7. Cost and Schedule

Although, TMT is not specifying a cost limit, the proposed cost and schedule are important criteria of the selection process. The overall schedule is defined in Section 6.0 of this RFP. As previously noted, Respondents must provide their proposed costs in the form of the completed VCAM Cost Matrix incorporated and attached to this RFP as Exhibit A.

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5.1.8. RFP Deviations.

In this section, Respondents must list and describe all deviations from the RFP. TMT is not obligated to accept any deviation from the RFP. If possible, Respondents are asked to provide estimated costs for the RFP approach and the deviation for comparison. If the approach required in the RFP is not considered feasible, Respondents are requested to explain their conclusions.

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6.0 Model Contract for VCAM System Preliminary Design and Prototyping

This contract ("Contract") is made effective as of _____, 2015 ("Effective Date"), by and between the TMT International Observatory LLC, a limited liability company organized and existing under the laws of the State of Delaware ("TMT"), and _____, a corporation organized and existing under the laws of the State of _____ ("Contractor"). Each party to this Contract may be referred to individually as "Party" and collectively as the "Parties." The Parties agree as follows:

For the purposes of this Contract, the following acronyms and definitions shall be used

Acronyms

A. AO	Adaptive Optics
B. CCD	Charge-coupled Device
C. DRD	Design Requirement Document
D. ICD	Interface Control Document
E. LGS	Laser Guide Star
F. MIT/LL	MIT Lincoln Laboratory
G. NFIRAOS	Narrow Field InfraRed Adaptive Optics System
H. NGS	Natural Guide Star
I. RFP	Request For Proposal
J. RTC	Real Time Controller
K. TEC	Thermoelectric Cooler
L. VCAM	Visible Wavefront Sensor Camera
M. WFS	Wavefront Sensor

Definitions

- A. **NFIRAOS:** NFIRAOS is the TMT first light Laser Guide Star Multi-Conjugate Adaptive Optics System. In natural guide star mode, NFIRAOS utilizes one high-order visible natural guide star ("NGS") wavefront sensor ("WFS"), several infrared low-order natural guide star wavefront sensors, one deformable mirror and one tip/tilt stage to sense and compensate wavefront aberrations introduced by the atmospheric turbulence and the telescope itself. In laser guide star mode, NFIRAOS additionally utilizes six laser guide star ("LGS") high order WFSs and a second deformable mirror.
- B. **VCAM:** NFIRAOS VCAM is the high order wavefront sensing sub-system of NFIRAOS. There are two types of NFIRAOS VCAMs. The LGS WFS camera version of VCAM provides wavefront sensing for the six LGS beacons generated by the TMT Laser Guide Star Facility. The LGS WFS version of VCAM uses a novel CCD, the CCID-87 polar coordinate detector as the imager. The NGS WFS camera version of VCAM provides wavefront sensing for the high order NGS when laser operations are not possible. The NGS WFS version of VCAM uses a 256 x 256 pixel conventional CCD (the CCID-74) as the imager. NFIRAOS VCAM consists of two major components, the VCAM Camera, and the VCAM Interface Controller. The VCAM Camera is expected to house and operate either the NGS or LGS CCD, providing the analog to digital conversion and clock and bias signals needed to readout the detectors (focal plane readout electronics), and the cooling system needed to cool the electronics and the hot side of the thermoelectric cooler ("TEC") used to control

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the temperature of the CCD detectors. In order to limit the size and power dissipation of the camera, the interface to the NFIRAOS computer systems (the NFIRAOS component controller, and the NFIRAOS Real Time Computer or RTC) and the required ac to dc power supplies are enclosed in a separate Interface Controller assembly. The complete VCAM system for NFIRAOS consists of six LGS VCAM Cameras and Interface Controllers with all required interconnecting cables, and one NGS VCAM Camera and Interface Controller with all required interconnecting cables.

- C. **LGS WFS CCD:** The CCID-87 polar coordinate detector is a high frame rate CCD imager designed to address the problem of adaptive optics (“AO”) laser guide star (LGS) spot image elongation on extremely large telescopes. The polar coordinate detector is designed for use in a Shack Hartmann (“SH”) wavefront sensor with square subapertures on a regular orthogonal grid. Each subaperture has an individual frame transfer imager that is optimally sized for the LGS image elongation as a function of distance from the laser projection point (aligned with the center of the telescope pupil); the polar coordinate detector requires 204,792 pixels, 31% of the pixels that are needed for 2,896 active subapertures with a conventional CCD. The center projection arrangement used for the LGS creates a rotationally symmetric layout. The design of the detector is based on 4 identical quadrants, each of which is simply a copy of the other, rotated by 90 degrees. The CCID-87 has 128 video outputs and is packaged in a windowed hermetic package with a TEC. The CCID-87 video outputs employ a very low noise readout amplifier using a planar P-JFET transistor as the first stage. A 1-quadrant prototype of this detector (the CCID-61) has been successfully developed by MIT/LL and tested by the W. M. Keck Observatory. The full-scale polar coordinate CCD (the CCID-87) is being designed and will be manufactured by MIT/LL.
- D. **NGS WFS CCD:** The CCID-74 is a conventional 256 x 256 pixel, split frame transfer CCD with 64 video outputs. These video outputs also employ the planar P-JFET output stage. The CCID-74 is packaged in a windowed hermetic package with a TEC. The CCID-74 has been designed and manufactured by MIT/LL.
- E. **NFIRAOS VCAM System:** NFIRAOS VCAM System includes the design, fabrication and test of the NFIRAOS visible natural and laser guide star wavefront sensor cameras. It includes all the hardware and software necessary to mount and operate these wavefront sensing cameras. In particular, it includes the detector housings, the lenslet arrays and associated mechanisms to mount the lenslet arrays (only for the laser guide star wavefront sensors), the focal plane readout electronics, the interface controllers, the cabling, associated software, and all equipment required for test and maintenance and handling fixtures. The LGS and NGS CCDs will be designed and procured separately by TMT and provided to the NFIRAOS VCAM System Vendor for integration and test within the NFIRAOS VCAM System. The lenslet array for the LGS VCAM will be specified and procured by TMT and provided to the VCAM System Vendor. The NFIRAOS VCAM System Vendor will be responsible for the integration and test of the NFIRAOS VCAM System before delivery to the NFIRAOS vendor site in Victoria, Canada.
- F. **NGS VCAM:** NGS VCAM refers to the NFIRAOS VCAM dedicated to the NFIRAOS visible natural guide star wavefront sensor.
- G. **LGS VCAM:** LGS VCAM refers to the NFIRAOS VCAM dedicated to the NFIRAOS sodium laser guide star wavefront sensor.

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Exhibit List

- A. **[Exhibit A]:** VCAM Cost Matrix
- B. **[Exhibit B]:** Subsystem Requirements Document for the NFIRAOS VISIBLE WAVEFRONT SENSOR CAMERA (VCAM)
- C. **[Exhibit C]:** Interface Control Document NARROW FIELD INFRARED ADAPTIVE OPTICS SYSTEM (NFIRAOS) to NFIRAOS VISIBLE CAMERA (VCAM)
- D. **[Exhibit D]:** Interface Control Document NFIRAOS VISIBLE CAMERA (VCAM) to NFIRAOS REAL TIME CONTROLLER (NRTC)
- E. **[Exhibit E]:** Interface Control Document NFIRAOS VCAM POLAR COORDINATE DETECTOR to NFIRAOS VISIBLE CAMERA (VCAM)
- F. **[Exhibit F]:** Mechanical ICD of the WFS Camera to LGS System
- G. **[Exhibit G]:** Mechanical ICD of the WFS Camera to NGS System
- H. **[Exhibit H]:** NFIRAOS VCAM Interface Controller Interface Drawing

The following Exhibit I is provided solely for reference purposes. Exhibit I is not incorporated into the Contract and is not binding on the Parties.

- I. **[Exhibit I]:** Contractor's VCAM Design and Development Proposal dated _____

Article I. Statement of Work ("SOW")

Contractor shall accomplish the following tasks:

- A. Task 1: NFIRAOS VCAM System Preliminary Design
 - 1. NFIRAOS VCAM System Preliminary Design: Contractor shall develop the preliminary design of the NFIRAOS VCAM System. TMT is seeking a camera design that is compatible for both types of camera (LGS and NGS) for ease of sparing. The preliminary design of the NFIRAOS VCAM System shall meet all the requirements and interface requirements specified in [Exhibit B], [Exhibit C], [Exhibit D], [Exhibit E], [Exhibit F], [Exhibit G], [Exhibit H]. The preliminary design of the NFIRAOS VCAM System shall include, but is not limited to, the following design tasks:
 - a. In accordance with the architecture defined in [Exhibit B], develop the preliminary design of the different assemblies within each component of the NFIRAOS VCAM System, including (but not limited to) the design of the VCAM housings for both the LGS and NGS cases, the focal plane readout electronics, interface controller electronics, cabling and software of the LGS and NGS detectors, the cooling system, and all tools required for test, maintenance and handling.
 - b. Develop the opto-mechanical preliminary design of the VCAM Camera including (but not limited to):

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- i. Develop the CAD model of the NFIRAOS LGS and NGS VCAM System.
 - ii. Develop a Finite Element Analysis (“FEA”) Model of the NFIRAOS LGS and NGS VCAM System for evaluation of opto-mechanical stability, vibration performance and seismic event survival. The model will be used by the NFIRAOS team to perform the NFIRAOS system analysis.
 - iii. Develop a computer model of the NFIRAOS LGS and NGS VCAM for thermal performance analysis. Perform a thermal performance analysis over the expected range of operating conditions as described in [Exhibit B].
 - iv. Develop an error budget for lenslet array alignment for LGS VCAM. Develop a detector alignment error budget for LGS and NGS VCAM.
 - v. Develop the mass budget of the NFIRAOS VCAM System.
 - vi. Develop assembly, alignment, and test plans for the NFIRAOS VCAM System.
 - vii. Develop installation and removal procedures, for the NFIRAOS LGS and NGS VCAM Cameras and interface controllers.
- c. Develop the electronics preliminary design of the VCAM System including (but not limited to):
- i. The design of the NFIRAOS VCAM focal plane readout electronics and interface controller for both the LGS and NGS cases. This includes the layout of any custom printed circuit boards (“PCBs”) required in the design.
 - ii. The cabling, wiring and grounding diagrams of the NFIRAOS VCAM System for both the LGS and NGS cases,
 - iii. The power consumption, power dissipation budgets, and cooling requirements of the NFIRAOS VCAM System.
- d. Develop the software preliminary design for the NFIRAOS VCAM System including (but not limited to):
- i. The NFIRAOS VCAM software preliminary design shall be developed in accordance with the architecture and data pathways specified in [Exhibit C] and [Exhibit D].
 - ii. Indicating the deployment of the software components on the physical hardware.
- e. Develop the safety hazard risk analysis and address new safety requirements (if any) within the NFIRAOS VCAM System including (but not limited to) the NGS and LGS CCDs at the interface level.
- f. Develop the Failure Mode and Effects Analysis (“FMEA”) and reliability prediction for the NFIRAOS VCAM System. This report shall be a bottoms-up summary of the predicted reliability of the NFIRAOS VCAM System based upon the reliabilities of the individual NFIRAOS VCAM System components including the NGS and LGS CCDs at the interface level.
- g. Provide the VCAM Vendor QA plan. The QA plan shall identify the acceptance methods (procedures/processes) to be implemented, particularly those required for verification of design safety (hazard/risk assessment), pass/fail criteria, workmanship standards, special process and training requirements, in-process inspection requirements, sub-contractor and supplier QA/QC requirements and supplier surveillance plans.

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- h. Develop the NFIRAOS VCAM System compliance matrix. The compliance matrix is the list of each requirement in the DRD. There should be a compliance statement against each requirement and corresponding justifications. The compliance matrix should not include the NGS and LGS CCDs.
- i. Develop the NFIRAOS VCAM System verification matrix and NFIRAOS VCAM Camera verification plan. For each requirement, the verification matrix shall indicate the type of verification that will be performed at each milestone, including a reference to a corresponding procedure defined in the verification plan. The verification plan shall include a brief description of the intended verification procedures for the NFIRAOS VCAM System. It should describe the sequence of tests, test equipment and identify the groups of requirements or requirement that will be verified including the NGS and LGS CCDs as integrated in the VCAM system.
- j. Develop the NFIRAOS VCAM System Fabrication, Integration and Test Plan at the Vendor Site. This document shall describe the fabrication, test, packaging and shipment of the NFIRAOS VCAM System to the NFIRAOS site including i) the fabrication process materials, processes and workmanship standards, ii) any sub-contracted assemblies and supplier surveillance/controls, iii) the integration and test plan, sequencing of tests, and details of tests which are not already described in the verification plan iv) the shipping plans including the on-site storage and handling equipment as well as control of invasive species during shipment, and v) any safety hazards/risks and mitigation specific to this phase.
- k. Develop the NFIRAOS VCAM System preliminary design report (s) to be presented at the NFIRAOS VCAM System preliminary design review.

B. Task 2: NFIRAOS VCAM Electronics Prototype Design, Manufacturing and Test

- 1. NFIRAOS VCAM Electronics Prototype Design: Contractor shall develop the design of the NFIRAOS VCAM Electronics Prototype.
 - a. Develop the Requirements for the NFIRAOS VCAM Electronics Prototype in collaboration with TMT. At a minimum, these requirements shall include:
 - i. The NFIRAOS VCAM Electronics Prototype shall meet the NFIRAOS VCAM System performance requirements for both the LGS and NGS cases, including but not limited to pixel clock rate, read noise and power dissipation for all of the environmental observing performance conditions defined in [Exhibit B].
 - ii. The NFIRAOS VCAM Electronics Prototype shall have a total of 32 output video channels and shall include a prototype interface controller.
 - iii. The NFIRAOS VCAM Electronics Prototype shall be mounted into a simple housing for test at the NFIRAOS VCAM System Vendor facility and at WMKO/TMT with the prototype polar coordinate CCD.
 - b. Define the NFIRAOS VCAM Electronics Prototype architecture block diagram.
 - c. Develop the final design of the NFIRAOS VCAM Electronics Prototype, including but not limited to all necessary trade studies, analysis and modelling studies (power, thermal, etc.), electrical and software interface specifications and all required fabrication and assembly drawings.

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- d. Develop the NFIRAOS VCAM Electronics Prototype verification plan. The verification plan shall include the procedures, test set-ups, test equipment and test pass/fail criteria to verify all requirements defined in Article I.B.1.a.
 - e. Develop the NFIRAOS VCAM Electronics Prototype design report(s).
2. NFIRAOS VCAM Electronics Prototype Manufacturing
- a. Procure all materials and tools required to manufacture the NFIRAOS VCAM Electronics Prototype and all required spares. Contractor shall identify any long lead items, and the associated costs and schedule, in the proposal.
 - b. Fabricate and assemble the NFIRAOS VCAM Electronics Prototype and all required spare assemblies as defined in Article I.B.1.a, I.B.1.b and I.B.1.c.
3. NFIRAOS VCAM Electronics Prototype Testing
- a. Test the NFIRAOS VCAM Electronics Prototype against the requirements defined in Article I.B.1.a, following the NFIRAOS VCAM Electronics Prototype verification plan defined in Article I.B.1.d.
 - i. TMT shall provide a packaged, engineering grade, single-quadrant polar coordinate detector prototype (the CCID-61) for testing the NFIRAOS VCAM Electronics Prototype.
 - ii. TMT representatives may observe or participate in all the tests or a sample of the tests. In this case, TMT and Contractor shall agree upon a list of tests to be witnessed and a schedule at the beginning of the NFIRAOS VCAM Electronics Prototype test phase. TMT shall be responsible for the cost of travel by TMT representatives to witness these tests.
 - b. Develop the NFIRAOS VCAM Electronics Prototype test report(s).
 - c. Pack the NFIRAOS VCAM Electronics Prototype into its shipping container.
 - d. Ship the NFIRAOS VCAM Electronics Prototype to the TMT VCAM technical manager located at the WMKO, Waimea, Hawaii for additional evaluation.
- C. Task 3: NFIRAOS VCAM System Final Design, Manufacturing and Test Proposal
1. Contractor shall prepare a firm fixed-price proposal that is valid for 60 days (the proposal should be consistent with the same proposal format and guidelines stated in Section 5 of the VCAM System Preliminary Design and Prototyping RFP). For the proposal, Contractor shall perform the activities defined below to complete the development of the NFIRAOS VCAM System and deliver it to the NFIRAOS Vendor Site located at NRC-Herberg in Victoria, Canada.
- a. Unless specified otherwise, all references to the NFIRAOS Vendor Site shall mean the NRC-Herzberg Institute of Astronomy and Astrophysics (“NRC Herzberg”) in Victoria, Canada.
 - b. The activities to complete the development of the NFIRAOS VCAM System and deliver it to the NFIRAOS Vendor Site include the following:

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- i. Final design of the NFIRAOS VCAM System.
 - ii. Quality assurance testing of the NFIRAOS VCAM CCDs:
 - a) Two (2) engineering grade devices and seven (7) science grade devices of the NFIRAOS VCAM CCD for the LGS WFS (MIT/LL CCID-87),
 - b) Two (2) science grade devices of the NFIRAOS VCAM CCD for the NGS WFS (MIT/LL CCI-74).
 - iii. Manufacture and assembly of seven (7) NFIRAOS LGS VCAM and a single NFIRAOS NGS VCAM, including the integration of the NFIRAOS VCAM CCDs within the NFIRAOS VCAM Cameras, as well as all required spares, shipping containers and tools.
 - iv. Test of the seven (7) NFIRAOS LGS VCAM and the single NFIRAOS NGS VCAM against the requirements and interface requirements as defined in [Exhibit B] through [Exhibit E].
 - v. Packing and shipping of the NFIRAOS VCAM System to the NFIRAOS Vendor Site.
- c. The proposal shall include a bottom-up cost estimate in U.S. dollars, broken down by tasks and per category as defined below:
- i. Hours and cost of non-recurring engineering labor,
 - ii. Hours and cost of manufacturing labor,
 - iii. Hardware costs,
 - iv. Sub-contractor and supplier costs,
 - v. Other costs, such as taxes, travel, duties, equipment, packing and shipping to the NFIRAOS Vendor Site.
- d. Any contingencies included in the cost estimate.
- e. The Task 3 proposal shall include a detailed, resource loaded schedule showing the project milestones and the different tasks to be performed for each main activity (such as NFIRAOS VCAM System final design or NFIRAOS VCAM System manufacturing). The amount of schedule "slack" in each task shall be indicated. The TMT schedule for the NFIRAOS VCAM System is as follows:

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- i. The due date for TMT to deliver the two (2) CCID-74 science grade detectors to the VCAM System Vendor is January 2017 (to be determined at a later date that shall be mutually agreed upon by the Parties).
 - ii. The due date for TMT to deliver the two (2) CCID-87 engineering grade detectors to the VCAM System Vendor is January 2017 (to be determined at a later date that shall be mutually agreed upon by the Parties).
 - iii. TMT shall deliver the seven (7) CCID-87 science grade detectors to the VCAM System Vendor no later than June 30, 2017 (to be determined at a later date that shall be mutually agreed upon by the Parties).
 - iv. The VCAM Vendor shall deliver the NFIRAOS VCAM System to the NFIRAOS Vendor Site no later than September 30, 2018.
- f. The Task 3 proposal shall include a risk register for the NFIRAOS VCAM System. The risk register shall contain a comprehensive list of foreseeable technical, manufacturing and programmatic risks. For each risk, the list shall include a clear description, the consequences, the rating (probability, severity and overall) and the proposed mitigation approach or resolution.
 - g. The Task 3 proposal shall provide the list and resume of key staff including their role in the project, and a list of sub-contractors that will be involved in the NFIRAOS VCAM System.
 - h. The Task 3 Proposal shall state any deviations from the Task 3 SOW (as defined below).
2. Contractor understands and accepts that the complete statement of work for the Task 3 Proposal ("Task 3 SOW") shall be provided by TMT to Contractor during the Preliminary Design and Prototyping Phase. The complete Task 3 SOW will include the remaining details for the deliverable documentation of the final design and fabrication, assembly and test phases, and the reviews and meetings required to complete the development and delivery of the NFIRAOS VCAM System.
 - a. Contractor shall propose a date for TMT to provide the complete Task 3 SOW. This date must provide sufficient time for the Respondent to complete the Work without any delays.

D. Deliverables

Whenever possible, all Deliverables shall be submitted by Contractor to TMT electronically at cboyer@tmt.org and pratheep@tmt.org. Contractor shall deliver the NFIRAOS VCAM Electronics prototype system (defined below) to the W.M. Keck Observatory in Hawaii. Contractor shall provide the following deliverables:

1. Deliverables for NFIRAOS VCAM System preliminary design. Contractor shall submit the following Deliverables to TMT:
 - a. Preliminary design report describing the work performed in Article I.A.1.a through I.A.1.d and I.A.1.k. The report shall include a summary of all trade studies, analysis and modeling activities performed during the preliminary design of the NFIRAOS VCAM System. Prior work and analytical results may be included in the NFIRAOS VCAM System preliminary design report where appropriate. The NFIRAOS VCAM System preliminary design report shall be in MS Word format.

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- b. The CAD model of the NFIRAOS VCAM System in a format authorized by TMT (i.e. Solidworks format or Solidworks compatible format) and any other models (i.e. ANSYS format or compatible for FEA, and Solidworks CFD for thermal analysis) developed in Article I.A.1.b.
 - c. A list of proposed updates to the NFIRAOS VCAM Interface Control Documents and interface drawings if needed.
 - d. The Safety hazard analysis developed in Article I.A.1.e. (in MS Excel format).
 - e. The failure mode and effects analysis (in MS Excel format) and the reliability report (in MS Word format) developed in Article I.A.1.f.
 - f. The NFIRAOS VCAM System QA Plan (or company QA plan) developed in Article I.A.1.g. (MS Word or PDF format).
 - g. The NFIRAOS VCAM System compliance matrix (in MS Excel format) developed in Article I.A.1.h.
 - h. The NFIRAOS VCAM System cross verification matrix (in MS Excel format) and the verification plan (in MS Word format) developed in Article I.A.1.i.
 - i. The NFIRAOS VCAM System Fabrication, Integration and Test Plan at the Vendor Site (in MS Word format) developed in Article I.A.1.j.
2. Deliverables for NFIRAOS VCAM Electronics Prototype Design, Manufacturing and Test. Contractor shall submit the following deliverables to TMT:
 - a. NFIRAOS VCAM Electronics Prototype design report(s):
 - i. NFIRAOS VCAM Electronics Prototype requirement document developed in Article I.B.1.a. and submitted in MS Word format.
 - ii. NFIRAOS VCAM Electronics Prototype design report describing the work performed in Article I.B.1.b., I.B.1.c, I.B.1.e including a summary of all trade studies, analysis and modelling activities. The NFIRAOS VCAM Electronics prototype system design report shall include a compliance matrix against the requirements defined in Article I.B.1.a. The NFIRAOS VCAM Electronics Prototype design report shall be in MS Word format.
 - iii. Electrical and software interfaces to the NFIRAOS VCAM Electronics Prototype developed in Article I.B.1.b and I.B.1.c (in MS Word format).
 - iv. NFIRAOS VCAM Electronics prototype verification plan developed in Article I.B.1.d (in MS Word format).
 - b. NFIRAOS VCAM Electronics Prototype test report (in MS Word format) and all raw test data (in MS Excel format) as developed and obtained in Article I.B.3.b.
 - c. NFIRAOS VCAM Electronics Prototype in its shipping container.
 3. Deliverables for NFIRAOS VCAM System Final Design, Manufacturing and Test Proposal
 - a. Firmed price proposal to perform the remaining tasks necessary to develop the NFIRAOS VCAM System and deliver it to NRC-Herberg as defined in Article I.C.1.a to Article I.C.1.h.

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4. Meetings and Reviews:
 - a. Unless stated otherwise, the TMT participants for all meetings and reviews described below shall be determined by the TMT Technical manager and will consist of TMT project office staff. TMT participants may also include external experts designated by TMT. The attendance of external experts designated by TMT is contingent upon the authorization of the Contractor. Contractor's authorization of external experts shall not be unreasonably withheld.
 - b. Kick-Off Meeting: The contractor shall organize a teleconference meeting with TMT at a date to be determined by the Parties to review the statement of work, schedule, deliverables and reporting requirements for the Parties.
 - c. Bi-weekly reporting: The Contractor shall have a teleconference with TMT every two weeks during the effective Term of the Contract to review Work progress against the Contractor's plan and any technical or programmatic issues that could impact the project, as well as the proposed corrective actions to resolve the issues. For the first bi-weekly meeting of each month, Contractor shall provide the percentage of completion for each Work activity. If the teleconference cannot be arranged, Contractor shall send in place an email report, which fulfills the bi-weekly reporting requirements.
 - d. Reviews: For each review, Contractor shall provide a summary of the expenses to date for the Work.
 - i. NFIRAOS VCAM System preliminary design review:
 - a) After electronic submission of all deliverables listed in Article I.D.1 for the NFIRAOS VCAM System preliminary design, Contractor shall organize a face-to-face meeting, no less than (2) or more than four (4) weeks after submitting the required documentation, for TMT's review and approval of the deliverables.
 - b) Following the review, TMT shall prepare a written evaluation of the action items and the review report within two (2) weeks of the review, indicating what modifications or additional information the Contractor shall provide, if any.
 - c) Contractor shall address the action items submitted by TMT within two (2) weeks of receiving TMT's written evaluation by submitting updated documentation for the NFIRAOS VCAM System preliminary design and/or proposing a plan for addressing these action items.
 - d) TMT and Contractor shall agree upon the final set of modifications and proposed plan within one (1) week following the Contractor response.
 - ii. NFIRAOS VCAM Electronics Prototype design review:

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- a) After submission of all deliverables listed in Article I.D.2.a for the NFIRAOS VCAM Electronics prototype, Contractor shall organize a teleconference meeting, no less than two (2) or more than four (4) weeks after submitting the documentation, to review the work performed in accordance with Article I.B.1 for the NFIRAOS VCAM Electronics prototype design.
 - b) Following the review, TMT shall prepare a written evaluation of the action items and the review report within two (2) weeks of the review, indicating what modifications or additional information are required.
 - c) Contractor shall address these action items within two (2) weeks by submitting updated documentation for the NFIRAOS VCAM Electronics prototype design and/or proposing a plan for addressing these action items.
 - d) TMT and Contractor shall agree upon the final set of modifications and proposed plan within one (1) week following the Contractor response.
- iii. NFIRAOS VCAM Electronics Prototype test review:
- a) After submission of all deliverables listed in Article I.D.2.b and Article I.D.2.c for the NFIRAOS VCAM Electronics prototype manufacturing and test, and submission of the proposal for the NFIRAOS VCAM System final design, manufacturing and test as defined in Article I.D.3.a., the Contractor shall organize a face-to-face meeting, no less than two (2) or more than four (4) weeks after submitting the documentation, to review the work performed in accordance with Article I.B.2 and Article I.B.3 for the NFIRAOS VCAM Electronics prototype manufacturing and test and Article I.C.1 for the preparation of the NFIRAOS VCAM System proposal.
 - b) Following the review, TMT shall prepare a written evaluation of the action items and the review report within two (2) weeks of the review, indicating what modifications or additional information are required.
 - c) Contractor shall address these action items within two (2) weeks by submitting updated documentation for the NFIRAOS VCAM Electronics prototype manufacturing and test and the NFIRAOS VCAM system final design, manufacturing and test proposal, and/or proposing a plan for addressing these action items.
 - d) TMT and Contractor shall agree upon the final set of modifications and proposed plan within one (1) week following the Contractor response.
 - e) Following the documentation modification plan approval, Contractor shall ship the NFIRAOS VCAM Electronics prototype to WMKO for further evaluation.

Article II. REPRESENTATIONS, WARRANTIES AND COVENANTS.

A. During the term of this Contract, TMT will respond to Contractor's reasonable requests for data and other information to the extent that (1) such information is known by or readily available to TMT, and (2) it is legally permissible for TMT to provide such information to Contractor. In connection therewith, TMT will make its personnel available to confer with Contractor regarding the Work and any potential constraints.

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B. Contractor is responsible for the direct management and supervision of its personnel. Contractor will inform all such personnel prior to the start of Work that there is no implied employment of Contractor personnel by TMT.

C. Contractor represents and warrants that the Deliverables will not infringe, misappropriate or otherwise violate any confidential or proprietary information, any trade secret or any intellectual property right belonging to any third party.

D. Contractor represents and warrants that it has not engaged in collusion with any other potential contractor to procure this Contract. Contractor further represents and warrants that no benefit of tangible value has been given, nor will be given to any of TMT's agents or employees as a result of being awarded this Contract.

E. Contractor understands and agrees that this is a fixed price contract and that there shall be no allowances or reimbursement for any cost whatsoever except as otherwise explicitly provided in this Agreement. Contractor agrees that the Fixed Price includes, but is not limited to, all applicable taxes, fees, shipping costs, insurance and duties. Contractor agrees to fulfill its obligations under this Agreement, regardless of cost, for the sole and sufficient compensation stated in Article IV with no expectation of additional compensation. TMT will not be obligated to pay the Contractor any amount in excess of the Fixed Price specified in Article IV.

Article III. TERM AND TERMINATION

A. Term. The term of this Contract begins as of _____, 2015 and shall end on _____. This Contract may be extended only by mutual written Contract of the Parties.

Article IV. PRICE AND PAYMENT

A. Fixed Price. In consideration for the Work to be performed by the Contractor, TMT agrees to pay the Contractor the following fixed price of \$_____ U.S. Dollars (hereinafter referred to as the "Fixed Price" or "FP"). The Fixed Price includes interim amounts payable following TMT's acceptance of each Milestone Deliverable as set forth below:

- | | |
|----------------|-----------|
| 1. Milestone 1 | 50% of FP |
| 2. Milestone 2 | 50% of FP |

B. Invoices. Following its delivery of each Milestone Deliverable to TMT, the Contractor shall submit an invoice corresponding to the Fixed Price designated for that deliverable to TMT. Each invoice shall be submitted cross-referencing the designated TMT purchase order number for this Contract. The TMT purchase order will be provided by TMT. The final invoice for this Contract shall be marked "FINAL." All invoices shall be submitted electronically to invoices@tmt.org or by mail to:

TMT International Observatory LLC
 1111 South Arroyo Parkway
 Suite 200
 Pasadena, CA 91105
 Attention: Pratheep Eamranond

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1. Contractor shall complete, execute and submit to TMT all required state forms to determine the applicability of California withholding tax. If Contractor is exempt from state withholding tax, Contractor will complete, execute and submit to TMT all required state forms certifying its tax exemption. Contractor must clearly indicate all work that is performed in California under this Contract as a separate line item on the invoice. With respect to transactions for which Contractor may be exempt from any tax or duty, Contractor will indicate its exemption claim within its invoice.

C. Payment. TMT's payments under this Contract will be made following TMT's review and approval of the invoice. Subject to the review and approval of the TMT Project Manager or the TMT Business Manager, the payment term on all invoices will be net (30) days from TMT's receipt and approval of the Contractor's invoice. TMT shall complete its review of the Contractor's invoice no later than ten (10) days from the receipt of the Contractor's invoice. TMT has the right to withhold any and all taxes and duties required by law or regulation. The Parties understand and agree that all terms and conditions regarding payment by TMT are contingent upon Contractor's full and timely compliance with all administrative and documentation requirements. Failure by Contractor to comply with all administrative and documentation requirements in a timely manner may result in a delay of payment. TMT is not liable for any delay of payment due to Contractor's non-compliance with this Article IV.C.

1. Payment shall be in US Dollars. The remittance address, if payment is made by check, shall be:

[Supplier Address for A/R]

Article V. PROPRIETARY INFORMATION

A. Proprietary Information Defined.

1. "Proprietary Information" means confidential proprietary information (including business, financial or technical data, machine-readable or interpreted information, information contained in physical components, mask works or artworks in written or other permanent form) that is delivered to the recipient, bears the date of disclosure, and is visibly identified by clear and conspicuous markings as the disclosing Party's Proprietary Information. A non-written disclosure shall be considered Proprietary Information to the extent that such disclosure is orally identified as Proprietary Information at the time of disclosure and is confirmed in writing by the disclosing Party. Such written confirmation shall: (i) sufficiently describe the information disclosed in detail, its scope, and the date and manner of disclosure; (ii) identify disclosers and recipients; (iii) be supplied within 10 days after oral disclosure; and (iv) refer to this Article.

2. Contractor's Proprietary Information does not and shall not under any circumstances include: (a) any deliverables submitted by Contractor to TMT under this Contract unless otherwise agreed to in writing authorized by the Parties, (b) information in TMT specifications or in any future modifications thereto, including, but not limited to, modifications suggested by Contractor; or (c) any scientific data.

B. Obligations of Receiving Party. The receiving Party shall preserve the disclosing Party's Proprietary Information for three years from the date of disclosure and will maintain the confidentiality of the Proprietary Information with at least the same degree of

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care that it uses to protect its own confidential information, but no less than a reasonable degree of care under the circumstances. The receiving Party will not disclose any of the disclosing Party's Proprietary Information, except to its employees, project members or consultants who have a need to know and who agree to abide by nondisclosure terms at least as comprehensive as those set forth herein. The receiving Party will not disclose a disclosing Party's Proprietary Information to any third party without the disclosing Party's prior written authorization. Any copies that are made will be identified as belonging to the disclosing Party and marked "Proprietary" or with a similar legend. A receiving Party may not use Proprietary Information to reproduce, redesign, or reverse engineer any products or equipment of the disclosing Party.

C. No Liability for Certain Disclosures. The receiving Party will not be liable for the disclosure of any information, regardless of its designation as Proprietary Information, if it is (a) rightfully in the public domain other than by a breach of a duty to the disclosing Party; (b) rightfully received from a third party without any obligation of confidentiality; (c) rightfully known to the receiving Party without any limitation on use or disclosure prior to its receipt from the disclosing Party; (d) independently developed by the employees of the receiving Party; or (e) generally made available to third parties by the disclosing Party without restriction on disclosure.

D. Disclosures Required by Law. Should a receiving Party be faced with a legal obligation to disclose Proprietary Information received under this Contract, the receiving Party shall, as soon as possible, notify the disclosing Party, and upon request of the disclosing Party shall reasonably cooperate in contesting such disclosure. Except in association with a failure to discharge the responsibilities set forth in this paragraph, neither Party shall be liable for any disclosures made pursuant to federal or state law.

E. This Article V shall survive expiration or termination of this Contract.

Article VI. ADDITIONAL TERMS AND CONDITIONS

A. Independent Contractor. Contractor is engaged as an independent contractor and not as an agent or employee of TMT. Contractor shall have no authority to bind or obligate TMT in any manner whatsoever. Contractor shall be solely liable and responsible for its employment practices and for paying its own employee salaries, benefits, taxes and withholdings.

B. Indemnity.

1. Contractor agrees to indemnify, defend and hold harmless TMT, its directors, officers, members, employees, agents, assigns and affiliates from any and all liabilities, claims, damages, losses, reasonable attorneys' fees, and other reasonable costs of defense (including costs incurred prior to commencement of a lawsuit) resulting from or attributed to (i) Contractor's breach of its representations, warranties or obligations set forth in this Contract; (ii) any assertion that any component of the Work infringes, misappropriates, or violates any patent right, copyright right, trade secret, or other proprietary right of any third party; or (iii) any negligent or unlawful act or omission of Contractor or any of its employees and/or agents in the performance of this Contract.

2. If TMT seeks indemnification pursuant to this Contract, TMT shall notify the Contractor in writing of any claim or the commencement of any action or proceeding that TMT believes is subject to indemnification (referred to as the "Claim"). TMT shall also forward all documents in its possession and

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communicate all information known by it to the Contractor to the extent such documents and information are relevant to the Claim.

3. The Contractor shall have the right, at its option and sole expense, to assume sole responsibility for defending or settling the Claim, and shall have the right to use legal counsel of its choice. If the Contractor exercises this option, (i) it shall notify TMT, (ii) TMT shall cooperate in the settlement or defense of the Claim, and (iii) the Contractor shall not be liable to TMT for any legal or other expenses subsequently incurred by TMT in connection with settling or defending the Claim. If the Contractor refuses to accept responsibility for defending or settling the Claim, TMT shall exercise reasonable efforts to defend or settle the Claim, and any recovery against TMT suffered by it in good faith under such circumstances shall be conclusive in TMT's favor against the Contractor.

4. This Article VI, Section B shall survive expiration or termination of this Contract.

C. Limitation of Liability. NEITHER PARTY SHALL BE LIABLE TO THE OTHER PARTY FOR ANY LOST PROFITS OR PUNITIVE, SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES ARISING OUT OF THIS CONTRACT, EVEN IF SUCH PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Notwithstanding anything to the contrary in this Contract, this paragraph shall not apply to damages arising out of or relating to the following: (i) damage claims payable to third parties, irrespective of the basis for such claims; and (ii) violations of law. This section shall survive expiration or termination of this Contract.

D. Insurance. At all times during the term of this Contract, the Contractor shall procure and maintain, at its own expense, the following insurance coverage: (A) workers' compensation at statutory limits, (B) employer's liability insurance with limits of at least \$1,000,000 per occurrence, and (C) comprehensive general liability (including bodily injury, property damage and contractual liability) insurance with limits of at least \$1,000,000 per occurrence. Contractor shall give TMT at least 30 days prior written notice of any cancellation of insurance coverage or any proposed reduction of insurance coverage below the limits set forth in this Section. Contractor shall provide TMT with a certificate of insurance for the required coverage promptly upon request.

E. Governing Law. This Contract shall be governed by and construed in all respects in accordance with the laws of the State of California without giving effect to its choice of law rules. This section shall survive expiration or termination of this Contract.

F. Export Regulations. Contractor shall comply with all export control laws and regulations in the performance of this Contract. The Contractor shall be responsible for (a) obtaining appropriate licenses or other approvals, if required, for exports of hardware, technical data, and software, or for the provision of technical assistance; and (b) all regulatory record-keeping requirements associated with the use of licenses and license exemptions/exceptions. This section shall survive expiration or termination of this Contract.

G. Dispute Resolution.

1. **Pre-Arbitration Procedures.** Except as provided below, in the event of any dispute or controversy arising out of or relating to this Contract, including its validity, enforceability, performance, or breach ("Dispute"), the Party alleging a Dispute will notify the other Party of the existence of the Dispute, and provide

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reasonable detail about the Dispute. Senior officials representing both Parties will meet and attempt to resolve the Dispute within 15 days of the notice.

2. Arbitration. In the event senior officials do not meet or are unable to resolve a Dispute within the above period, the Dispute shall be resolved exclusively by final binding arbitration in accordance with the then-current Commercial Arbitration Rules of the American Arbitration Association (AAA). The Parties shall endeavor to select a mutually acceptable arbitrator within fifteen (15) days of the Notice of a demand of arbitration ("Arbitration Notice"). In the event the Parties are unable to agree to such a selection, AAA procedures shall be used to select a single arbitrator. The costs for the arbitration and the fees of the arbitrator shall be shared equally by the Parties. All Parties agree that arbitration shall take place within the County of Los Angeles, California. The arbitrator shall not have the authority, power, or right to award punitive damages. The arbitrator shall have the power to issue mandatory orders and restraining orders in connection with the arbitration. The arbitrator shall endeavor to commence the arbitration within sixty (60) days of the Arbitration Notice. A written award shall be rendered by the arbitrator within thirty (30) days of the end of the arbitration hearing(s), and shall be final and binding on the Parties. Judgment may be entered thereon in any court having jurisdiction.

3. Continued Performance Pending Dispute Resolution. Pending the resolution of the Dispute, the Parties shall, without delay, continue to perform their respective obligations under this Contract.

4. This Article VI, Section G shall survive expiration or termination of this Contract.

H. Notice. Written notices from one Party to the other shall be given by one of the following methods: (a) United States registered mail, return receipt requested, and said notice shall be deemed to have been given three (3) days after said notice is deposited into the United States mail; (b) personal delivery, and said notice shall be deemed given upon such delivery; or (c) recognized overnight courier service, (d) telefax; or (e) e-mail, and said notice shall be deemed given upon delivery by such service at the following addresses or at such other address of which either Party shall advise the other in writing:

To TMT:	TMT International Observatory LLC 1111 South Arroyo Parkway Suite 200 Pasadena, CA 91105 ATTN: Pratheep Eamranond pratheep@tmt.org
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To Contractor:	[Contractor Notice Information]
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This section shall survive expiration or termination of this Contract.

I. Force Majeure. Neither of the Parties shall be responsible for failure or delay of performance if caused by: an act of war, hostility, or sabotage; act of God; electrical, internet, or telecommunication outage that is not caused by the obligated Party; government restrictions (including the denial or cancellation of any export or other license); or other event outside the reasonable control of the obligated Party. The Parties will use reasonable efforts to mitigate the effect of a Force Majeure event. If such event

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continues for more than 30 days, either Party may cancel unperformed services upon written notice.

J. Entire Contract. This Contract constitutes the complete and exclusive statement of the Contract between the Parties and supersedes all prior representations, understandings, and communications, oral and written, between the Parties relating to the subject matter thereof.

K. Headings. The headings within this Contract are inserted for convenience of reference only and not to define, describe or limit the scope or the intent of this Contract or any term hereof.

L. Assignment. The Parties may not assign or delegate any of their rights or obligations under this Contract unless it is authorized through an advance, written amendment that is executed in accordance with Article VI.R of this Contract, and any attempt to do so shall be void.

M. TMT Property. FAR clause 52.245-1 (June 2007) is incorporated into this Contract in its entirety with the following exceptions:

1. "TMT" shall be substituted for all instances of "Government,"
2. "TMT contract manager" shall be substituted for all instances of "contracting officer" or "property administrator,"
3. "Customer Furnished Property" shall be substituted for instances of "Government Furnished Property,"
4. Paragraph (h)(1) of FAR clause 52.245-1 is revised to read as follows:
 - a. Risk of Loss. Contractor, upon the delivery to it or acquisition by it of any TMT property, assumes the risk of and shall be responsible for all loss thereof or damage thereto. When such property is no longer needed for the performance of this Contract, or at such other time as may be directed by TMT, Contractor shall return such property to TMT, as applicable, in as good a condition as when received, except for reasonable wear and tear, and except for such property as has been reasonably consumed in the performance of work hereunder.

N. Waiver. No failure of either Party to exercise any power given hereunder or to insist upon strict compliance with any obligations specified herein, and no custom or practice at variance with the terms hereof, shall constitute a waiver of any Party's right to demand strict compliance with the terms hereof.

O. Severability. If any term or provision of this Contract, or the application thereof to any person or circumstance, shall to any extent be found to be invalid, void, or unenforceable, the remaining provisions of this Contract and any application thereof shall, nevertheless, continue in full force and effect without being impaired or invalidated in any way.

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P. No Third-Party Beneficiary. Nothing in this Contract, express or implied, is intended to confer on any person other than the Parties hereto and their respective successors and permitted assigns any rights, remedies, obligations or liabilities under or by reason of this Contract.

Q. Data Rights. Except as otherwise stated in this Contract and required by law, TMT will own all rights to the work product developed or fabricated pursuant to this Contract and will have the right to use, reproduce and adapt it for any purpose. If requested, Contractor will sign or assist in preparation of documents necessary to perfect title to the work product at TMT's expense. TMT's ownership and title to its information shall not be affected by the transfer of the information to the Contractor for purposes of carrying out the terms of this Contract. Ownership and right to use or modify the work product shall survive the term of this Contract.

R. Changes to Contract. This Contract may be modified, amended or waived only by a written instrument executed by both TMT and the Contractor. If the terms of this Contract are modified, amended or waived such that the change causes an increase or decrease in the cost of, or the time required for, the Work, the parties may agree to an equitable adjustment in the Fixed Price, the delivery schedule, or both. Contractor must assert its right to an adjustment under this clause within fifteen (15) days from the date it receives a written request for a change from TMT. Failure to agree to an adjustment shall be a dispute under the Dispute Resolution clause.

S. Termination for Default. TMT reserves the right to terminate all or any part of this Contract if Contractor breaches any provision of this Contract and fails to cure such breach within ten (10) days of receiving notice thereof from TMT. TMT may immediately terminate this Contract in the event of any of the following (a) insolvency of Contractor, (b) filing of a voluntary petition in bankruptcy by Contractor, (c) filing of any involuntary petition of bankruptcy against Contractor, (d) appointment of a receiver or trustee for Contractor, (e) or execution of an assignment for the benefit of creditors by Contractor, provided such petition, appointment, or assignment is not vacated or nullified within fifteen (15) days after such event. In the event of termination for default, TMT shall have no remaining liability to Contractor under this Contract other than to pay for any labor or materials accepted by TMT on or before the effective date of the default. TMT's rights under this paragraph are in addition to any other remedies available hereunder or by law.

T. Termination for Convenience. TMT reserves the right to terminate this Contract, or any part hereof, for its sole convenience. In the event TMT gives Contractor notice of such termination, Contractor shall immediately stop all Work hereunder and shall cause any and all of its suppliers and subcontractors to promptly cease work. Within sixty (60) days after the effective date of a termination for convenience, Contractor shall submit a detailed termination claim to TMT with sufficient supporting data to permit TMT's audit and such additional supporting information as TMT requests ("Termination Claim"). The Termination Claim must be certified by the Contractor to represent the sum of all claims under the terminated Contract. The Contractor must also certify on the Termination Claim that no additional claim for services, materials, rights or benefits under the terminated Contract will be brought by the Contractor. Subject to the terms of this Contract, Contractor shall be paid its reasonable out-of-pocket costs for terminating the Work as of the effective date of the termination. TMT's payment to Contractor shall be due within thirty (30) days after its receipt of the Termination Claim less any amount disputed in good faith by TMT. TMT, or its agents, shall have the right to audit and examine all books, records, facilities, work, material, inventories, and other items related to any termination claim of Contractor. Contractor shall not be entitled to reimbursement

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for any work performed or costs incurred which reasonably could have been avoided at the time of termination.

U. Effect of Termination. Upon termination of this Contract, the Parties shall have no further obligation to one another, except for those obligations that survive the termination of this Contract as expressly set forth herein.

V. Counterparts. This Contract, and any amendments hereto, may be executed in counterparts, each such counterpart to be considered an original and all of which shall be construed together as one and the same document.

W. Authorization. The undersigned individuals represent that they are fully authorized to execute this Contract on behalf of the named Parties.

IN WITNESS WHEREOF, intending to be bound, Contractor and TMT have caused this Contract to be signed by their duly authorized representatives.

TMT International Observatory LLC

Contractor

By _____

By _____

Name

Name

Title

Title

Date

Date

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7.0 Exhibits

All RFP Exhibits are provided on an "as is" basis. All of the Exhibits are subject to change without notice. TMT is not responsible for the content of these Exhibits or the results of using these Exhibits for any use other purpose than the review of the design and preparation of costs and schedules for this RFP.

List of Exhibits:

- A. **[Exhibit A]:** VCAM Cost Matrix
- B. **[Exhibit B]:** Subsystem Requirements Document for the NFIRAOS VISIBLE WAVEFRONT SENSOR CAMERA (VCAM)
- C. **[Exhibit C]:** Interface Control Document NARROW FIELD INFRARED ADAPTIVE OPTICS SYSTEM (NFIRAOS) to NFIRAOS VISIBLE CAMERA (VCAM)
- D. **[Exhibit D]:** Interface Control Document NFIRAOS VISIBLE CAMERA (VCAM) to NFIRAOS REAL TIME CONTROLLER (NRTC)
- E. **[Exhibit E]:** Interface Control Document NFIRAOS VCAM POLAR COORDINATE DETECTOR to NFIRAOS VISIBLE CAMERA (VCAM)
- F. **[Exhibit F]:** Mechanical ICD of the WFS Camera to LGS System
- G. **[Exhibit G]:** Mechanical ICD of the WFS Camera to NGS System
- H. **[Exhibit H]:** NFIRAOS VCAM Interface Controller Interface Drawing

The following Exhibit J is provided solely for reference purposes. Exhibit I is not incorporated into the Contract and is not binding on the Parties.

- I. **[Exhibit I]:** Contractor's VCAM Design and Development Proposal dated _____
- J. **[Exhibit J]:** Offer Submittal Form

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TMT International Observatory LLC

EXHIBIT K - Offer Submittal Form

Organization Information

Offeror Name:

U.S. EIN (If Applicable):

Address:

*Street Address**City**State**ZIP Code*

Offeror Information

Full Name:

*Last**First**M.I.*

Title:

Address:

*Street Address**City**State**ZIP Code*

Tel: ()

Fax: ()

TOTAL ESTIMATED
COST OF PROPOSAL

E-mail Address:

Electronic Mailing Instructions

Please send to:

pratheep@tmt.org

cboyer@tmt.org

cwong@tmt.org

TMT RFP No.: TMT.BUS.MGT.15.081.REL01

Terms and Condition

Acceptance. The Offeror hereby accepts all the terms and condition set forth in the referenced RFP. The signature affixed below is made by an individual authorized to bind the Offeror.

Authorized Signature

Date Signed

Print Name

Title

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(Last Page of the RFP)

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