

ENCLOSURE C

**SYSTEMS ENGINEERING ADVANCED SERVICES
(SEAS)**

REPRESENTATIVE TASK ORDERS (RTOs)

RFP NNG15499015R

SEAS Representative Task Order 1 (RTO 1)

Task Background

NASA Headquarters has awarded Goddard Space Flight Center a mission to globally find and track forest and brush fires from the tropics to the temperate zone. The ABC mission is required to provide near-real time images of fires and smoke plumes using nearly contiguous spectral bands from visible to near infrared. The satellite is targeted to launch around June 2020. This task is to provide mission & instrument systems engineering support for mission formulation, payload preliminary design and ground operations formulation as defined below. NASA has agreements from several interested countries in these observation zones who want to participate in using the fire detection data of this mission. NASA has a Memorandum of Agreement (MOA) with these countries describing what NASA will provide.

Period of Performance

The task order will be awarded effective January 1, 2016, with a period of performance from January 1, 2016 through December 31, 2018.

Science Requirements

The science requirements driving the mission are as follows:

Table 1 – Science Requirements

Scientific area of interest	40 degrees N and S latitudes
Spectral Requirements	
Spectral Range	At least 0.5 to 5 microns
Spectral Resolution ($\lambda/\Delta\lambda$, λ = wavelength)	At least 20
Spectral Gaps	Visible Range – No greater than 50 nm
	Near-IR Range* – No greater than 250 nm
Ground Resolution (true nadir pointing)	Better than 5 meters at 0.5 microns
	Better than 15 meters at 5 microns
Target Location Accuracy (Absolute location)	Better than 200 meters in latitude and longitude in geodetic coordinates
Repeat Imaging	when an observation triggers an event, provide at least one repeat image of the same area no more than 120 minutes apart

* In the IR spectral range the gaps should coincide with the high absorption regions of the atmosphere

Mission Requirements

Based on initial concept work conducted by a team of GSFC civil servants, the following mission requirements exist:

Table 2 – Mission Characteristics

Mission Lifetime	10 years
Launch System	Delta II 7900-series (notional)
Observatory Cost	Less than \$400M
Risk Classification	B
Mission Ops	NASA recommends the Project use existing NASA communications and Ops Centers, such as TDRSS and the EOS Operations and Data Processing Center
Member Country MOA	NASA will provide: <ol style="list-style-type: none"> 1. Data calibration and archive 2. Notice of a fire event in < 30 minutes including site-specific imagery 3. An Ops Center to member country data rate of up to 100 MB/sec

Applicable Documents

- NPR-7120.5E NASA Space Flight Program and Project Management Requirements
- GSFC-STD-1000F GSFC Rules for the Design, Development, Verification, and Operation of Flight Systems
- NASA/SP-2007-6105 NASA System Engineering Handbook
- FFS-001 Science Level 0 Requirements
- FFS-002 Mission Assurance Requirement Plan

Statement of Work

The contractor shall complete formulation efforts for the ABC Mission. The contractor shall staff a systems engineering team to address the science and mission requirements and complete the subtasks outlined below. The contractor shall include discipline-specific support to augment the systems engineering team where this makes sense to complete the requirements for each subtask. The contractor’s systems engineering team shall report to the project manager and project scientist, who are civil servants at the Goddard Space Flight Center.

The overall period of performance is 36months. The Payload Preliminary Design Review is scheduled for 34months after task award. The spacecraft and payload will be designed and built at GSFC. The observatory Integration & Test (I&T) will be at GSFC and the launch site will be the Kennedy Space Center. The contractor will travel as needed for meetings and design reviews.

Subtask 1: Mission Formulation

1. Define the mission concept and identify trade studies that drive the mission architecture.
2. Write and review mission-level requirement specifications as required.
3. Define an observatory architecture that meets the requirements.
4. Define a science payload (telescope and science instrument) architecture that provides the science data.
5. Define the spacecraft and its resources that support the science payload.
6. Define the appropriate trade studies for a) relevant telescope technologies including their Technology Readiness Level (TRL) and relative value to the mission and for b) the telescope design.
7. Define the appropriate trade studies for a) relevant instrument technologies including their TRL and relative value to the mission and for b) a Science Instrument (SI) design.
8. Define plans for the telescope and instrument technology development and other high-risk or long-lead items, including off-ramps and alternatives.

Deliverables

Table 3 – Subtask 1 Deliverables

Deliverable	Due Date
Schedule to Mission Preliminary Design Review (MPDR)	30 days after task award
Preliminary Mission Concept Review Presentation	3 weeks prior to MCR
Final Mission Concept Review (MCR) Presentation	1 week prior to MCR
Configuration Managed versions of the following:	
Requirements specification document(s)	1 month prior to MCR
Spacecraft Resources Budget	1 month prior to MCR
Trade Study Final Report(s)	1 month prior to MCR
Risk Assessment	1 month prior to MCR
System Engineering Management Plan (SEMP)	1 month prior to MCR

Subtask 2: Payload Preliminary Design

1. Provide systems engineering for a telescope preliminary design that meets the mission requirements.
2. Provide systems engineering for a Science Instrument (SI) preliminary design that meets the mission requirements.
3. Provide a draft integration and test plan for the telescope, the SI, and the entire payload.
4. Define the data and power resources for the payload.
5. Write a flight software systems preliminary design document and estimate the on-board flight software needed to operate the payload.
6. Define the thermal control subsystem necessary to operate the payload.
7. Perform risk assessment.
8. Prepare draft and final Mission Preliminary Design Review documentation.
9. Conduct PDR Dry Run 3 weeks prior to MPDR.
10. Update specifications and plans.
11. One month after the start of Phase B, NASA HQ requests that an optional capability be considered for this mission. NASA JPL has an existing qualified instrument that measures forest canopy and soil moisture. In order for HQ to decide to include this instrument, it has requested NASA GSFC to provide an analysis of the impact to mission and satellite requirements, and to the other systems engineering products that are needed to determine the viability of adding this option to the mission.

Deliverables

Table 4 – Subtask 2 Deliverables

Deliverable	Due Date
Payload Preliminary Design Review Presentation Draft	4 weeks prior to PDR
Payload Preliminary Design Review Documentation	1 week prior to PDR
Payload Preliminary Design Review (PDR) Presentation Final	1 week prior to PDR
Response to Optional Capability (Task 11)	1 week prior to PDR

Subtask 3: Ground Operations Formulation

1. For Mission Concept Review, design and present a ground system architecture and document the trade studies that lead to the design.
2. For Mission Concept Review, write and provide the draft ground system requirements, draft Con Ops, draft Interface Requirements Control Documents (IRCDs), and draft Memorandum Of Understandings (MOUs) with other NASA infrastructure entities that are providing ground system functions.
3. For Mission Concept Review, provide an integration and test plan.
4. For Mission Concept Review, provide a schedule and manpower plan up to PDR.

5. For the Mission Preliminary Design Review (MPDR), provide a ground system design.
6. For the Mission Preliminary Design Review, provide a draft operations concept document.
7. For the Mission Preliminary Design Review, provide a draft data calibration and handling plan, including plans for Member Country early-warning, and site-specific imagery data distribution.
8. Prepare **Mission** Preliminary Design Review documentation.
9. Prepare **Mission** Preliminary Design Review presentation and conduct Dry Run 3 weeks prior to MPDR.

Deliverables

Table 5 – Subtask 3 Deliverables

Deliverable	Due Date
Draft Ground System Requirements, IRCDs, Ops Con	6 weeks prior to MCR
Schedule & Manpower Plan to Mission PDR	1 week prior to MCR
Ground System Mission Concept Review Presentation	1 week prior to MCR
Draft Requirements, IRCDs, Ops Con	1 week prior to MPDR
Draft Data Calibration and Data Handling Plan	1 week prior to MPDR
Preliminary Mission Preliminary Design Review Presentation	1 week prior to MPDR

- End of RTO 1 -

SEAS Representative Task Order 2 (RTO 2)

Task Background

NASA Headquarters has awarded Goddard Space Flight Center a mission to globally find and track forest and brush fires from the tropics to the temperate zone. The Project X mission is required to provide near-real time images of the earth's surface using nearly contiguous spectral bands from visible to near infrared. The satellite is targeted to launch in June 2020. This task is to provide mission systems support for payload and observatory integration and test (I&T) support as defined below.

Task Period of Performance

The task order will be awarded effective May 1, 2017, with a period of performance from May 1, 2017 through April 30, 2019.

Mission Requirements

Based on initial concept work conducted by a team of GSFC civil servants, the following mission requirements exist:

Table 1 – Mission Characteristics

Mission Orbit:	
Circular	700 km
Inclination	55° (minimum)
Mission Lifetime	Minimum 10 years
Launch System	Taurus
Launch Mass	200 kg
Delta-V Requirements	800 m/s
Attitude Control	3-axis stabilized, nadir-pointing
Pointing accuracy	10 arc-sec, 1 sigma
Pointing Stability	0.1 arc-sec over 1 sec
Communications	
Telemetry (incl. Science data)	X-Band
Command	S-Band
Clock Accuracy	5 millisecond knowledge to UTC
Risk Classification	B

Applicable Documents

NPR-7120.5E	NASA Space Flight Program and Project Management Requirements
NASA-STD-1000F	GSFC Rules for the Design, Development, Verification, and Operation of Flight Systems
NASA/SP-2007-6105	NASA System Engineering Handbook
GSFC-STD-1001A	Criteria for Flight and Flight Support Systems Lifecycle Reviews
PX-001	Project Level 1 Requirements
PX-002	Mission Assurance Requirement Plan
PX-003	Mission Requirements Document

Statement of Work

The contractor shall complete final implementation and integration and test efforts for the Project X Mission. The contractor shall staff a systems engineering team to verify the science and mission requirements and complete the subtasks outlined below. The contractor's systems engineering team shall report to the project manager and project scientist, who are civil servants, at Goddard Space Flight Center. The overall period of performance is twenty-four months. Work shall start just after completion of Mission Critical Design Review (CDR) and the Observatory Pre-Ship Review (PSR) is scheduled for twenty-three months after task award. The contractor will travel as needed to design reviews and instrument technical interface meetings until the instrument is delivered. The contractor may have to travel for spacecraft subsystems for any major anomalies affecting the spacecraft interfaces.

Assumptions

1. All work will be performed on-site at GSFC, unless otherwise stated.
2. All subsystem Ground Support Equipment is provided by subsystem Product Development Leads.
3. Observatory environmental testing is expected to last several months.

Subtask 1: Finalize Design and Observatory Integration and Test

1. Finalize observatory system design incorporating engineering changes and updating documentation as needed, utilizing existing engineering tools.
2. Perform system design trades as necessary.
3. Analyze, track and finalize the mass, power and software resources for the subsystems and system.
4. Take delivery of the science payload and integrate with spacecraft.
5. Take delivery of the science payload Ground Support Equipment (GSE) and integrate with spacecraft GSE.
6. Integrate the various flight spacecraft subsystem components and instrument according to the integration and test plan.

7. Perform trades on how to best utilize instrument test equipment and whether modification is necessary to properly test the payload or new targets and/or sensors are needed to perform Comprehensive Performance Testing (CPT).
8. Verify Interface Control Documents (ICDs) of the subsystems during final design efforts and spacecraft integration.
9. Track, manage, and perform risk assessment at subsystem and system level.
10. Execute Instrument technology performance measurements and assessments to include but not limited to:
 - a. Data compression techniques
 - b. Science data formats and distribution
 - c. Science instrument performance and latency requirements with the ground system

Deliverables

Table 2 – Subtask 1 Deliverables

Deliverable	Due Date
Updated Verification Matrices	at Pre-Environmental Review (PER)
Updated System I&T Plan	1 month prior to System Integration Review (SIR)
Status and Schedule Reports	Monthly
Observatory Comprehensive Performance Test Plan	4 months prior to environmental testing

Subtask 2: Mission Implementation

1. Update and finalize System Integration and Test plan, including launch site and shipping operations. Perform the necessary tasks to make sure integration facilities, clean rooms, ground support equipment, handling fixtures, cranes, and electrical test equipment are ready or available when required.
2. Identify, document, and do analyses or tests to disposition any discrepancies or anomalies during integration and test.
3. Update the Concept of Operations document for final approval.
4. Develop and test the Mission Operations Center (MOC) architecture.
5. Write system level test plans and execute system level tests to verify interfaces with launch vehicle, MOC, and launch facility. This may also include external interfaces like a Science Operations Center (SOC).
6. Develop and finalize a Launch and Early Orbit checkout plan.
7. Develop and finalize a launch site operations plan.

Deliverables

Table 3 – Subtask 2 Deliverables

Deliverable	Due Date
Schedule to PSR	30 days after task award
System Integration Review Presentation	3 months after task award
Environmental Test Readiness Review Documents	1 month prior to environmental testing
Final versions of the following:	
Command Telemetry Handbook and Database	1 month prior to PSR
Risk Assessment	1 month prior to PSR
Transition Plan	1 month prior to PSR
Update the following:	
Operations Concept Document	1 month prior to PSR
Verification and Validation Plan	1 month prior to PSR
Technical Data Management Plan	1 month prior to PSR

Subtask 3: Environmental Testing

1. Execute the environmental test plan for the observatory.
2. Define the requirements for mechanical and electrical GSE needed to perform environmental tests on the observatory.
3. Perform tracking and closing of Problem Reports and Problem Failure Reports.
4. Perform risk tracking, assessment, mitigation, review and retirement.
5. Perform verification tracking and closure for both instrument and spacecraft in all flight configurations.

Deliverables

Table 4 – Subtask 3 Deliverables

Deliverable	Due Date
Completed CPT Package	1 month prior to PSR
Completed Verification Logs	1 month prior to PSR

- End of RTO 2 -