



ATTACHMENT
(TBD)

USGS EROS
Landsat 9

Landsat Mission Operations
Contract
STATEMENT OF WORK
(DRAFT)

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Landsat 9 Controlled Document

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Landsat 9 Project

Landsat Mission Operations (LMO)

Contract

**DRAFT Statement of Work
(SOW)**

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CM Foreword

This document is a Landsat 9 Project (CM)-controlled document. Changes to this document require prior approval of the applicable Configuration Control Board (CCB) Chairperson or designee. Proposed changes shall be submitted to the Landsat 9 Project Office, along with supportive material justifying the proposed change.

In this document, a requirement is identified by “shall,” a good practice by “should,” permission by “may” or “can,” expectation by “will,” and descriptive material by “is.”

Questions or comments concerning this document should be addressed to:

TBD

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List of TBDs/TBRs

Item No.	Location	Summary	Ind./Org.	Due Date

DRAFT

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1.0 INTRODUCTION

Landsat 9 is a joint mission being formulated, implemented, and operated by the National Aeronautics and Space Administration (NASA) and the Department of Interior (DOI) United States Geological Survey (USGS). Landsat 9 is a remote sensing satellite mission providing coverage of the Earth's land surfaces. This mission continues the 43+ years of global land data collection and distribution provided by the Landsat series of satellites.

This Statement of Work (SOW) defines the Contractor's efforts required for the Mission Operations Center (MOC) development and implementation, along with Ground System and Observatory integration for the Landsat 9 Mission, and flight operations of the Landsat 9 Observatory.

The Landsat 9 Observatory will provide the USGS with continuation of four decades of global terrestrial imaging by extending the measurement series previously carried out by the Landsat series of satellites. NASA will provide the space segment (spacecraft and instruments) and launch segment. The USGS will provide the ground segment, including the Mission Operations Center (MOC), Landsat Ground Network and science data processing, as well as archive and distribution. The USGS will also perform mission operations.

Figure 1-1 identifies the segments, systems, and elements required to accomplish the Landsat 9 mission.

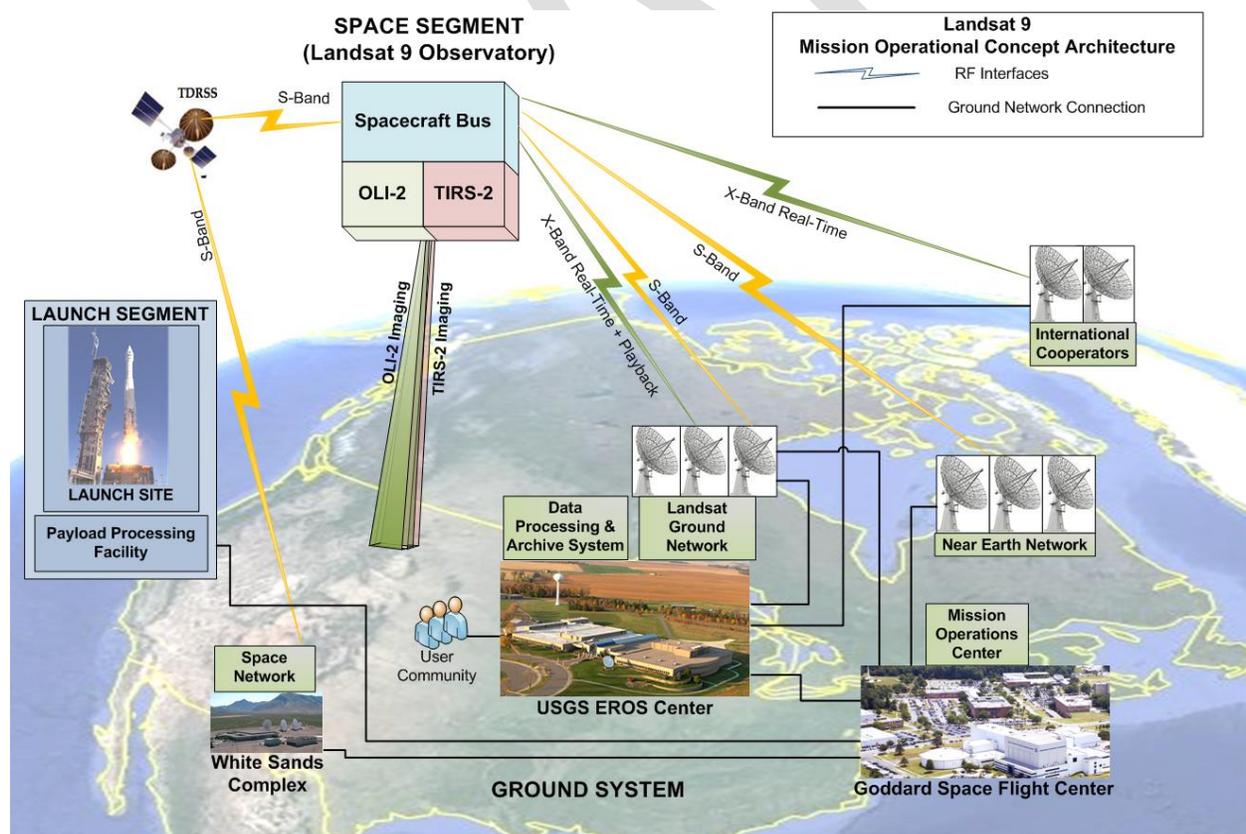


Figure 1 Landsat 9 Block Diagram

The Landsat 9 Spacecraft will be launched from Vandenberg Air Force Base on a NASA-provided launch vehicle.

1.1 Scope

This Statement of Work (SOW) defines the minimum required effort from the contractor of the Landsat Mission Operations (LMO) Contract that shall include but is not limited to the design, engineering analysis, development, integration, test evaluation and delivery of the primary and backup Mission Operations Center (MOC) systems as well as support of the launch, on-orbit checkout, and acceptance of the Landsat 9 Observatory, and continued flight operations of the Landsat 9 mission. Details of this work are included within this document as well as the additional applicable documents listed in section 1.3.

The primary functions of the LMO Contract include:

- MOC Development
 - Development and test of MOC systems (hardware and software), to include command and control, mission planning and scheduling, trending and analysis, flight dynamics, observatory health and safety monitoring, on-board storage management, and flight software management
 - Integration, testing and delivery of MOC systems to the primary and backup government-provided MOC facilities.
- Flight Operations support to Pre-launch, Launch, and Early Orbit activities
 - Participation as required in overall mission design and review process
 - Development of operations products, scripts, etc. required for testing and operations
 - Participation in mission integration and operational readiness testing and checkout activities toward mission readiness, led by the government
 - MOC staffing and operations as part of the larger project team conducting launch and early orbit operations, led by the government
- On-orbit Landsat 9 Flight Operations through period of performance
 - All on-orbit MOC staffing and operations
 - Maintenance and Sustainment of all MOC systems and software

The functional MOC system will be delivered to a Mission Operations Center (MOC) in a Government provided facility at the NASA Goddard Space Flight Center in Greenbelt, Maryland. A backup MOC (bMOC) system will be delivered to a Government-provided bMOC facility also at NASA Goddard Space Flight Center (**TBD**).

The Government is responsible for providing the observatory and the Ground System, other than the MOC systems, for mission systems integration, and mission operations. The Contractor shall support the LMO-related portions of the Government's ground system integration and mission system integration efforts. The Contractor shall also provide a Flight Operations Team (FOT) that will support the MOC development, ground system and mission integration and testing, observatory on-orbit checkout and the ongoing mission operations from the NASA GSFC MOC facility.

This Statement of Work requires delivery, installation and integration of the primary and backup MOC system capabilities to the GSFC MOC and GSFC bMOC (TBD) facilities, which shall meet the requirements of the L9 Mission Operation Center Requirements Document (MOC-RD), (LSDS-1648). It also includes instantiations of the MOC systems delivered to a spacecraft/observatory integration and test facility and to an instrument development and test facility. This Statement of Work requires delivery of all contract deliverables associated with the LMO scope of work. The MOC systems shall meet the requirements of all contractual documents.

Provisional acceptance of the MOC system shall take place prior to the launch of the L9, following the verification of all requirements, successful completion of all MOC testing, and the successful completion of the L9 Operations Readiness Review. Final acceptance of the MOC system shall take place at the end of the on orbit checkout phase of the L9 observatory, following verification of any post-launch MOC deliveries/releases as well as a successful Post Launch Assessment Review (PLAR) and On-Orbit Acceptance Review (OAR).

1.2 Terms and Definitions

1.2.1 Terms

- “TBD” (To Be Determined) indicates further research or analysis is needed to determine the information - a pending decision. “TBR” (To Be Refined) means that the stated information needs more analysis and will be reviewed for appropriateness by the Contractor and the Government and the value may be changed prior to final definition by the Government. All changes to resolve these “TBX” items will be done through a formal process of configuration change review, approval, and DO modification.
- The term “observatory” refers to the spacecraft bus fully or partially integrated with one or more flight instruments.
- The term “Government” represents the appropriate NASA and/or USGS Landsat 9 management office or, where “the Government” is indicated as providing a function for or interface to the LMO Contractor, the function or interface may be provided by Government or Landsat 9 support service contractors.
- The term “developer” as used in this SOW shall be considered synonymous with “Contractor”

1.2.2 Definitions

- *Shall* – Compliance by the Contractor is mandatory. Any deviations from these contractually imposed mandatory requirements require the approval of the Contracting Officer.
- *May* – At the discretion of the Contractor or Government.
- *Will* – Designates the intent of the Government. Unless required by other contract provisions, noncompliance with the will requirements does not require approval of the contracting officer and does not require documented technical substantiation.
- *Engineering Peer Review (EPR)* – a meeting with approximately 2 to 5 Government representatives to discuss specific details of a given subsystem design or performance, subsystem test results, mode performance, etc. EPRs typically take place at the

Contractor's facility and take a day. EPRs are the principal means to familiarize review team members prior to a major design review. EPR actions are formally tracked by the EPR organizer and status provided to the project to verify closure of action items.

- *Technical Interchange Meeting (TIM)* – a meeting with approximately 5 to 10 Government representatives to discuss a system process or feature. For example, to reach understanding of an operation or analysis, presentation of test results, discuss planned interface changes, plan for an upcoming test, etc. TIMs typically are held at the Contractor's facility and run no more than two days. Actions are informally tracked by the TIM organizer.
- *Design Review (DR)*. Design reviews are major milestones in the implementation where information is formally presented to a panel of Government experts and external reviewers. DRs can involve up to 30 Government representatives and run up to four days. Action items are formally logged and tracked by the Project Office.
- *Release* – A major, pre-planned MOC hardware or software change package that contains a full installation of all software components being installed (stand-alone installation).
- *Patch* – A minor MOC hardware or software change (typically unplanned fixes or improvements) that is not required to include a full installation of software and is assumed to be installed on top of the latest release.
- *System Delivery* – Either a release or a patch delivered to the MOC or bMOC facility.

1.3 Applicable Documents

The documents listed in this section apply directly to the performance of the Landsat 9 Mission Operations Contract. These documents establish detailed specifications, requirements, and interface information necessary for the performance of the contract. Unless otherwise specified, the document version listed herein shall apply. In the case of conflicting requirements, the order of precedence of documents not specifically called out in the Contract is: this Statement of Work, the MOC Requirements Document, and then the Contract Data Requirements List.

- a. Landsat 9 Mission Operations Center (MOC) Requirements Document (MOCRD) (Document # LSDS-1648)
- b. Landsat 9 Mission Operations (LMO) Contract Data Requirements List (CDRL) (Document # TBD)
- c. Landsat 9 Ground System (GS) Requirements Document (GSRD) (Document # TBD)
- d. Landsat 9 Ground System Interface Requirements Document (GSIRD) (Document # TBD)
- e. Landsat 9 Spacecraft to Ground Interface Control Document (Document # To Be Provided)
- f. Landsat 9 Mission Operations (LMO) Surveillance Plan (Document # TBD)
- g. Land Satellites Data System (LSDS) Financial and Performance Reporting Requirements Document, LSDS-456
- h. Landsat 9 Mission Operations Concept (Document # TBD)
- i. Landsat 9 Ground System Operations Concept (Document # TBD)
- j. NIST Special Publication 800-53 Revision 4
- k. NIST FIPS PUB 140-2 certified uplink security system
- l. NIST FIPS PUB 197
- m. L9 MOC IT Security Compliance Matrix (Document # TBD)

- n. USGS-NASA L9 MOC ISA (Document # TBD)
- o. GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews
- p. Gold Rules (TBD)
- q. NPR 8000.4, Risk Management Procedural Requirements, April 25, 2002

1.4 Reference Documents

These documents contain information that may be useful in enhancing the understanding of the work required by this SOW.

- a. NASA NPR 7120.5E, NASA Space Flight Program and Project Management Requirements, Date TBD
- b. Landsat 9 Acronym List and Lexicon (Document # TBD)
- c. NPR 2810.1, Security of Information Technology (Date TBD)
- d. Committee on National Security Systems (CNNS) Policy No. 12 (Document # TBD)
- e. USGS Land Satellites Data Systems (LSDS) Risk Management Plan (Document # TBD)
- f. NASA Procedural Requirements for Limiting Orbital Debris (Document # TBD)
- g. Landsat Worldwide Reference System-2 (WRS-2) Definition, 427-02-07.

2.0 MANAGEMENT

2.1 Project Management

The Contractor shall maintain a project office to manage the technical activities and resources of the LMO Contract. The Contractor shall appoint a Project Manager to direct and manage the LMO Contract activities. The Contractor's Project Manager shall have responsibility for the overall technical performance, resource management, and schedule management of the contractual effort and all subcontracts. The Contractor's designated Project Manager shall report to a level of company management appropriate to ensure prompt resolution of all problems.

The Contractor shall prepare a Project Management Plan, in accordance with CDRL PM-01 that documents the manner in which the Contractor will manage and conduct the work described in this SOW. The Contractor shall define and implement a contract Work Breakdown Structure (WBS) categorizing the tasks to be performed during development, implementation, and operations and sustainment in accordance with the Project Management Plan.

The Contractor shall compile lessons learned (both positive and negative) documenting the experiences of the Contractor throughout the execution of the contract in accordance with CDRL PM-10. Lessons Learned are to be updated and provided prior to each major review.

The Contractor shall deliver a Final Report in accordance with CDRL PM-11 at the end of the contract period of performance.

2.1.1 Government Insight

The Contractor shall be open to Government attendance at all Contractor and subcontractor internal reviews, audits, meetings and other activities within the scope of the contract. The Contractor shall supply documents, records, and data to support Government activities associated with the LMO Surveillance Plan (Document # TBD). The Contractor shall develop an Organizational Conflict of Interest Avoidance Plan, in accordance with CDRL PM-02.

For access and insight activity, "Government" includes Government personnel and Government support contractor personnel. The Contractor shall allow and enable the use of Non-Disclosure Agreements with Government contractors where appropriate. The Contractor shall notify the Contracting Officer and the Contracting Officer's Representative (COR) of meetings, reviews or tests in sufficient time (nominally at least 10 working days for major reviews and formal tests) to permit meaningful Government participation.

The Contractor shall adhere to the requirements for the LMO as defined in the LMO Surveillance Plan. Should the Government identify non-compliance with requirements, a difference in interpretation of test results or in requirements, the Contractor shall take action to ensure compliance.

2.1.2 Government Visitor Support

The Contractor shall provide facilities to support up to two visiting Government representatives at the MOC system development site, including office space, telephones, and network access to the Contractor's electronic discrepancy database. The Contractor shall provide within this office space high-speed (broadband) internet access. Government representatives will include

government employees and/or technical support contractors, including but not limited to project management, technical and engineering staff.

2.1.3 Access to Controlled Facilities

The Contractor shall obtain all required access authorizations and submit any paperwork required for the Contractor to access Government controlled facilities.

The Contractor shall allow access by the Government to all Contractor facilities related to and supporting the LMO effort.

2.1.4 Risk Management

The Contractor shall establish and maintain a comprehensive risk management program. The Contractor shall generate a Risk Report that is presented and reviewed at all Monthly Project Status Reviews (MPSRs). The Contractor shall invite the Government to attend Contractor Risk Management Board meetings. The Contractor shall develop and implement a project-specific Risk Management Plan (RMP), in accordance with CDRL PM-03, as a means to anticipate, mitigate and control risks and to focus project resources to ensure success of the project.

The primary activities of the Contractor Continuous Risk Management (CRM) process are:

- a. Identify, analyze, plan actions/mitigations, track, control, and document reliability, quality, technical performance, schedule, and budget risks before they become problems.
- b. Evaluate, classify, and prioritize all identified risks.
- c. Develop and implement risk mitigation strategies, actions, and tasks and assign appropriate resources.
- d. Track risks being mitigated; capture risk attributes and mitigation information by collecting data; establish performance metrics; and examine trends, deviations, and anomalies.
- e. Control risks by performing: risk close-out, re-planning, contingency planning, or continued tracking and execution of the current plan.
- f. Communicate and document (via the risk recording, reporting, and monitoring system) risk information to ensure it is conveyed between all levels of the project.
- g. Report on outstanding risk items at all management and design reviews using a 5x5 risk matrix based on contractor's assessment of risk likelihood and consequence.

The Contractor shall document the project-specific implementation of the CRM process in a RMP. Preparation of the RMP includes the content shown in NPR 8000.4, "Risk Management Procedural Requirements."

The Contractor shall document and report all identified risks in accordance with the project's RMP. The Contractor shall address identified risk areas at project status reviews and at Integrated Independent Reviews (GPR 8700.4) (TBD). The Contractor shall make risk status available to all members of the project team for review. The Landsat 9 Project Office and the MOC Contractor will agree on what level of detail is appropriate for each review and for MPSRs. Although not all risks will be fully mitigated, the Contractor shall address all risks with mitigation and acceptance strategies agreed upon at appropriate mission reviews. The government may choose to elevate risks to the USGS L9 RMB, in which case the Contractor shall support updates to the MOC risk material in accordance with the USGS L9 RMB schedule

or as directed. The USGS L9 Project Manager may choose to elevate MOC risks to the L9 Joint NASA/USGS Mission RMB, in which case, the Contractor shall support inputs and updates to MOC risk material in accordance with the L9 Joint NASA/USGS Mission RMB schedule or as directed.

The Contractor shall maintain a Risk List throughout the project life cycle, including residual risks, along with programmatic impacts. The list should indicate which risks have the highest probability, which have the highest consequences, and which risks represent the greatest risk to mission success. The list should also identify actions being taken to address each specific risk. The Contractor shall maintain the Risk List under configuration control.

2.2 Resource Management

The Contractor shall establish, implement, and maintain a comprehensive resource management system for planning, authorizing, and controlling the total resources effort for each task and for providing timely and adequate visibility into manpower and schedule performance. The system shall be consistent with the Contractor's standards.

The Contractor shall provide the necessary resources for monitoring, controlling, executing, and administering the LMO contract and subcontracts to ensure compliance with all contractual requirements.

2.2.1 Financial Management

The Contractor shall provide Financial Reports to the Government in accordance with CDRL PM-04 and the contractor's standard policies and procedures. The Contractor shall report financial and cost data at the MPSR and quarterly. The Contractor shall implement an EVM system in accordance with the guidance in the Land Satellites Data System (LSDS) Financial and Performance Reporting Requirements Document, LSDS-456. The Contractor shall conduct an Integrated Baseline Review (IBR) of scope, schedule and cost with the government in accordance with CDRL RE-01.

2.2.2 Schedule Management

The Contractor shall establish, implement, and maintain an integrated scheduling system consistent with their corporate procedures and documented in the Project Management Plan CDRL PM-01. The Contractor shall provide and maintain an Integrated Master Schedule (IMS) in accordance with CDRL PM-05. The Contractor shall obtain approval from the Government prior to changing the IMS baseline.

The Contractor shall prepare updates to the IMS at least monthly, as part of the monthly reporting process. The contractor shall address issues with the schedule as they arise in the weekly or monthly meeting process. The Government will maintain a Ground System IMS, which incorporates key milestone events based on the MOC IMS. The Contractor shall support the Government in adjusting the MOC IMS as mission and ground system level schedules change.

2.3 Reviews and Meetings

*The dates listed in this section are notional and subject to change. Dates listed are calendar years.

The reviews listed in this section shall not be considered a comprehensive set of reviews for the Contractor's program. Additional reviews that the Contractor deems necessary to successfully execute the program may be conducted at the Contractor's discretion. The Contractor shall notify the Government at least 10 working days in advance of lower level Contractor subsystem reviews to allow the Government time to attend the review as part of its insight activities.

The Contractor shall demonstrate compliance with the review success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews, for all reviews, as applicable to the MOC and flight operations. Other reviews may be conducted following the engineering peer review process defined in the SEMP as appropriate. Any tailoring of the GSFC-STD-1001 success criteria will be mutually agreed upon by the Contractor and government.

2.3.1 MOC Reviews

All MOC reviews will be convened and review boards appointed and chaired by the Government. The Contractor shall respond as required to action items assigned by the Government. The Contractor shall host, prepare and present the following MOC Level reviews.

- MOC System Requirements Review (MOC-SRR)
- MOC Preliminary Design Review (MOC- PDR)
- MOC Critical Design Review (MOC-CDR)
- MOC Pre-Ship Review (MOC-PSR)
- MOC Post Test Review (MOC-PTR)

The Contractor shall provide review packages in accordance with the definitions in the corresponding CDRLs. The Contractor shall assume that each MOC review requires one to two days to complete. The Contractor shall propose dates to the Government for the following MOC reviews. For planning purposes the Contractor shall assume the notional dates in the following table for these reviews.

Review	CDRL	Date
MOC-SRR	CDRL RE-02	Approximately ATP + 2 Months (Spacecraft SRR + 1 Month)
MOC-PDR	CDRL RE-03	Approximately ATP + 6 Months (Spacecraft PDR + 1 Month)
MOC-CDR	CDRL RE-04	Approximately ATP + 11 Months (Spacecraft CDR + 1 Month)
MOC-PSR	CDRL RE-05	No later than 2 days prior to each major MOC delivery
MOC-PTR	CDRL RE-06	No later than 10 business days following MOC delivery SATs

Table 2-1 MOC Reviews

The Contractor shall coordinate the review agenda and content with the Government. The Contractor shall respond to action items as requested by the Government. The Government will convene a delta review if the success criteria for a review are not met to the Government's satisfaction. The Contractor shall host these delta reviews, and prepare and present these reviews. For proposal purposes, the Contractor shall assume one delta review will be required

during the contract duration. The details of the MOC-PSR and MOC-PTR reviews are described in more detail in sections 5.4 and 5.5.

2.3.2 Ground System Reviews

The Government will host and will also present material at Ground System reviews, to be conducted at USGS EROS. The Contractor shall prepare and present the MOC development and operations-related portions of the following Ground System Reviews in accordance with the CDRL RE-07.

- Ground System Preliminary Design Review (GS-PDR)
- Ground System Critical Design Review (GS-CDR)

For planning purposes the Contractor shall assume the following dates for these reviews.

Review	Date
GS-PDR	Approximately Q4 2017
GS-CDR	Approximately Q1 2018

Table 2-2 Ground System Reviews

The Contractor shall support and attend the Ground System reviews and review dry-runs, which will be hosted by the Government. The Contractor shall respond to action items as requested by the Government. For planning purposes, assume the Ground System review dry-runs will occur approximately four weeks in advance of each review. The Contractor shall assume the dry run location will be the same as that of the review. The Contractor shall assume that each Ground System review and each dry-run requires two days to complete.

2.3.3 Landsat 9 Mission Level Milestone Reviews

The Government will lead, host and coordinate presentation material for Mission-level reviews. The Contractor shall prepare and present a portion of the following Mission Level reviews and provide their portion of the review packages.

- Mission Operations Review (MOR)
- Flight Operations Review (FOR)
- Operational Readiness Review (ORR)
- Post-Launch Assessment Review (PLAR)
- On-Orbit Acceptance Review (OAR)

The Contractor shall participate in and support the Government in preparation for the following Mission Level milestone reviews in accordance with CDRL RE-07:

- Mission Preliminary Design Review (Mission PDR)
- Mission Critical Design Review (Mission CDR)
- Mission System Integration Review (SIR)

For planning purposes the Contractor shall assume the following dates for these reviews.

Review	Date
Mission-PDR	Approximately Q3 2017

Mission-CDR	Approximately Q1 2018
System Integration Review (SIR)	Approximately Q3 2019
Mission Operations Review (MOR)	Approximately L-12 months
Flight Operations Review (FOR)	Approximately L-6 months
Operational Readiness Review (ORR)	Approximately L-4 months
Post-Launch Assessment Review (PLAR)	Approximately L+3 months
On-Orbit Acceptance Review (OAR)	Approximately L+3 months

Table 2-3 Mission Reviews

The Contractor shall respond to action items as requested by the Government. The Contractor shall participate in a dry run of all Mission-Level Milestone Reviews with the Government starting four weeks in advance of each review. The Contractor shall plan to support the dry runs of reviews via teleconference and web exchange. The Contractor shall assume that the Mission Level reviews will take three days and that dry runs will take two days. The Contractor shall assume that Mission-level reviews and dry-runs will occur at the NASA Goddard Space Flight Center.

The Contractor shall also support as necessary the following additional Mission-Level Pre-Launch Reviews. It is expected that these additional reviews require a lesser degree of preparation and participation by the MOC Contractor than the other Mission-Level Reviews. For planning purposes the Contractor shall assume the following dates for these reviews.

Review	Date
Flight Readiness Review (FRR)	Approximately L-2 weeks
Launch Readiness review (LRR)	Approximately L-1 week

Table 2-4 Mission Pre-Launch Reviews

2.3.3.1 Instrument Milestone Reviews

The Instrument (OLI2 and TIRS2) development reviews are expected to have been completed prior to the LMO contract award. Therefore, The Contractor shall review the CDR material for both instruments upon award and The Contractor shall also plan to attend and support the Landsat 9 Instrument Integration Readiness Reviews (IIRRs) at the spacecraft facility. The Contractor shall present MOC information and other material as appropriate during these instrument reviews. The Contractor shall assume two days of attendance at each review at the spacecraft Contractor's facility. For planning purposes the Contractor shall assume the following dates for these reviews.

Review	Date
OLI2 IIRR	Approximately Q3 2019
TIRS2 IIRR	Approximately Q3 2019

Table 2-5 Instrument Reviews

2.3.3.2 Spacecraft Reviews

The Contractor shall attend and support the Government in preparation for the following spacecraft reviews:

- Spacecraft Preliminary Design Review (SPDR)
- Spacecraft Critical Design Review (SCDR)
- Pre-Environmental Review (PER)

The Contractor shall assume three days of attendance at the spacecraft Contractor's facility for each review. For planning purposes the Contractor shall assume the following dates for these reviews.

Review	Date
Spacecraft Preliminary Design Review (SPDR)	Approximately Q3 2017
Spacecraft Critical Design Review (SCDR)	Approximately Q1 2018
Pre-Environmental Review (PER)	Approximately Q4 2019

Table 2-6 Spacecraft Reviews

2.3.4 Ground System Element Reviews

The Contractor shall participate in and support, via teleconference and web exchange, the Government at the following Ground System Element reviews:

- Ground Network Element (GNE) Design Change Review and Critical Design Review
- Data Processing and Archive System (DPAS) Design Change Review and Critical Design Review

The Contractor shall assume one day for each Design Change Review and Critical Design Review. For planning purposes the Contractor shall assume the following dates for these reviews.

Review	Date
GNE Design Change Review	Approximately Q3 2017
DPAS Design Change Review	Approximately Q3 2017
GNE Critical Design Review	Approximately Q1 2018
DPAS Critical Design Review	Approximately Q1 2018

Table 2-7 Ground System Element Reviews

2.3.5 Engineering Peer Reviews (EPR)

The Contractor shall define and implement a set of Engineering Peer Reviews (EPRs) for the subsystems of the Mission Operations Center commensurate with the scope, complexity, and acceptable risk of the product. The Contractor shall submit the Peer Review Plan in accordance with CDRL PM-06.

The Contractor shall chair and host EPRs at the Contractor's facility with Government participation on the review panels. The Contractor shall document EPRs in accordance with CDRL RE-08, Engineering Peer Review Data Packages. The Contractor shall systematically and comprehensively peer review the design and products at the individual subsystem level and lower levels, as appropriate. Subsystem and software design reviews are considered to be EPRs and subject to this procedure. The Contractor shall conduct multiple peer reviews, as appropriate, over the lifecycle of each subsystem and component, with content consistent with the evolving design and development. Applicable peer reviews shall be completed prior to and summarized at the corresponding MOC review (e.g. MOC-CDR). At a minimum, the Contractor shall complete an appropriate set of subsystem or lower-level peer reviews for customized portions of the MOC prior to MOC PDR and again prior to MOC CDR. Successful completion of these reviews and resolution of associated technical issues and actions is considered to be an important aspect of entry criteria in the formal review process.

The Contractor shall participate in spacecraft EPRs as appropriate at the spacecraft vendor facility. The Contractor shall also use EPRs for the focused evaluation of concepts, designs, plans and processes associated with combinations of operations, subsystems and system functions that cross traditional subsystem or discipline boundaries.

As a minimum, EPRs shall be conducted to cover the following items:

- Mission Data Management
- Mission planning and scheduling including any software that is implemented in support of this capability.
- Analytical modeling capability (described in section 5.2.7)
- Command management and processing system including any software that is used to build observatory load files and flight software loads, along with interfaces to Space Network (SNAS), Near-Earth Network (NEN), and the Landsat Ground Network (LGN) for commanding.
- Telemetry and Command Systems, including telemetry trending and analysis capabilities
- MOC system automation and availability design & implementation
- MOC and bMOC Network and Security Implementation
- Flight Dynamics software supporting orbit and attitude prediction and determination including software associated with planning and execution of orbit maneuvers.
- Flight products & procedure planning

The Contractor shall track action items from EPRs and maintain EPR presentation and closure documentation for the duration of the contract.

2.3.6 Monthly Project Status Reviews and Reports

The Contractor shall communicate the status of the MOC technical effort, operations, schedule, and resource condition to the Landsat 9 Project Office and Ground Systems Management Team on a monthly basis. The Contractor shall develop and deliver a Monthly Project Status Review package, in accordance with CDRL PM-07.

The Contractor shall provide monthly status report on the technical effort, cost, schedule, and operational performance in accordance with the WBS to adequately describe the status of

contract activities to the Government. The Contractor shall provide a Monthly Status Review to the USGS L9 Project and MOC Management summarizing the monthly report.

The monthly project status review package shall include the Integrated Master Schedules (IMS). The Contractor shall provide monthly financial reports to the Contracting Officer's Representative (COR).

All reports shall be made available electronically (adobe PDF is acceptable). The Contractor shall conduct the Monthly Status Review face-to-face with the Government on a quarterly basis at a minimum. The Contractor shall support monthly status reviews via teleconferences for the months' status that are not conducted in face to face meetings. The Contractor shall participate in splinter meetings with the Government for one additional half day immediately following each face-to-face monthly project status review.

2.3.7 Other Reviews and Meetings

2.3.7.1 Kickoff Meeting

The Contractor shall present for review the plans, schedules, and activities required to meet the Contract requirements. The agenda and information to be presented shall be coordinated with the Government prior to the meeting, and will largely be based on the Contractor's proposal, updated to reflect any changes since the offer submission, including any directed changes. The Kickoff Meeting shall occur at the Contractor's facility two weeks following the MOC contract award. The Contractor shall provide a copy of the material presented at the Kickoff Meeting.

2.3.7.2 Scheduled Weekly Teleconferences

In addition to other informal communications, the Contractor shall participate in a scheduled weekly teleconference with the Landsat 9 Project Office and Ground Systems Management Team to communicate status, issues, and schedule progress and plans of the overall contract effort. The Contractor shall establish the meeting agenda and distribute meeting minutes, action items, and other documentation as required. The Contractor shall provide detailed status, description of issues, and schedule for each major element of the contract.

2.3.7.3 Technical Interchange Meetings (TIMs), Working Groups (WGs), and Routine Meetings

The Contractor shall inform the Government at least one week in advance of technical interchange meetings resolving technical issues concerning critical MOC systems or sub-systems. In certain cases TIMs may be combined with monthly status meetings. TIMs shall also include discussion of prioritized development and delivery schedules. The Contractor shall assume for planning purposes that TIMs will occur on quarterly basis.

The Contractor shall participate in Government-led working groups. At the time of the writing of this document, planned Government-led working groups likely requiring MOC Contractor participation are included in the Table below:

Review/Meeting	Period	Meeting Frequency	Length (hours/meeting)	Location
Space to Ground & Network Interface Working Group (includes Communications Security and Mission Data Systems)	SRR - LRD	Weekly	1	Teleconference
Verification Working Group: Spacecraft/Satellite/On-orbit	PDR - OAR	Monthly	4	Teleconference
Mission Operations Working Group	PDR - OAR	Weekly	1	Teleconference
Fault Management Working Group	PDR-6 months through PER	Quarterly	2	Teleconference
Integration & Test Working Group	PDR - CDR CDR - PER PER - LRD	Monthly Monthly Bi-weekly	2 4 2	Teleconference
Simulators Working Group	SRR – CDR CDR - OAR	Monthly Weekly	2 1	Teleconference
Flight Support Team Working Group	3 months prior to first team simulation/rehearsal through LRD	Weekly	1	Teleconference
Mission Readiness Test WG	CDR-6 months through 6 months prior to first scheduled MRT 6 months prior to first schedule MRT through post- test review of final executed MRT	Monthly Weekly	2 1	Teleconference
Simulation / Rehearsal Working Group	6 months prior to first team simulation/rehearsal through LRD	Weekly	1	Teleconference
On-Orbit Activation & Commissioning Timeline Working Group	Observatory SIR through LRD	Monthly	4	Teleconference

Review/Meeting	Period	Meeting Frequency	Length (hours/meeting)	Location
<i>Ground System Interfaces Working Group</i>	<i>SRR - ORR</i>	<i>Weekly</i>	<i>1</i>	<i>Teleconference</i>
<i>Ground System Integration and Readiness Testing Working Group</i>	<i>PDR-2 months through ORR</i>	<i>Weekly</i>	<i>1</i>	<i>Teleconference</i>
<i>Ground System Engineering Working Group</i>	<i>Award – End of Mission</i>	<i>Weekly</i>	<i>1</i>	<i>Teleconference</i>
<i>IT Security Working Group</i>	<i>SRR - ORR</i>	<i>Weekly</i>	<i>1</i>	<i>Teleconference</i>
Database Working Group	PDR – PLAR	Monthly	4	Teleconference
Working Group Placeholder	CDR – OAR	Monthly	4	Teleconference
MOC Infrastructure and Facilities Working Group	SRR-ORR	Monthly	2	Teleconference

Table 2-8 Working Groups

The Contractor shall interface with all USGS, NASA, NOAA, and International support organizations, as specified in the Operations procedures, Interface Control Documents (ICDs), and Operations Agreements (OAs). The Contractor shall interface with the USGS EROS facility to perform planning and scheduling functions as defined in the Landsat 9 Ground System Operations Concept, and requirements documents. The contractor shall support meetings such as Configuration Control Boards and integrated product team (IPT) teleconferences as needed.

The Contractor shall support and maintain the interfaces required for standard operations and coordination of Landsat mission activities. This shall include coordination with the Landsat Ground Network (LGN) for TT&C activities, coordination with LGS and International Cooperator stations for science data reception, and science data collection coordination with other USGS missions.

2.3.7.4 Cooperative Mission Activities

The Contractor shall support communication and coordination between the Landsat missions and other U.S. and non-U.S. missions. Specifically, coordination with other missions in the same orbit (705 km, 98.2 degree, sun-synchronous, polar orbits) is essential to safe operations. This includes adherence to existing coordination agreements such as *Operations Coordination Plan for the Morning and Afternoon Constellations* dated October 2014.

The Contractor shall support feasibility and technical studies related to enhancing and maximizing the Landsat Program's mission. This support includes the identification, assessment, and development of operations concepts, image acquisition strategies, trade studies, and modeling tools involving Landsat legacy and follow-on missions, and collaborative mission and multi-mission approaches, with regard to Landsat 7 & 8, and Landsat 9.

The Contractor shall support operations and sustaining engineering activities for system, concept, and process re-use across Landsat missions.

2.3.7.5 International

The Contractor shall support collaborative activities with International Cooperators and their stations such as the annual Landsat Ground Station Operators Working Group (LGSOWG) and the Landsat Technical Working Group (LTWG) meetings, including the generation of presentation materials and mission modeling (e.g. how international ground network configuration changes may impact on-orbit resources and other Cooperators), as directed by the Flight Systems Manager (FSM) or Landsat Mission Manager.

The Contractor shall provide mission scheduling support for International Ground Stations. Further, the Contractor shall provide coordination, scheduling and commanding in support of International Cooperator's ground station testing in support of their data acquisition requirements as directed by the USGS FSM. This support includes but is not limited to station certification, account management, product delivery, anomaly analysis, manual scheduling for special events, conflict resolution, and modeling ground network expansion and its impacts to on-orbit resources and other Cooperators as directed.

2.3.7.6 Status and Planning Meetings

The Contractor shall notify and allow the Government access to Contractor status and planning meetings, including daily stand-ups

2.4 Management Processes

2.4.1 Configuration Management

The Contractor shall perform configuration management (CM) in support of the LMO contract effort at both the development and MOC (Ops) levels. The Contractor shall develop and deliver the Hardware and Software Configuration Management Plan in accordance with CDRL PM-08. The Contractor shall maintain configuration of all MOC deliveries/releases, test environments, operations products, and delivered items, including but not limited to flight software, simulators, T&C databases, and all other contractor deliverable items throughout all phases of development, test and until final acceptance of the MOC. The Contractor shall provide the Government access to MOC and bMOC hardware and software configuration status and tracking via the Contractor's automated tool. The Contractor shall notify the Government of and allow Government participation in all development CCB. The Government will chair the CCB for the MOC and bMOC operations configuration as well as the Operations CCB following launch, consistent with existing Landsat policies and processes. The Contractor shall perform and document configuration verification as sub-systems are incorporated into higher-level systems, including prior to formal tests, and at major Project milestones.

The CM system shall have a change classification and impact assessment process that results in Class 1 and Class 2 Configuration Change Requests (CCRs) being forwarded to the Landsat 9 Project in accordance with CDRL SE-02 for Engineering Change Requests, Deviations, and Waivers. Class 1 changes are defined as changes that impact mission science and performance requirements, system safety, cost, schedule, single point failures, and external interfaces. All

other changes are considered to be Class 2 changes. Class 2 changes can be resolved within the MOC CCB, however Class 1 changes must be submitted to and processed by the Project or Program level CCB prior to approval by the MOC CCB. The Contractor shall submit for Government consideration a waiver or deviation for any item that is found to be non-compliant with the requirements of the contract Statement of Work (SOW) or the MOC requirements document and is not reworked to be compliant, or is not replaced with a compliant item. The Contractor shall provide the Government electronic access to the Contractor's system for tracking non-compliances.

The Contractor shall prepare and provide the following configuration control documentation:

- Configuration Control Board (CCB) status shall be reported at the Monthly Project Status Review and in all monthly status packages in accordance with CDRL PM-07.
- The Configuration Item Identification List (CIIL), CDRL SE-03, and the Computer Software Configuration Items (CSCIs), CDRL MD-15.

2.4.2 Software Management

The Contractor shall document in the Software Development and Management Plan (SDMP), in accordance with CDRL PM-09, the software management approaches and processes for software analysis, design, development, documentation, version control, test, validation, risk management, metric collection, and assurance of all software products. The Contractor shall adhere to the government approved SDMP.

2.4.3 Action Item Tracking

The Contractor shall develop and apply a process for capturing and responding to action items assigned by the review boards (including EPRs), at monthly meetings, technical interchange meetings, and working group meetings. Milestone reviews, as defined above, are not complete until actions are completed or a detailed plan for closure is submitted and approved by the Government. The Contractor shall provide the Government access to the action item tracking solution.

2.4.4 Problem Tracking

The Contractor shall implement and manage a closed-loop problem tracking process that includes problem or discrepancy reporting, problem analysis, corrective action, and closure for all discrepancies reported during development and Factory Acceptance Testing as well as discrepancies found at the MOC from the point of delivery through the end of the period of performance. The process shall be implemented for tracking all types of MOC problems, including, but not limited to hardware, software, ops products, testing discrepancies and on-orbit anomalies. The process shall include: a protocol to review past performance to determine the incidence of identical or related discrepancies, an escalation procedure (to inform higher levels of management and the Government) based on mission criticality, and a closeout process for root cause determination, anomaly mitigation, and recurrence control. The contractor shall use the problem tracking system in the MOC starting with the installation and configuration of the first MOC delivery for and all MOC activities thereafter. The problem tracking process shall incorporate interfaces as appropriate to the Ground System problem reporting process and

system, as some problem reports will affect interfaces, be generated via Ground System level testing, or otherwise span, migrate between, or have child-parent relationships to other noted discrepancies. The Contractor shall document the process in the SDMP, CDRL PM-09.

The Contractor shall provide Government access to the MOC problem tracking system, including the ability to access remotely (web-enabled), submit problems (discrepancy reports), submit a recommended priority for action, and review individual problems as well as summary problem status metrics and reports.

The Contractor shall report on the overall status of MOC problems as part of the monthly reporting process.

2.4.5 Internal Technical Memoranda

The Contractor shall provide all MOC-relevant technical internal memoranda as requested by the Government in accordance with CDRL SE-04, Contractor Generated Internal Technical Information. The correspondence can be informal to preserve timeliness. The Government shall have access to these memoranda on a timely basis via hard copy or the electronic library described below.

2.4.6 Electronic Library

The Contractor shall provide to the Government and Government contractor personnel, for review purposes, remote access to an electronic library. This library shall contain all completed reports, analyses, requirements documentation, internal technical memoranda, change requests and documentation, CDRLs, and all other MOC-specific documents prepared by the Contractor. Within this library the Contractor shall maintain an index of the material (updated monthly) and a search engine for document access. The non-CDRL material contained in these electronic databases may be in Contractor format. The Contractor shall make the contents of the electronic library remotely downloadable. The Contractor shall include engineering drawings in this library or provide some other storage/retrieval arrangement, at their option.

The contractor shall make the electronic access system available within 6 months of the start of the contract. When the first release of the MOC systems is delivered to the MOC, the Contractor shall move the electronic access system to a MOC network, or instantiate a new one within the MOC, at their option. The Contractor shall migrate all the historical information into the MOC-sited library as part of the setup.

3.0 SYSTEMS ENGINEERING

The Contractor shall perform systems engineering to support all MOC-related activities during all stages of development, operations and sustaining engineering. The Contractor shall develop a Systems Engineering Management Plan (SEMP) as described in CDRL SE-01.

The systems engineering effort shall include, but is not limited to, requirements management, analyses of technical requirements, functional and performance allocation of derived requirements, traceability, definition and maintenance of all interfaces, MOC system design and verification of all defined, allocated, and derived requirements, systems analyses and special studies as required, risk management support, and tradeoff analyses. This shall include but not be limited to the following specific activities:

- a. Providing systems engineering technical direction and oversight throughout all phases of the project.
- b. Leading and supporting all peer reviews, project milestone, and status reviews as defined in section 2.3, and preparing related documentation.
- c. Performing all necessary system studies, trades, and risk assessments necessary to develop the MOC system design consistent with CDRL SE-05.
- d. Performing all necessary coordination, studies and analyses required to interface the MOC to the Landsat 9 observatory, observatory simulator, and all Government Landsat 9 ground assets, including support to ground system requirements development and mission operations.
- e. Performing systems engineering and analysis in support of tests at the MOC level and throughout ground system and mission integration.
- f. Supporting system level technical interface meetings and working groups, including technical issue resolution, performance verification plan buy-offs, pending configuration change requests (CCRs), CDRL data submission review/approval status, test data review, anomaly resolution activities, and test support planning.

3.1 Requirements Management

The Contractor shall provide the definition, allocation, derivations, and traceability of system and subsystem requirements, including software requirements, and the verification approach. The Contractor shall develop and deliver the Specification Tree in accordance with CDRL SE-06. The Government will continue to maintain the MOC Requirements Document (MOC-RD) as a "level 4" requirements document within the Government requirements management system. The Contractor shall maintain a copy of the MOC-RD in the Contractors requirements management system for purposes of traceability, analysis, and verification.

The Contractor shall maintain and manage MOC requirements in an electronic format. The Contractor shall provide regular exports of all the MOC requirements and metadata in a DOORS-NG compatible format. The Contractor shall accept updates to the MOC-RD in electronic format, when generated.

The Contractor shall conduct complete analyses and simulations in support of technical requirements compliance demonstrations to fully establish, define, maintain, and control budget allocations for all required performance and design parameters.

Tasks include the following as a minimum:

- a. Performing requirements management and traceability using a commercial software tool.
- b. Flow-down and traceability of MOC Requirements Document (MOC-RD) requirements to lower-level system and software requirements, and developing the MOC Lower-Level Systems Requirements Document (SRD) in accordance with CDRL SE-07.
- c. Ensuring that all requirements are forward and backward traceable (“parent/child” relationship traceable) between system and software requirements and between software requirements, design, and test.
- d. Functional and performance allocations and derivations.
- e. Conduct area specific peer reviews throughout the requirement derivation and allocation process
- f. Maintaining and controlling critical MOC technical performance metrics, margins, budgets that are reported at the Monthly Status Reviews.

3.2 Interface Definition and Verification

The Contractor shall meet the interface requirements of the Landsat 9 Mission Operations Center Requirements Document and the Landsat 9 Spacecraft to Ground Systems ICD (Document # TBD). The Contractor shall participate in the review and development coordination of the Landsat 9 Spacecraft to Ground Systems ICD as part of the Space-to-Ground Interface Working Group.

The Contractor shall review and provide technical inputs to the Government led documentation development for the following external interfaces to the MOC:

1. DPAS-to-MOC ICD
2. GNE-to-MOC ICD
3. Robotic Systems Protection Program (RSPP) to Landsat 9 ICD (TBR)
4. MOC Interfaces to SN, NEN, NISN and FDF (TBR)

The Contractor shall develop and provide documentation support for other external interfaces not explicitly listed above as necessary (e.g. spacecraft vendor, launch site, instrument vendors).

The Government and Contractor will have signature approval on the ICDs. The Contractor shall design, build, test, and deliver a MOC and bMOC in compliance with all of the ICDs.

The Contractor shall develop and maintain ICDs between all major internal functional areas, based on the MOC design in accordance with CDRL SE-08. The Contractor shall perform all verification of internal interfaces. The Contractor shall verify their portions of external interfaces, and support the Government in complete verification of external interfaces.

3.3 Design and Performance Verification

The Contractor shall design the MOC system to meet the requirements of the Mission Operations Center Requirements Document.

The Contractor shall develop and maintain all necessary plans and procedures to verify that the MOC meets all requirements described in the Landsat 9 Mission Operations Center Requirements Document. The Contractor shall perform MOC requirements verification in accordance with approved plans and procedures. The Contractor shall also perform and document all analyses of the data and information from the design, development, testing, and

acceptance of the Contractor's hardware and software that are required to ensure that the MOC will meet its specifications and objectives. These tasks include, but are not limited to the following:

- a. Preparing and maintaining the System Performance Verification Plan and Matrix, CDRL SE-09 for use at the software, subsystem, and MOC system level. The System Performance Verification Plan (SPVP) and System Performance Verification Matrix (SPVM) shall be tied to the requirements database and shall be exported on a regular basis for Government review in a DOORS-NG compatible format. The SPVP and SPVM shall include interface verification both internally and for all external elements of the MOC, including the MOC integration with the observatory and its simulators, Spacecraft/Observatory Simulator (SOS), DPAS, GNE, and any other Government-provided Landsat 9 assets that interface with MOC systems.
- b. Performing MOC requirements testing and verification in accordance with the approved System Performance Verification Plan, Matrix, and all other test plans and procedures.
- c. Analyzing and making available for inspection the required lower level design specifications in order to meet higher-level performance requirements. All such analyses shall be identifiable and accessible for Government review.
- d. Preparing and maintaining verification test procedures for use at the software, subsystem, and MOC system level.
- e. Providing systems engineering support to development of installation procedures and interface checkout/testing procedures.
- f. Providing the necessary effort and support systems for MOC analysis during all levels of testing, interface verification, and during acceptance.
- g. Perform the necessary systems engineering tests and analyses to assure that all requirements of this contract are accomplished successfully and on time.
- h. Conducting test evaluation and test reporting, and providing MOC Verification Reports compliant with CDRL SE-10.
- i. Providing a MOC User's Manual in accordance with CDRL MD-16.

3.4 Special Studies

The Contractor shall conduct, in addition to the requirements specified in this document and the contract, additional engineering studies, tests, technical analyses, reviews of test results, design modifications, and tasks relating to the development, implementation, delivery, integration, and early-orbit operation of the LMO, as authorized by the Government and in accordance with Contract Clause **TBD**. Each task will be initiated by written direction from the Government contracting officer. The Government will coordinate with the Contractor to define each task in detail, and establish manpower ceilings, performance schedules, and deliverables.

4.0 MISSION AND SOFTWARE ASSURANCE

The MOC system may include but is not limited to any software, firmware, and hardware that are required to fulfill the requirements of the LMO Contract.

The Contractor shall develop and implement a Software Development and Management Plan (SDMP), PM-09, which lays out the software engineering processes, defines the discrepancy tracking process (refer to section 2.4.4), addresses the principles of best software development practices and describes procedures for software acquisition, development, test, verification, maintenance, operations, and management. The Contractor shall derive processes and procedures using NASA Software Engineering Requirements specified in the NPR 7150.2B as a reference, and identify any deviations from NPR 7150.2B guidance in the SDMP.

The Contractor shall develop, implement, and maintain a comprehensive software assurance program which employs NASA-STD-8739.8 and NASA-STD-8719.13C as overarching guidance. The Contractor shall assume the MOC software assurance classification is Class C (TBR) Safety Critical for observatory command, control, and safety; the Contractor shall employ a software classification of Class C (TBR) for all other functions. The Contractor shall address any deviations from the requirements of Sections 6 and 7 of NASA-STD-8739.8 and identify all required tasks, deliverables, and data outputs in the SDMP. The Contractor shall develop and deliver a Software Assurance Plan as part of the Software Development and Management Plan.

The Contractor shall classify all MOC software at the functional element / application-level as belonging to one of the following criticality classifications and shall define the management approach of each class in the Software Development and Management Plan:

- (a) Mission Critical or Safety Critical
- (b) Mission Support
- (c) Engineering Analysis
- (d) Commercial
 - (1) Commercial software acquired for integral use within planned operational elements shall be assigned a criticality equal to that of the element of which it is a part.

The Contractor shall classify all MOC software as belonging to one of the following types of software and shall define the management approach of each class in the Software Development and Management Plan (SDMP):

- (a) Developed
- (b) Reuse
- (c) Heritage
- (d) Off-the-Shelf (OTS)
 - (1) OTS software is further defined as Commercial-Off-the-Shelf (COTS), Modified-Off-the-Shelf (MOTS) software, and Government-Off-the-Shelf (GOTS) software. The details of OTS utilization and management of such shall be provided in the Contractor's SDMP.

The Contractor shall maintain a process and procedures for database development. The process shall include activities such as internal reviews, walkthroughs, providing status, test, and discrepancy resolution. The Contractor shall:

- a. Utilize a process for the verification and validation of the database system.
- b. Ensure that system/software releases and database releases are configured with one another.
- c. Implement CM on the database system to ensure that the database release version is defined and documented, controlled and that the integrity of the data contained within is controlled.

Ensure that security measures are implemented on the database system and on the data contained within the database system.

Reliability, availability and maintainability assurance requirements for the MOC system and associated elements shall include the following:

- a. Starting in the conceptual design stage the Contractor shall clearly define, based upon MOC-RD availability and reliability requirements, levels of performance. The Contractor shall establish and implement specific design criteria needed to mitigate unacceptable levels of performance. Design criteria shall be accessible for Government review at any time and presented at all formal design reviews.
- b. Based on the definition of acceptable levels of performance, the developer shall define the minimum acceptable maintainability parameters. Maintainability parameters shall be accessible for Government review at any time and presented at all formal design reviews. Maintainability parameters include, but are not limited to, the following:
 1. Diagnostic time to detect and fault isolate to the defective components/sub-systems/applications.
 2. Time required to codify and integrate updates to the defective components/sub-systems/applications.
 3. Time required to complete checkout and restore operational status.
- c. The Contractor shall assure that software, equipment, and components obtained from COTS and GOTS providers meet allocated requirements.

The Contractor shall develop and implement specific design criteria to facilitate maintenance or repair actions. In establishing maintainability design criteria that meets the specification, the Contractor shall use data obtained from similar system installations. Design criteria shall include design for modularity, accurate fault diagnostics, standardization, and commonality. Design criteria shall be accessible for Government review at any time and presented at all formal design reviews.

5.0 MISSION OPERATIONS CENTER (MOC) DEVELOPMENT

The primary functions of the MOC system include observatory command and control, mission planning and scheduling, science data collection and calibration activity modeling and scheduling, trending and analysis, orbit and attitude determination and control, health and safety monitoring, on-board storage management, verification of the X-band Science data capture statistics, and flight software management.

The Government is responsible for providing the spacecraft, Operational Land Imager 2 (OLI 2), and Thermal Infrared Sensor 2 (TIRS 2) instruments and the portions of the Ground System other than the MOC and bMOC systems. The Government is also responsible for mission systems integration and mission operations for non-MOC systems, including ground networks and science data processing functions. The Contractor shall support the MOC-related portions of the ground system integration and mission system integration efforts.

The MOC system shall interface with the science data processing system portal at the U.S. Geological Survey's (USGS) Earth Resources Observation and Science (EROS) Center in Sioux Falls, SD in order to receive additional mission acquisition planning inputs along with instrument characterization and calibration activity planning inputs, and to provide science data capture feedback. The system shall provide the MOC with acquisition activity schedule requests, including characterization and calibration activities, along with supporting information so that the MOC can insert additional science data collection and calibration activities into the overall Observatory schedules and plans. The supporting information will include any constraints for the acquisition and calibration activity schedules. The MOC interface requirements to the science data processing system portal are specified in the DPAS-to-MOC ICD.

5.1 Infrastructure

5.1.1 Facilities

The Contractor shall prepare the MOC & bMOC Facility Plan (CDRL MD-01) and ensure the MOC & bMOC facilities are compliant with the MOC ICDs and applicable requirements documents. The MOC & bMOC Facility Plan shall document the MOC & bMOC facility needs including power, heating, cooling, temperature, and humidity control, square footage requirements including prospective infrastructure, equipment layout, contingency power, and network connectivity and interfaces.

5.1.2 Networks

The Contractor shall design, provision, install, and manage the internal networks of the MOC, bMOC, and LSR within the boundaries described in USGS-NASA L9 MOC ISA (Document # TBD). The Contractor shall configure, maintain, and support MOC, bMOC, and LSR internal network infrastructure. The Contractor shall document network infrastructure design as part of the MOC Design Specification and Description (CDRL MD-02). The Government will provide all external network connections, network connections between separate facilities on-site at GSFC (e.g. MOC and LSR, MOC and mission equipment room if applicable), and approve the internal network design. The Contractor shall coordinate with the Government on MOC network

interface matters which require NASA's CSO interaction. The Contractor's network design shall support all MOC external interfaces.

5.1.3 IT Security

The Contractor shall comply with NIST Special Publication 800-53 Revision 4 in accordance with the USGS guidance provided in the Government-furnished L9 MOC IT Security Compliance Matrix (Document # TBD). The Contractor shall populate and deliver the completed MOC IT Security Compliance Matrix per CDRL MD-03, given a MOC system threat level classification of moderate (TBR). The Government will review and approve the compliance matrix and the Contractor's implementation of IT security requirements. The Contractor shall coordinate the implementation of IT security requirements with the Government. The Contractor shall provide a MOC System Security Plan in accordance with CDRL MD-04 which includes, but is not limited to, the overall MOC security approach, risk assessments and contingency security plans.

The Contractor shall implement security controls on external network interfaces.

The Contractor shall perform periodic credentialed scans, perform intrusion detection and prevention, configure and monitor firewalls, and coordinate enforcement of security risk mitigations within the Contractor-managed networks as described in section 5.1.2. The Contractor shall maintain systems security posture to include but not limited to: patching and software updates of systems on a periodic basis or as directed by the Government; implementation of scan resolutions; monitoring of system logs; inventory and electronic delivery of Contractor-managed system configuration in accordance with SSP.

The Contractor shall install, operate and support the following Government-furnished security tools: Tenable Security Center (TBR), the Government-furnished scanning software tool; LogRhythm (TBR), the Government-furnished log-monitoring appliance; KACE (TBR), the Government-furnished system configuration inventory tool to ensure proper population of NASA (TBR) agency databases. Government-furnished security tool support includes, but is not limited to: provision of hardware to run the tools if applicable, tool installation, tool configuration, configuration and adjustment of associated firewall rules to allow egress of tool-generated network traffic, and support of related troubleshooting activities.

The Contractor shall document any deviations, POAMs, or findings as a result of scans, and implement any corrective actions post-Government approval. The Contractor shall report computer security incidents to the Government in accordance with the DOI Computer Security Incident Response Handbook (Document # TBD). The Contractor shall periodically generate and deliver IT security status reports to the Government on a monthly basis at a minimum.

5.1.4 Communication Security (COMSEC)

The Contractor shall develop and implement the capabilities to perform spacecraft command encryption compliant with the spacecraft implementation. The Contractor shall use a NIST FIPS PUB 140-2 certified uplink security system and NIST FIPS PUB 197 Advanced Encryption Standard algorithms that employ 256 bit keys (TBR) to encrypt the command and load uplink for subsequent decryption by the spacecraft.

The Contractor shall review and provide input to the Government-led Landsat 9 Key Management Plan in accordance with CDRL MD-05.

5.2 Design and Development

The Contractor shall design and develop the MOC system, including sub-system and interface requirements, which satisfies all the requirements of the MOC-RD. The Contractor shall deliver a MOC Design Specification and Description in accordance with CDRL MD-02.

5.2.1 Telemetry, Command and Control

The Contractor shall develop the MOC Telemetry, Command and Control capabilities in accordance with the L9 MOC-RD.

The Contractor shall establish and maintain the Landsat 9 T&C Project Database (PDB), which will combine spacecraft, instrument, and MOC command and telemetry databases and translations required to operate and maintain the observatory and ground system in a common format. The Government, through the Spacecraft contractor, will provide combined instrument and spacecraft command and telemetry databases (the Observatory T&C database) to the Landsat 9 MOC.

The Contractor shall perform the translation, verification, and validation necessary to ingest and integrate the Observatory T&C database within the Landsat 9 PDB. The Government will provide truth sets and other data, with each Observatory T&C database delivery to be used within the Contractor's database validation process.

5.2.2 Planning and Scheduling

The Contractor shall develop Planning and Scheduling capabilities in accordance with the L9 MOC-RD (LSDS-1648).

5.2.3 Mission Monitoring and Analysis

The Contractor shall develop Mission Monitoring and Analysis capabilities in accordance with the L9 MOC-RD (LSDS-1648).

5.2.4 Flight Dynamics

The Contractor shall develop Flight Dynamics capabilities in accordance with the L9 MOC-RD (LSDS-1648).

5.2.5 Memory Management

The Contractor shall develop Memory Management capabilities in accordance with the L9 MOC-RD (LSDS-1648).

5.2.6 Automation

The Contractor shall develop Automation capabilities in accordance with the L9 MOC-RD (LSDS-1648).

The Contractor shall develop required capabilities and procedures in support of Government approved “lights out operations”. The Contractor shall work to automate routine real-time and off-line operations. The Contractor shall develop a scripting capability in support of automation and operational activities, including but not limited to real time operations, Mission Data Management (MDM) alerts, automated post pass reporting, automated reporting of failed product generation, and automated Stored State of Health accounting. The Contractor shall develop automation flow diagrams, steps, and procedures in support of lights out operations.

5.2.7 Analytical Modeling

The Contractor shall develop an adaptable, moderate-high fidelity analytical modeling capability based directly on MOC functional capabilities and applications for the purposes of modeling and simulating activities pertaining to, at a minimum, science collections, mission data management, SSR management, calibration activities, LGN X-Band and S-Band station contingencies, data latency, and gaps between X and S-Band contact times. The Contractor shall implement the analytical modeling capability based on the requirements in the MOCRD and operate the analytical modeling capability on an as-needed basis or as directed by the FSM. The Contractor shall make all modeling results and analysis (including graphical displays if applicable) available to the Government. The Contractor shall deliver the analytical modeling software and any peripheral tools to the Government as a stand-alone capability which meets the requirements in the MOCRD.

5.3 Backup MOC (bMOC)

The Contractor shall design, develop, test and deliver a bMOC system in accordance with the requirements within the MOC-RD. The Contractor shall implement the bMOC functionality in concert with the corresponding MOC functionality and release schedule. The Contractor shall perform the applicable portions of the MOC system acceptance testing needed to verify and validate the bMOC requirements. The Contractor shall staff the bMOC to support applicable Ground and Mission Readiness Testing objectives.

5.4 Integration and Test

The Contractor shall deliver a MOC Integration and Test Plan in accordance with CDRL MD-06 that defines the overall approach and process for fully integrating all deliveries into the MOC and bMOC and prepares the MOC system and facility for ground and mission integration and test activities.

Prior to each MOC delivery, the Contractor shall perform factory (pre-delivery) acceptance testing (FAT) to internally verify the MOC meets the requirements of the MOC-RD. Factory acceptance testing is defined to be MOC system standalone testing without the actual interfaces to the other Landsat 9 ground system elements, but using a method(s) to simulate the interfaces per the applicable ICDs. The Contractor shall allow Government personnel access to all MOC application factory acceptance testing data and result summaries at least 3 working days prior to

each delivery/release to the MOC. Test result summaries shall be included in the delivery package described in Section 5.5 below.

The Contractor shall develop and deliver the following items in accordance with the stated CDRL to support MOC system and element-level testing:

- a. MOC Factory Acceptance Test Plans, CDRL MD-07
- b. MOC Factory Acceptance Test Procedures, CDRL MD-08
- c. MOC Factory Acceptance Test Reports, CDRL MD-09

The Contractor shall allow Government personnel access to all MOC system factory acceptance testing and site acceptance testing and test planning meetings, including Contractor-led Test Readiness Reviews and Post Test Reviews.

The Contractor shall maintain and update the Requirements Verification Matrix (generated per CDRL SE-09 to include the status (pass, fail, deferred, etc.) of each requirement throughout the testing phases and various testing activities.

The Contractor shall participate in informal interface testing between the MOC system and other ground system elements/facilities during MOC development. Informal interface tests include the network connection tests and use of test data in the formats defined by MOC Interface Control Documents informally exchanged (e.g. by email or FTP site) between the MOC and other ground elements/facilities. The Contractor shall exercise test data provided by other ground elements, and shall provide MOC test data to ground elements.

The Contractor shall host, incorporate and utilize a government-furnished Landsat Scalable Integrated Multi-mission Support System (LSIMSS) (portable simulator) to support MOC development and testing at the Contractor's facility.

For each MOC delivery, following the factory acceptance testing and prior to delivery to the MOC or bMOC, the contractor shall perform a Pre-Ship Review (PSR) per CDRL RE-05. The Pre-Ship Review also serves as the post-test review for the factory acceptance testing. The contractor shall notify the government of delivery PSRs at least 3 business days in advance. The government will provide approval for continuation of the MOC system delivery based on the outcome of the PSR.

The Contractor shall perform site acceptance testing (SAT) on-site at the MOC and/or bMOC following completion of delivery installation and integration activities. Site acceptance testing is defined to be MOC system testing performed in the GSFC MOC or bMOC location with the actual interfaces to the other Landsat 9 ground system elements as they are available. The Contractor shall use method(s) to simulate interfaces per the applicable ICDs for any interfaces that are not yet available. MOC system deliveries are not considered ready for use until after the successful completion of the site acceptance testing, as determined by the government in the Post Test Review CDRL RE-06.

Following Site Acceptance Testing, the Contractor shall provide the following:

- a. MOC Site Acceptance Test Plans, CDRL MD-10
- b. MOC Site Acceptance Test Procedures, CDRL MD-11
- c. MOC Site Acceptance Test Reports, CDRL MD-12

Following the first MOC system delivery to the MOC, the Contractor must perform regression testing on all subsequent deliveries made to the MOC. The Contractor shall propose a

Regression Test Plan as part of the Software Development and Management Plan (SDMP), CDRL PM-09. Regression testing is part of site acceptance tests performed in the MOC and are part of the government evaluation of the site acceptance testing.

5.5 Delivery Support

The Contractor shall provide multiple MOC system deliveries, with each delivery demonstrating increased functionality leading to the final MOC system delivery, satisfying all functionality as required in the MOC-RD. The Contractor shall generate a MOC and bMOC release and delivery schedule per CDRL MD-13 that supports releases with incremental capabilities to support key operations readiness activities and milestones. The defined deliveries shown in Error! Reference source not found., are intended to define the needed minimum capabilities and need by dates of the government to support GS and Mission testing. Additional releases/deliveries may be proposed by the Contractor to meet those needs and need by dates. Delivery completion must be achieved by the need by date and is defined as the point in which the delivered capability has been fully tested in the MOC and bMOC and is available for use in Mission or Ground System test events or simulations.

Delivery	Delivery Need By Date	Capability
Mini-MOC: (T&C)	ATP + 18 months (TBR)	Telemetry and Command (T&C) and Front End Processor (FEP) functions to support integration and testing at the spacecraft vendor site. Mini-MOC will be used for interface testing with the SOS prior to delivery to the MOC from the Spacecraft vendor, as well as early interface and functionality testing prior to the start of Mission Readiness Tests.
MOC Release 1: (T&C)	GRT 1 minus 4 months (TBR) - Ground System Readiness Testing	Telemetry and Command (T&C) and Front End Processor (FEP) functions to support GRT 1 in order to test the T&C interface between the MOC and the Ground Network Element via the LSIMSS.
MOC Release 2: (T&C / P&S)	GRT 2 minus 3 months (TBR) - Telemetry and Command and Planning & Scheduling Support - Ground System Readiness Testing	Functionality developed by the Contractor for initial delivery, including but not limited to MOC telemetry and command functions, capability to produce flight dynamics mission planning products, perform planning & scheduling activities to support development of FOT products and operations procedures; capability to support telemetry and command processing with the spacecraft bus and instrument,

		validation of the initial (preliminary) Project Database, and FOT routine operations product development.
MOC Release 3: (GRT Performance & DITL Testing)	GRT 3 minus 4 months (TBR) -GRT Performance Readiness & DITL Testing	Complete MOC and bMOC functionality including all interfaces to ground system elements; capability to support ground system integration and test, including subsystem integration of the MOC and interface connectivity testing of MOC interfaces. This delivery shall support formal MOC installation and Ground System integration and test. Required updates/patches to previous delivery, as identified sub-system integration and interface connectivity testing, if any; capability to support performance and capstone Ground Readiness Testing (GRT).
MOC Release 3.x: (DITL Updates for Mission Sims)	First Mission simulations minus 2 months (TBR)	Complete MOC & bMOC functionality including all interfaces and launch support room functionality. Required updates and patches to previous delivery identified as part of Landsat 9 Ground Readiness Testing, if any; capability intended to support Landsat 9 mission simulations.
MOC Release 3.x: (Updates for Operational Readiness)	Mission Flight Operations Review minus 3 months (TBR)	Required updates/patches to previous delivery identified as part of Landsat 9 Mission Readiness Tests or simulations if any. Represents required updates/patches to previous delivery needed to demonstrate Landsat 9 Flight Operations Readiness. This release is intended to represent the final release prior to the last MRT and MOS tests. Any emergency patches following the Close-Out Release to address discrepancies from this release or other releases must be delivered NLT "Launch Freeze" – 2 weeks.

MOC Release 4: (Post-Launch)	Post-Launch	Represents required updates/patches to previous delivery identified during the on-orbit check-out and commissioning of the Landsat 9 observatory, if any. This release is intended to be the final release prior to post-launch final acceptance of the MOC.
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Table 5-1 MOC Delivery Capabilities

The Contractor shall adhere to the approved MOC system release schedule. The Contractor shall deliver, install, and configure all MOC releases, as shown in **Error! Reference source not found.**, at each of the facilities hosting a MOC systems or subsystem (MOC, bMOC, and S/C I&T). The Contractor shall test and verify that each MOC delivery/release is complete.

With each MOC delivery, the Contractor shall provide MOC software. For major releases, the delivery shall include a full installation package that could be installed as stand-alone.

All MOC system deliveries shall consist of the following items as part of the delivery package:

1. User's Manual in accordance with CDRL MD-16
2. Version Description Document (VDD) in accordance with CDRL MD-14 to include:
 - Release Installation, Setup and Configuration Procedures
 - Hardware Inventory and intended usage description
 - Source Code (if provided)
 - Executables
 - Factory Acceptance Test Results/Reports (CDRL MD-09)
 - Matrix of requirements addressed by this release
3. Site Acceptance Test Plan (CDRL MD-10) and Procedures (CDRL MD-11)
4. Delivery Letter identifying the versions of the User's Guide, VDD, Installation Instructions/Procedure, Source (if applicable), and Executables
5. Other documentation as appropriate

The Contractor shall follow release and patch version naming conventions consistent with defined Ground System processes. The Contractor shall develop the MOC Installation, Setup, and Configuration Procedures in accordance with CDRL MD-17 for all MOC deliveries, so that MOC release installations, emergency patches/installations, regression testing, re-testing and re-installation can be easily performed, if needed.

Prior to delivery of any MOC release or patch, the Contractor shall complete a Pre-Ship Review as defined in section 5.4. Prior to the Pre-Ship Review, the Contractor shall submit a configuration change request (CCR) to the Ground System CCB for configuration of all delivered documents associated with the delivery, as defined in Delivery Package as described above. The Government will provide the Ground System configuration management tool and process to be followed. The delivery CCR should be submitted no later than 48 hours prior to the PSR to allow time for review. The approval of the CCR serves as conditional contractual acceptance of the software delivery, pending successful demonstration of installation, checkout and site acceptance testing within the MOC (per section 5.4).

The Contractor shall perform the installation and integration of the MOC system at the Observatory I&T facility (MOC-C&T), NASA/GSFC MOC, and NASA/GSFC bMOC. For

each facility the Contractor shall execute the MOC Installation, Setup, and Configuration Procedures (CDRL MD-17) as well as the Site Acceptance Test Procedures (CDRL MD-11). The Contractor shall perform integration and interface connectivity testing from each of the facilities hosting an instance of the MOC system to demonstrate network connectivity and data flow as defined by the MOC system ICDs. The Contractor shall verify that the MOC system is compliant with all MOC ICDs. The Contractor shall execute Site Acceptance Tests and verify the requirements of the MOC-RD. Successful completion of the SAT and resolution of any critical discrepancies shall serve as the final contractual acceptance of the MOC system delivery.

For minor software patches, the Government will levy the CCR contents and CDRL requirements and forego the PSR, consistent with the size and complexity of the software patch being delivered. Successful completion of patch installation and site acceptance testing serves as final contractual acceptance of the MOC patch.

The Contractor will provide system administration services at each of the facilities receiving a MOC system (NASA/GSFC MOC, GSFC bMOC, Observatory I&T facility). The Contractor system administration services will include system administration of the installed MOC system(s) within the facilities.

The Contractor shall provide engineering and operating system maintenance update recommendations. The Contractor shall perform testing of such updates prior to formulating recommendations to the Government.

The Contractor shall provide technical helpdesk support during normal Eastern Time zone business hours (nominally 8:00 a.m. – 5:00 p.m.) via telephone beginning with the MOC system C&T delivery through final acceptance of the MOC system. The Contractor shall resolve all MOC system discrepancies and incorporate lessons learned for future integrations.

5.6 Government Furnished Facilities, Equipment, and Software

The Contractor shall provide MOC, bMOC, and LSR network infrastructure, hardware, and software as outlined in this SOW and the MOC-RD. The Contractor shall develop the MOC and bMOC Facility Plan in accordance with CDRL MD-01. The summary of Government furnished items is listed below for reference.

- Landsat 9 MOC, bMOC, and LSR facility at GSFC (includes office and workstation furniture, heating, cooling, and phone services)
- Ground station services (LGN, NEN, SN, International Cooperators)
- Network connectivity between the Landsat 9 MOC/bMOC/LSR and available ground stations, vendor facilities, Launch site, NEN, SN
- Spacecraft and observatory simulators (SOS, LSIMSS, Softsim(s), Demodulator for SOS support)
- IT Security tools (Scanning software, log monitoring system, electronic system configuration inventory tool (TBR))

6.0 INTEGRATION, TESTING, AND OPERATIONS READINESS

In addition to the development of MOC systems, the Contractor shall accomplish integration, testing, and operations readiness activities necessary to achieve a “mission ready” state for the Landsat 9 mission system and operations staff prior to launch. The Contractor is encouraged to identify and leverage synergies between integration, test, and operations readiness activities in order to gain schedule and staffing efficiency and margin in accomplishing the various objectives specified in this section.

6.1 Flight Operations Development

The Contractor shall provide requisite resources and establish a Flight Operations Team (FOT) with appropriate ramp up to support MOC development, integration and test, and ops readiness activities as needed. The Contractor shall ensure members of the FOT participate in design, development, test activities, as well as MOC reviews and meetings and other pre-launch activities as appropriate. At a minimum, the Contractor’s FOT shall:

1. Participate in Mission, Ground System, and MOC milestone reviews
2. Participate in Space to Ground and Ground System interface definitions
3. Participate in MOC subsystem requirements, design peer reviews, and ground support equipment interface definitions
4. Participate in MOC subsystem and system level testing
5. Participate in Observatory classroom training activities
6. Lead the development of operational capabilities within the MOC and prepare the MOC for testing to include at a minimum:
 - Develop and implement Operations Configuration Management system for MOC and bMOC, stand up Ops CCB, and implement Version control process
 - Develop Operations Training and Certification plan and supporting material for training and certifying/re-certifying the FOT
 - Develop MOC and Observatory Standard Operating Procedures (SOPs) in accordance with CDRL OR-01
 - Develop MOC and Observatory Contingency Operating Procedures (COPs) in accordance with CDRL OR-02
 - Develop MOC and Observatory scripts to support execution of the SOPs and COPs in accordance with CDRL OR-03
 - Develop telemetry displays and graphs
 - Develop MOC Day in the Life (DITL) and Orbit in the Live (OITL) tests, develop all procedures, processes, and test materials necessary
7. Observe and support spacecraft and observatory level testing to include Comprehensive Performance Tests (CPTs), Orbit / Day in the Life Tests (OITLs / DITLs), RF Compatibility Tests, and Thermal Vacuum Testing (TVAC).

8. The Contractor’s FOT shall support Ground System and Mission level testing as needed. These activities are described in more detail in the following sections. At a minimum, the Contractor’s FOT shall:
- Participate in Ground Readiness Test planning and test execution activities
 - Command the observatory simulator during Ground Readiness tests
 - Participate in Mission Readiness Test planning and test execution activities
 - Command the observatory in Landsat 9 Mission Readiness tests
 - Command the observatory or observatory simulator in exercises, mission simulations and rehearsals
 - Execute on a routine basis MOC DITL and OITL activities in preparation for MOC operational readiness
 - Generate discrepancy reports as required

6.2 Ground System Integration

The Contractor is responsible for integration of MOC hardware and software. The Government is responsible for integration of the MOC system with other elements of the Landsat-9 ground system, including networks, ground stations, mission data processing nodes, etc. The Contractor shall support Government-led integration activities as directed. These activities will include, but are not limited to, the establishment of network connectivity between the MOC/bMOC and other ground system elements, plus checkout, testing, and readiness exercises involving the MOC and bMOC as well as participation in TRRs and PTRs.

6.3 Ground System Testing

The Contractor shall support Ground Readiness Testing to verify and validate the functional requirements of the integrated Landsat 9 Ground System. The Contractor shall provide on-site, and/or on-call operations and engineering support, as appropriate, to the GRT activities, including dry-runs and other preparations. The Contractor shall also prepare the MOC/bMOC scripts, procedures, etc. to be used to execute the GRT. A summary of the minimum Ground Readiness Test Activities the Contractor shall support is listed in Table 6-1. The numbering of the GRTs is not intended to imply that they will happen in sequential order, but just serves as a naming convention. The timing of the following tests will occur in accordance with the GS Integrated Master Schedule and I&T plan. For the purposes of planning, assume that GRTs will begin at launch minus 30 months and conclude at launch minus 6 months.

GRT Activity	Description	Needed Capabilities	Duration
GRT 1	Test the T&C interface and functionality between MOC/GNE	Command & Telemetry (MOC Release 1)	TBD

GRT 2	GRT 1 with addition of GS P&S interfaces and functionality	Mission Planning & Scheduling (MOC Release 1)	TBD
GRT 3	Performance test all functions, external interfaces	All MOC functions & interfaces (MOC Release 2)	TBD
GRT 4	Single interval in the Life (SITL) – Test SITL for LIT generation	MOC Release 2	TBD
GRT 5	Day in the Life (DITL) - Full daily ops, concludes formal GRT. DITL procedure will be used thereafter for regression testing on future releases	Full Daily Ops functions (MOC Release 3)	TBD
GRT Long	Full daily ops over long duration of 14 – 30 days	Extended Full Daily Ops (MOC Release 3)	TBD

Table 6-1 GRT Activities Summary

6.4 Mission System Integration

The Government is responsible for the integration of the Landsat 9 ground system to the space segment. The space segment encompasses the spacecraft and the instruments, and is referred to as the observatory. The integrated system of the space and ground segments is the Landsat 9 Mission System. The Contractor shall support Government-led integration activities as directed. Specific areas of Contractor support to Mission System Integration include, but are not limited to:

- Participation in mission system interface working groups.
- Development and integration of a mini-MOC system at the spacecraft vendor site. The mini-MOC consists of Telemetry and Command (T&C) and Front End Processor (FEP) functions to support integration and testing between the MOC and spacecraft and instruments and their simulators during spacecraft development prior to launch.
- Checkout, testing, and readiness exercises of the interfaces between the MOC, mini-MOC, and observatory at the spacecraft vendor facility.
- Configuration, checkout, testing and readiness exercises of the interfaces between the MOC system, and MOC-CTP at the spacecraft vendor facility.

- Configuration, checkout, testing and readiness exercise of the interfaces between the MOC system and SOS-CTP at the spacecraft vendor facility, and the MOC facility.
- Incorporation into the MOC, bMOC, MOC-CTP, SOS-CTP, and mini-MOC of the integrated spacecraft and instrument Telemetry and Command (T&C) database provided by the spacecraft vendor, including periodic updates.
- Integration into the MOC, bMOC, and development facilities of the LSIMSS observatory and station simulator as appropriate for I&T and development purposes. Execute PDB updates within the LSIMSS and coordinate with the Government for related simulator maintenance and support.
- Integration into the MOC, bMOC, and development facilities of the SoftSIM software based observatory simulator as appropriate for I&T and development purposes.
- Support integration of the MOC with telemetry feeds from the Payload Processing Facility (PPF) and KSC Ground System for pre-launch flows and ascent telemetry flow.
- Checkout, testing, and readiness exercises between the MOC and PPF.
- Checkout, testing, and readiness exercises between the MOC and KSC Ground System.
- Incorporation into the MOC of an integrated spacecraft and instrument simulator (the SOS) provided by the spacecraft vendor.
- Configuration management, checkout, testing, and readiness activities involving the integrated MOC and simulator(s).
- Support updates and follow-on regression testing, as needed, of the T&C database and simulator.

6.5 Mission System Testing

The Government is responsible for Mission System Testing via Mission Readiness Tests (MRTs) to verify the functional requirements of the integrated Landsat 9 Mission System. The Government will facilitate the test working group sessions to plan and prepare for test execution, and lead test execution.

The Contractor shall support the Landsat 9 integrated test team to plan, coordinate, and execute MRTs. The integrated test team consists of representatives from the Government, Contractor, and spacecraft and instrument providers. The Contractor shall participate with the integrated test team in devising the test goals, requirements, and success criteria for the MRTs. The Contractor shall provide detailed inputs to the test procedures based on the mutually-defined test steps. The Contractor shall develop the MOC command procedures, scripts, display pages, plots, contingency plans, etc. to be used in the testing, and support reviews of these products.

The Contractor shall execute MRTs in the MOC/bMOC facilities and provide on-call operations and engineering support in “test-as-you-fly” manner to include dry-runs, pre-test setup, and other preparatory activities. The Contractor shall participate in TRRs and Post-Test Reviews for each MRT. The Contractor shall generate and provide test data products as needed. The Contractor shall participate in post-test analysis of MRT results. The Contractor shall support the resolution of any spacecraft anomalies and incorporate lessons learned for future tests.

The timing, duration, and scope of the MRTs will be defined by the Government, and will be adjusted to accommodate spacecraft and instrument integration and test pre-launch. The minimum baseline set of MRTs planned for Landsat 9 is contained in the following table:

Test	Duration	Configuration
MRT 1	1 day, 24 hrs/day	Spacecraft I&T complete; prior to instrument integration
MRT 2	3 days, 24 hrs/day	Observatory I&T complete with all instruments
MRT 3	3 days, 24 hrs/day	Observatory I&T complete with all instruments
MRT 4	2 days, 24 hrs/day	Observatory I&T complete with all instruments; during thermal vacuum testing
MRT 5	4 days, 24 hrs/day	Observatory I&T complete with all instruments
MRT 6	2 days, 24 hrs/day	Observatory I&T complete with all instruments

Table 6-2 MRT Activities Summary

The MRT durations shown in Table 4.3.4.7-1 do not include Spacecraft/Observatory setup time or Spacecraft/Observatory-to-MOC interface verifications. The MRT durations are times set aside for Government-run testing. The Government reserves the right to redistribute the total number of hours represented in the table between the MRTs. MRT schedules will be coordinated between the Government and the Spacecraft Contractor. MRTs may be executed in any order, except MRT 1 shall be first. At least one MRT, nominally MRT 1, shall be conducted using Government-provided RF compatibility test equipment.

Beginning no later than (NLT) six months prior to the first scheduled MRT, the Contractor shall support up to five 8-hour pre-MRT interface tests with the Spacecraft vendor to demonstrate that commands and telemetry flow successfully between the Spacecraft Vendor and the MOC hardware/software. The fidelity of each test shall increase incrementally. The interface tests are intended to build confidence in the spacecraft to MOC interface prior to the start of MRTs. The Contractor shall support the Government in planning and scheduling these interface tests.

6.6 Operations Readiness

Operations Readiness encompasses four areas:

- Maturing the delivered ground system from a development to an operations-ready state
- Development and validation of command procedures, scripts, display pages, plots, standard operating procedures, contingency operating procedures, mission planning rules, etc. to operate the integrated mission system
- Training of operations staff to operate the integrated mission system
- Participation in a progressive series of independent reviews to assess progress toward readiness for on-orbit operations

The Contractor shall deliver a Transition to Operations Plan (CDRL OR-06) that defines the approach and plan for achieving operational readiness and transitioning the MOC from development to operations.

6.6.1 System Operational Readiness

The Contractor shall plan and execute a campaign to bring the MOC hardware and software systems to a state of operational readiness following the completion of development and integration. Some of this campaign may be conducted in parallel with development and integration activities, as appropriate. The campaign will include, but not be limited to, checkout, tests, and/or readiness exercises to completely exercise the system in operational manner. The campaign shall be structured in such a way that major MOC sub-systems (T&C, Planning and Scheduling, etc.) are subject to rigorous checkout and supported by development subject matter experts throughout the campaign.

The Contractor shall identify and prioritize system issues impacting effective operations, and fix those issues in a timely, prioritized manner. The Contractor shall deploy Operations Configuration Management tools and processes to continuously track the MOC hardware and software configuration, deploy approved changes to the system baseline, and rapidly conduct audits of the deployed baseline. The Contractor shall provide an audit report prior to each scheduled GRT, MRT or Mission Simulation test. The Contractor shall maintain updated metrics on problem discovery and subsequent resolution.

6.6.2 Operations Product Readiness

The Contractor shall develop, validate, and manage Operations Products to guide operations of the space segment and MOC in early mission, nominal, and contingency situations. These products include, but are not limited to, command procedures, scripts, telemetry pages, mission planning rules, standard operating procedures, contingency operating procedures, etc.

The Contractor shall participate in technical interchanges with spacecraft and instrument providers to identify procedural details to operate the observatory in early mission, nominal, and contingency situations. The Contractor shall synthesize these details into the appropriate Operations Products. Throughout development and validation of space segment Operations Products, the Contractor shall collaborate with spacecraft and instrument providers to ensure technical accuracy.

The Contractor shall validate all Operations Products in an operations-like environment to the fullest extent possible. For space segment Operations Products, the Contractor will use simulators to accomplish validation where the simulation is accurate and realistic. Where realistic simulation is not available for space segment Operations Products, the Contractor will validate procedures using the integrated spacecraft and instruments.

The Contractor shall develop an Operations Product style guide to ensure consistent “look and feel” of Operations Products. The Contractor shall develop a multi-tier rating system to delineate the maturity level of each Operations Product from development through validation to an operations ready state. The Contractor shall maintain updated metrics on maturity of all Operations Products and provide a summary report at the Monthly Status Review. The Contractor shall provide Government access to the multi-tier rating system and maturity metrics.

6.6.3 Operations Staff Readiness

The Contractor shall develop and execute an Operations Staffing Plan in accordance with CDRL OR-04 that identifies each operator and operations support position necessary for safe, effective mission operations. The plan shall also specify the staffing ramp-up approach to achieve full operations team staffing with sufficient margin to accomplish all necessary training and certification activities. The Contractor shall maintain updated metrics on staffing of the operations team.

The Contractor shall develop and execute an Operations Staff Training and Certification Plan in accordance with CDRL OR-05. This Training and Certification Plan will specify an appropriate combination of classroom training and readiness exercise participation to certify staff readiness for each operator and operations support position defined in the Operations Staffing Plan. The Contractor shall then execute the training and certification program in accordance with the plan. For each classroom training session the Contractor shall prepare, provide, and present all course materials. The Contractor shall make this training available to Government operations and early mission engineering staff. The Contractor shall maintain updated metrics on training and certification status of all Operations Staff.

As part of the Operations Staff Training and Certification program, the Contractor shall participate in a minimum of six (6) mission simulations to simulate typical on-orbit observatory operations. The Government is responsible for planning, development and execution of the mission simulations. The Contractor shall support planning, development and execution of the mission simulations as needed. The minimum baseline set of mission simulations planned for Landsat 9 is contained in the following table:

Simulation	Duration (Days)	Hours / Day	Contractor Support Level
Launch, Early Orbit & Activation (LEO&A) Sim 1	3	8	Full LEO&A team – 1 person per sub-system/console position per shift at MOC
LEO&A Sim 2	4	12	Full LEO&A team – 1 person per sub-system/console position per shift at MOC
LEO&A Sim 3	4	24	Full LEO&A team – 1 person per sub-system/console position per shift at MOC
LEO&A Sim 4	5	24	Full LEO&A team – 1 person per sub-system/console position per shift at MOC
LEO&A Sim 5	5	24	Full LEO&A team – 1 person per sub-system/console position per shift at MOC

Total WRS-2 in the Life (TWITL) Sim	16	8	Contractor subject-matter experts on call at Contractor facility for anomaly resolution support
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Table 6-3 Mission Simulations Summary

The Contractor shall support launch rehearsals as needed.

6.6.4 Operations Reviews

The Contractor shall participate in a series of Government-led independent readiness reviews to assess progress towards the achievement of operations readiness pre-launch. These reviews may include peer reviews and formal board reviews. Participation includes, but is not limited to, preparation of materials, presentation of materials, answering of requests for action, etc.

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7.0 EARLY ORBIT OPERATIONS AND ACCEPTANCE

The Contractor shall perform Landsat 9 Mission Operations during the Launch and Early Orbit (LEO), observatory check-out, commissioning, and throughout the mission life phases, under the direction of the Government. This section applies to operations during the early mission phases, specifically LEO, observatory checkout, and commissioning.

7.1 Integrated Mission Timeline

Prior to launch, the Government is responsible for generating an Integrated Mission Timeline (IMT) of the observatory early mission activities. The IMT provides the detailed, time-ordered list of activities and associated Operations Products necessary to activate, test, and commission the Landsat 9 mission following launch, including the ascent plan. The Contractor shall participate in IMT development. The Contractor shall review and provide inputs, and comments/corrections to IMT products. In conjunction with IMT development, the Contractor shall participate in development of plans and processes that will be exercised in the MOC during the Launch through Commissioning phase of the Landsat 9 mission including, but not limited to, on-console communications, operations CCBs, schedule and stored command load review processes, daily planning processes, staffing and shift plans, anomaly notification and response processes, and IMT change processes.

7.2 Early Mission Operations

During the early mission phases, the Contractor shall participate in all early orbit and commissioning processes and meetings including short and long-term planning, update and review of Operations Products, operations CCBs, and anomaly team meetings. The Contractor shall present status of MOC system performance through system acceptance by the Government. Status shall be presented at daily or shift-handover meetings and shall include, but is not limited to, the configuration of all systems/tools, old and new anomalies, resolved anomalies, and plans for the next day/shift, along with any other relevant information.

The Contractor shall staff the operations team at the MOC facility on a round-the-clock basis (24/7) beginning one week prior to launch through successful completion of on-orbit commissioning, nominally 90 days following launch, and transition to “lights out” operations. Upon successful completion of commissioning, the Contractor shall reduce the operations team from the commissioning staffing to a level commensurate with nominal on-orbit operations. The Contractor shall incorporate automation into the MOC system and processes so that “lights out operations”, defined as a maximum of 10/7 flight operations, can be achieved no later than OAR plus three months. The Contractor shall include details of 10/7 staffing adjustments in the Operations Staffing. This along with any other staff adjustment action shall be based on specific criteria jointly developed by the Government and Contractor prior to launch. The Contractor, along with the Government, shall assess the MOC systems and flight operations team’s readiness to transition to “lights out” operations (10/7 flight operations) of the Observatory relative to the established criteria. The Government will authorize transitions from 24/7 flight operations to any reduced staffing level.

The Contractor shall provide on-site and/or on-call support, as appropriate, for any MOC operational problems or anomalies through MOC final acceptance.

The bMOC will serve in a backup role for observatory health and safety along with science operations during all mission phases including LEO, observatory checkout, and commissioning phases. The bMOC shall, at a minimum, be able to perform health and safety monitoring, commanding, required mission planning, and science image acquisition to ensure needed on-orbit Observatory health and safety and continuity of science collections.

7.3 MOC Acceptance

Provisional acceptance of the MOC shall take place prior to the launch of Landsat 9, following the verification of all requirements, successful completion of all MOC testing, and the successful completion of the Landsat 9 Operations Readiness Review (ORR). Final acceptance of the MOC shall take place at the end of the on orbit checkout phase of the L9 observatory, following verification of any post-launch MOC deliveries/releases as well as a successful Post Launch Assessment Review (PLAR) and On-Orbit Acceptance Review (OAR). The Contractor shall participate in and support the MOC portion of the Landsat 9 PLAR (note: this release(s) may or may not be required but should be planned for by the Contractor) as well as the MOC portion of an On-Orbit Acceptance Review (OAR) prior to Government final acceptance of the MOC. The Contractor shall deliver an Acceptance Data Package in accordance with CDRL OR-07 as a prerequisite to Government acceptance.

8.0 OPERATIONS AND SUSTAINMENT

**The CDRL references within this section are notional and will be provided at a later time.*

The Contractor shall provide the following services for the remaining contract period of performance following MOC on-orbit acceptance and declaration of initial operating capability.

The Contractor shall provide project management support necessary to perform the mission operations and the support services described in Section 2.0 of this SOW. The Contractor shall ensure the workforce with the necessary skill sets are available and that each are competent, reliable, and perform according to the requirements and expectations to operate and maintain Landsat 9 flight operations and systems.

The Contractor shall perform on-orbit operations of the Landsat 9 Observatory. This includes all activities necessary to maintain spacecraft and instruments' health and safety, while working to achieve the objectives of the mission. The Contractor shall provide continuity for daily operations activities, and perform on-going monitoring, analysis, configuration management, troubleshooting, performance reporting and trending, and operation of onboard systems and MOC ground systems.

The Contractor shall develop tools or automation processes to enhance or work around operational issues. The Contractor shall plan, rehearse, and execute all unique and non-routine activities such as orbital maneuvers, special calibration events, and anomaly recovery activities. The Contractor shall conduct post event analysis for all unique and infrequent activities.

The Contractor shall perform periodic proficiency tests of MOC systems and back-up MOC (bMOC) systems, as well as proficiency tests with ground stations, and special contingency stations in order to validate routine and contingency procedures as well as system configuration and ensure proper training and certification of flight operations team. See the CDRL for Flight Operations Training and Certification Plan for additional detail.

8.1 Project Management

The Contractor shall maintain a project office to manage the technical activities and resources of the LMO Contract. The Contractor shall appoint a Project Manager to direct and manage the LMO Contract activities. The Contractor's Project Manager shall have responsibility for the overall operational and technical performance, resource management, and schedule management of the contractual effort and all subcontracts. The Contractor's designated Project Manager shall report to a level of company management appropriate to ensure prompt resolution of all problems.

The Contractor shall prepare a Project Management Plan, in accordance with CDRL (TBD) that documents the manner in which the Contractor will manage and conduct the work described in Sections 8, 9, and 10 of this SOW. The Contractor shall define and implement a contract Work Breakdown Structure (WBS) categorizing the tasks to be performed during development, implementation, and operations and sustainment in accordance with CDRL (TBD).

The work to be performed shall be carried out under direction of the designated USGS Flight Systems Manager (FSM). For normal operations, the FSM will approve all procedures used to operate and maintain the spacecraft, payload and space/ground support activities. During special and contingency operations, the FSM will review and approve all planning, execution and post-

event analysis. The government's active participation in flight operations management increases with operational situation severity.

8.1.1 Government Insight

The Contractor shall be open to Government attendance at all Contractor and subcontractor internal reviews, audits, meetings and other activities within the scope of the contract. The Contractor shall supply documents, records, and data to support Government activities associated with the LMO Surveillance Plan (Document # TBD). The Contractor shall develop an Organizational Conflict of Interest Avoidance Plan, in accordance with CDRL (TBD). For access and insight activity, "Government" includes Government personnel and Government contractor personnel. The Contractor shall allow and enable the use of Non-Disclosure Agreements with Government contractors where appropriate. The Contractor shall notify the Contracting Officer and the Contracting Officer's Representative (COR) of meetings, reviews or tests in sufficient time (nominally at least 10 working days for major reviews and formal tests) to permit meaningful Government participation.

8.1.2 Access to Controlled Facilities

The Contractor shall obtain all required access authorizations and submit any paperwork required for the Contractor to access Government controlled facilities.

The Contractor shall allow access by the Government to all Contractor facilities related to and supporting the LMO effort.

8.1.3 Risk Management

The Contractor shall establish and maintain a comprehensive risk management program for flight operations. The Contractor shall generate a risk matrix report that is presented and reviewed at all Monthly Project Status Reviews (MPSRs), along with mitigation strategies and steps as appropriate. The Contractor shall invite the Government to attend Contractor Risk Management Board meetings. The Contractor shall develop and implement a flight operations specific Risk Management Plan (RMP), in accordance with CDRL (TBD), as a means to anticipate, mitigate and control risks and to focus resources to maximize success of mission operations activities.

The primary activities of the Contractor Continuous Risk Management (CRM) process are:

- h. Identify, analyze, plan actions/mitigations, track, control, and document reliability, quality, technical performance, schedule, and budget risks before they become problems.
- i. Evaluate, classify, and prioritize all identified risks.
- j. Develop and implement risk mitigation strategies, actions, and tasks and assign appropriate resources.
- k. Track risks being mitigated; capture risk attributes and mitigation information by collecting data; establish performance metrics; and examine trends, deviations, and anomalies.
- l. Control risks by performing: risk close-out, re-planning, contingency planning, or continued tracking and execution of the current plan.
- m. Communicate and document (via the risk recording, reporting, and monitoring system) risk information to ensure it is conveyed between all levels of the operations project.

- n. Report on outstanding risk items at all management reviews using a 5x5 risk matrix based on contractor's assessment of risk likelihood and consequence.

The Contractor shall document the project-specific implementation of the CRM process in a RMP in accordance with CDRL (TBD). Preparation of the RMP includes the content shown in NPR 8000.4, "Risk Management Procedural Requirements."

The Contractor shall document and report all identified risks in accordance with the project's RMP. The Contractor shall address identified risk areas at project status reviews. The Contractor shall make risk status available to all members of the project team for review. The Landsat 9 Project Office and the MOC Contractor will agree on what level of detail is appropriate for each review. Although not all risks will be fully mitigated, the Contractor shall address all risks with mitigation and acceptance strategies agreed upon at appropriate mission operations reviews.

The Contractor shall maintain a Risk List throughout the project life cycle, including residual risks, along with programmatic impacts. The list should indicate which risks have the highest probability, which have the highest consequences, and which risks represent the greatest risk to mission success. The list should also identify actions being taken to address each specific risk. The Contractor shall maintain the Risk List under configuration control.

For each primary risk (those falling in the yellow or red sections of the 5x5 Risk Matrix), the Contractor shall prepare and maintain the following within the risk management tool:

- Description of the risk, including primary causes and contributors, current mitigation strategy, and information collected for tracking purposes.
- Primary consequences should the undesired event occur.
- Estimate of the probability of occurrence (qualitative or quantitative) together with the uncertainty of the estimate and the effectiveness of any implemented risk mitigation measures.
- Potential additional risk mitigation measures, which shall include a comparison of the cost of risk mitigation versus the cost of occurrence multiplied by the probability of occurrence.
- Characterization of a primary risk as "acceptable" shall be supported by a rationale (with the concurrence of the Landsat 9 FSM that all reasonable mitigation options (within cost, schedule, and technical constraints) have been instituted.

8.2 Resource Management

8.2.1 Financial Management

The Contractor shall provide Financial Reports to the Government in accordance with CDRL (TBD) and the contractor's standard policies and procedures. The Contractor shall report financial and cost data at the MPSR and quarterly.

8.2.2 Schedule Management

The Contractor shall maintain an integrated scheduling system consistent with their corporate procedures and documented in the Project Management Plan CDRL (TBD). The Contractor shall provide and maintain an Integrated Master Schedule in accordance with CDRL (TBD). The Contractor shall obtain approval from the FSM prior to changing the IMS baseline.

The Contractor shall prepare updates to the IMS at least monthly, as part of the monthly reporting process. The contractor shall address issues with the schedule as they arise in the weekly or monthly meeting process.

8.3 Reviews and Meetings

8.3.1 Monthly Project Status Reviews and Reports

The Contractor shall communicate the status of the MOC operations effort, technical effort, schedule, and resource condition to the Landsat 9 FSM and Mission Management Team on a monthly basis. The Contractor shall develop and deliver a monthly project status review package, in accordance with CDRL (TBD). The monthly project status review package shall include Integrated Master Schedules (IMS) prepared in accordance with CDRL (TBD).

The Contractor shall provide monthly status report on the operational performance, technical effort, cost, and schedule in accordance with the WBS to adequately describe the status of contract activities to the Government.

The Contractor shall provide monthly financial reports in accordance with CDRL (TBD) to the Contracting Officer's Representative (COR). All reports shall be made available electronically (adobe PDF is acceptable).

8.3.2 Technical Interchange Meetings (TIMs), Working Groups (WGs), and Routine Meetings

The Contractor shall inform the Government at least one week in advance of technical interchange meetings resolving operational or technical issues concerning critical Observatory or MOC systems or sub-systems. In certain cases TIMs may be combined with monthly status meetings. TIMs shall also include discussion of prioritized operational activities. The Contractor shall also participate in Government-led working groups.

8.4 Management Processes

8.4.1 Configuration Management

The Contractor shall perform configuration management (CM) in support Landsat 9 flight operations. The Contractor shall maintain the Hardware and Software Configuration Management Plan. The Contractor shall maintain configuration of all MOC and bMOC deliveries/releases, test environments, operations products, and delivered items, including but not limited to flight software, simulators, T&C databases, and all other contractor deliverable items throughout all phases of mission operations. The Government will chair the CCB for the MOC and bMOC operations configuration as well as the Operations CCB following launch, consistent with existing Landsat policies and processes.

The Contractor shall provide, use, administer, and maintain tools and software applications used in support of configuration management. The Contractor shall maintain documentation, plans, and procedures as required for supporting mission operations and mission support activities. The

Contractor shall maintain and update (as needed) the spacecraft manufacturer and instrument vendors provided documentation.

The Contractor shall follow established configuration management processes (e.g. peer review and internal sign-off) for all FOT products including documentation of new or updated products. The Contractor shall maintain full control of any changes to the ground system, and Observatory configuration, and has the responsibility for the approval of any activities relating to changes to any of the support elements or facilities within the flight operations domain. The Contractor shall maintain a set of configuration controlled flight operations procedures, which include procedures for nominal, special and contingency operations. The Contractor shall support the FSM to coordinate configuration changes across other mission components.

The Contractor shall prepare and provide the following regarding configuration control:

- Configuration Control Board (CCB) status shall be reported at the Monthly Project Status Review.
- The Configuration Item Identification List (CIIL) (TBD) and the Computer Software Configuration Items (CSCIs) (TBD) in accordance with CDRL (TBD).
- Government access to MOC and bMOC hardware and software configuration status and tracking via the Contractor's automated tool.

8.4.2 Software Management

The Contractor shall document in the Software Development and Management Plan (SDMP), in accordance with CDRL (TBD), the software management approaches and processes for MOC system software maintenance and sustainment and assurance of all software products. The Contractor shall adhere to the government approved SDMP.

8.4.3 Action Item Tracking

The Contractor shall apply a process for capturing and responding to action items assigned by the FSM or during monthly meetings, technical interchange meetings, and working group meetings. The Contractor shall provide the Government access to the action item tracking solution.

8.4.4 Problem tracking

The Contractor shall maintain a closed-loop problem tracking process that includes problem or discrepancy reporting, problem analysis, corrective action, and closure. The process shall be implemented for tracking all types of MOC problems, including, but not limited to hardware, software, ops products, testing discrepancies and on-orbit anomalies. The process shall include: a protocol to review past performance to determine the incidence of identical or related discrepancies, an escalation procedure (to inform higher levels of management and the Government) based on mission criticality, and a closeout process for root cause determination, anomaly mitigation, and recurrence control. The problem tracking process shall incorporate interfaces as appropriate to the Ground System problem reporting process and system, as some problem reports will affect interfaces, be generated via Ground System level testing, or otherwise span, migrate between, or have child-parent relationships to other noted discrepancies. The Contractor shall document the process in the SDMP CDRL.

The Contractor shall provide Government access to the Contractor's problem tracking system, including the ability to access remotely (web-enabled), submit problems (discrepancy reports), submit a recommended priority for action, and review individual problems as well as summary problem status metrics and reports. The Contractor shall report on the overall status of MOC problems as part of the monthly reporting process.

8.4.5 Internal Technical Memoranda

The Contractor shall provide all MOC-relevant technical internal memoranda as requested by the Government in accordance with CDRL (TBD), Contractor Generated Internal Technical Information. The correspondence can be informal to preserve timeliness. The Government shall have access to these memoranda on a timely basis via hard copy or the electronic library described below.

8.4.6 Electronic Library

The Contractor shall provide to the Government and Government contractor personnel, for review purposes, remote access to an electronic library. This library shall contain all completed reports, analyses, requirements documentation, internal technical memoranda, change requests and documentation, CDRLs, and all other MOC-specific documents prepared by the Contractor. Within this library the Contractor shall maintain an index of the material (updated monthly) and a search engine for document access. The non-CDRL material contained in these electronic databases may be in Contractor format. The Contractor shall make the contents of the electronic library remotely downloadable. The Contractor shall include engineering drawings in this library or provide some other storage/retrieval arrangement, at their option.

8.5 Flight Operations Team

Following on-orbit acceptance of the Observatory and transition to nominal operations, the Contractor shall ensure the Flight Operations Team (FOT) provides the following in support of Landsat 9 flight operations:

1. Necessary work force skill sets are available, and that each are competent, reliable, and trained to perform according to the requirements and expectations to operate and maintain Landsat 9 flight operations and systems while on contract to perform mission operations.
2. Currency and relevancy of the training plan and supporting mission material required for routine, recurring training and re-certification of the FOT.
3. Leadership for anomaly assessment, analyses, and resolution activities.
4. Support for spacecraft and instrument anomaly assessment, analyses, and resolution activities, including actions assigned via the Anomaly Review Team (ART).
5. Currency and proficiency of simulators in support of routine, infrequent, and anomaly recovery activities.
6. Command and control of the observatory in accordance with requirements and procedures for the duration of the contract period of performance.

7. Necessary leadership and support for all normal operations, contingency operations, anomaly recovery, and decommissioning planning activities.
8. Leadership and support of Command Authorization Meetings in conjunction with the required subject matter experts, including spacecraft and instrument vendors, the IOT, and the Flight Systems Manager and Mission Manager to plan and approve all non-routine observatory activities.
9. Support working groups with the OLI-2 and TIRS-2 support teams to plan for upcoming mission planning and scheduling activities that result in Instrument command load submission to the MOC P&S system.
10. Automation operations preparation and post-event monitoring processes and procedures consistent with mission objectives in support of Government approved “lights out operations”.

The Contractor shall maintain the Mission Operations Center (MOC) and bMOC ground systems and infrastructure provided as GFE listed in Attachment **TBD**. This includes configuration control and management, systems engineering, network engineering, network administration, systems and database administration, facility support, installation, and integration support.

The Contractor shall perform software development as needed to enhance MOC system automation capabilities and/or address bug fixes as authorized through the Work Authorization process and coordinated through the Government Configuration Management process. As part of this work, the Contractor shall plan, develop and test all associated software releases and patches so that each are ready for integration into the operational system.

Upon the request of the USGS Flight Systems Manager (FSM), the Contractor shall support feasibility and technical studies related to Landsat operations concepts, Landsat science image acquisition, Landsat legacy and follow-on missions, and collaborative mission and multi-mission approaches with other Landsat missions.

8.6 Observatory Subsystems and Associated Operations

The Contractor shall plan, rehearse, perform and assess real-time, special, and contingency operations which involve or impact one or more Observatory subsystems. At a minimum, the Contractor shall support Landsat 9 operational engineering, trending and functional analysis of the Attitude Control System, Propulsion, Electrical Power System, Command and Data Handling System, Instruments (OLI-2 & TIRS-2), Communications System, Thermal Control System, and Flight Software. The Contractor shall update and maintain all Standard Operating Procedures (SOP) or Contingency Operations Procedures (COP) for flight activities in accordance with CDRL (**TBD**). The Contractor shall be responsible for scheduling and executing periodic maintenance of onboard systems as defined in the SOPs. Associated ground configuration parameters (paging, limits, and displays) are to be managed and updated to match the configuration of the Observatory. The Contractor shall support development of revised operations concepts and and/or modification and testing of new flight constraints.

8.7 Real-time and Support Operations

The Contractor shall support all real-time operations of the Observatory from both ground and space networks. Real-time operations consist of those activities that are necessary to support direct communication with the spacecraft and include pre/post-pass operations, telemetry acquisition, tracking and command, orbit and attitude maintenance maneuvers, system configuration, Observatory state of health assessment, housekeeping telemetry processing, command load uplink and verification, table and memory load/dump operations, mission data management, and management of the Solid State Recorder (SSR) to capture and downlink all science and spacecraft engineering data. Support operations are those off-line activities that are necessary to support the safe and nominal operation of the Observatory and include planning and scheduling, orbit determination, maneuver planning, stored command load generation, attitude modeling, and trending and statistical analysis of Observatory performance. The Contractor shall develop and maintain SOPs for these activities.

The Contractor shall perform the routine image acquisition planning and scheduling function for Landsat 9. The Contractor shall communicate and coordinate with the USGS EROS data acquisition manager for additional image acquisition input and direction pertaining to other than routine imaging such as night imaging, special science campaigns, or off-nadir imaging.

The Contractor shall manage ground network contact scheduling processes and procedures to confirm contact schedules with the Landsat Ground Network, and to resolve scheduling conflicts. The Contractor shall provide additional ground station scheduling products for international cooperators to the Data Processing and Archive (DPAS) per the ICD as required for supporting mission activities.

The Contractor shall ensure adequate S and X-Band communications services are available through the Landsat Ground Network (LGN), Near-Earth Network (NEN), Space Network (SN), or other government provided communications networks for command, control, and tracking of the observatory, delivery of spacecraft and instrument telemetry, and delivery of science imagery to ground systems. The Contractor shall coordinate and communicate directly with LGN operators as required to perform mission activities and troubleshoot issues. The Contractor shall schedule and perform periodic proficiency tests with ground stations and special contingency ground stations in order to validate routine and contingency procedures as well as system configuration.

The Contractor shall manage and update, if necessary, mission planning rules to generate conflict-free schedules to support activities for all spacecraft contacts, and required spacecraft special activities. The Contractor shall ensure that command loads are verified prior to uplink and are uplinked in a timely manner prior to the load start. The Contractor shall support reviews of any special load products with an appropriate approval process (such as a Command Authorization Meeting (CAM)).

The Contractor shall generate and execute a test plan prior to implementing updates operationally. The Contractor shall maintain automation flow diagrams, steps, and procedures in the operations library. During both manned and lights out operations the Contractor shall maintain a console log and collect metrics on pass, automation, MDM, and ground system performance for weekly reporting.

8.8 Engineering Support

The Contractor shall provide spacecraft, instrument, and MOC & bMOC systems and network engineering support for routine operations following acceptance of the MOC and declaration of initial operating capability. Additionally, the Contractor may propose and the Government may authorize special studies to be performed by the Contractor in support of system enhancements, automation, and continued operations of the Landsat 9 MOC.

8.8.1 Nominal Operations Engineering Support

The Contractor shall perform systems engineering in support of operational MOC and bMOC systems to ensure systems and software functions are reliable and available. Accordingly, the Contractor shall provide systems and software engineering resources as required. Contractor systems and software engineering support shall include day-to-day activities such as troubleshooting, scripting, software and hardware integration into the operational environment, interface management, discrepancy tracking, and general systems support including cross-functional systems engineering.

Following MOC system acceptance by the Government, the Contractor shall provide the following services for the period of performance of the contract:

1. Maintain the MOC system in order to meet contract requirements. Any maintenance-related deliveries shall comply with the delivery process described in section 5.5.
2. Manage MOC software and hardware license and maintenance contracts.
3. Update and sustain all MOC system hardware and software, including application, database and operating system software.
4. Provide on-call technical support for the MOC subsystems to assist in discrepancy or anomaly resolution as needed.

The Contractor shall maintain the repository of MOC hardware, software, applications, databases, and other system configuration items. The Contractor shall maintain configuration management of the T&C Project Database (PDB); maintain Translators to convert between Spacecraft and Application databases; and provide and maintain a development environment for MOC PDB users.

8.9 Anomaly Detection, Isolation, Analysis, and Recovery

An anomaly is defined as the occurrence of any event that causes the spacecraft, payload, data retrieval, or any of the ground-based support systems to perform in a non-standard manner during any normal or special operation. An anomaly may occur in either on-orbit or ground-based elements of the flight operations system. The Contractor shall be responsible for maintaining a defined plan for escalating anomaly response and using it to support anomaly resolution activities as defined in this section. When an anomaly occurs, the Contractor shall summarize and report the events within one business day to the FSM, unless the incident is mission threatening or exceeds specific performance or mission objective thresholds, in which case the FSM shall be notified immediately. The Contractor shall write and maintain a set of Contingency Operating Procedures (COP) for anomaly response and recovery in accordance with CDRL (TBD). When required, pre-approved response procedures are to be executed by the

Contractor for defined anomalies as per validated and approved Contingency Operating Procedures (COP).

8.9.1 Support for Resolution of On-Orbit Anomalies

The Government is responsible for creating and managing an Anomaly Resolution Team (ART). The FSM will be the ART chair. In addition, the Government shall be responsible for any augmentation of technical staff to support anomaly analysis and recovery. The ART shall have lead responsibility for analysis of anomalies that are determined to be the result of the performance of an on-orbit system or subsystem, or a result of a procedural error. The ART is also responsible for providing root cause analysis and development of a corrective action recommendation to be given to the FSM. The Contractor shall investigate and collect information, document, and participate in the analysis of such anomalies in support of the ART, as directed by the FSM. The Contractor shall also implement corrective actions as authorized by the FSM.

The Contractor shall enter the Observatory event into the appropriate MOC discrepancy or anomaly reporting system within 24 hours to support tracking of analysis and disposition until closure. Following completion of anomaly resolution, the Contractor shall update documents, constraints and limits, page notifications, and procedures accordingly. As required, the Contractor shall ensure that all FOT members are fully trained on any Observatory changes or procedural modifications.

As part of anomaly closeout, the Contractor shall populate and maintain the Landsat 9 mission profile within NASA META so that it reflects the current Landsat 9 flight system configuration.

8.9.2 Support for Resolution of Ground-Based Anomalies

Under the oversight of the FSM, the Contractor shall have responsibility for investigating and collecting trending and telemetry information, documenting observations, providing technical recommendations, and (where applicable) executing resolution of anomalies that are determined to be the result of performance or failure of a ground-based system or subsystem, or a result of procedural error.

Contingency operations procedures for likely and/or critical anomalies shall be written and maintained by the Contractor. The Contractor shall provide version control of contingency operations procedures and locate each in a central repository available for immediate use by flight engineers and operational staff 24 hours a day.

The Contractor shall enter ground based anomaly events into the appropriate MOC discrepancy or anomaly reporting system within one week to support tracking of analysis and disposition until closure. Following completion of anomaly resolution, the Contractor shall update documents, constraints and limits, page notifications, and procedures accordingly. As required, the Contractor shall train all FOT members in accordance with any Observatory changes or procedural modifications.

8.10 Mission Monitoring and Analysis

The Contractor shall maintain, collect, and store all housekeeping and engineering data in the central mission repository delivered to the MOC. The Contractor shall maintain and ensure

availability of all housekeeping and engineering data collected from the Observatory within a trending analysis system. The Contractor shall process, trend and analyze routine housekeeping and engineering data on a daily, short term, long-term, and periodic basis required for Observatory health, safety, and performance analyses. All daily monitoring shall use all data points at their highest or optimal sampling rate in order to reduce data gaps introduced through averaging for daily Observatory monitoring.

In addition, the Contractor shall produce and provide ad hoc reports as needed to support anomaly investigations, maneuver planning, special operations, definitive reporting, and on-demand requests by the FSM. All requests for telemetry will be authorized by the FSM. The FSM may opt to authorize standing requests for providing telemetry to external parties. The Contractor shall only provide telemetry or other technical information to external parties upon authorization of the FSM or Mission Manager.

The Contractor shall review Observatory subsystem plots daily and hold an Observatory wide trend review once per week.

8.11 Flight Dynamics

The Contractor shall perform Flight Dynamics functions including orbit determination, maneuver planning and execution, attitude determination and control and associated analysis. The Contractor shall also support conjunction assessment activities and perform risk mitigation analysis. The Contractor shall provide orbit and attitude maneuver planning and execution to satisfy mission objectives.

The Contractor shall support reviews of any maneuver products with an appropriate approval process (such as a CAM). After the execution of a thruster-based maneuver, the Contractor shall provide analysis of the burn performance and track fuel consumption, tank pressure, and thruster efficiency for future maneuver planning.

The Contractor shall coordinate with the FSM to ensure Landsat 9 orbit with respect to the A-Train Afternoon Constellation is within agreed to parameters and on how to communicate any deviations from the expected orbital envelope. The Contractor shall notify the FSM so he/she can notify all member satellites of the Morning Constellation of any and all instances of the Landsat 9 spacecraft transitioning into or out of Safe or Survival Mode. The Contractor shall work with the USGS-approved conjunction analysis service organization (e.g. NASA's Conjunction Assessment/Risk Analysis group) and provide mission ephemerides for conjunction assessment and maneuver screening. The Contractor shall update, as necessary, maneuver and decommissioning profiles based on current spacecraft fuel reserve estimates and state of health.

8.12 Mission and Science Data Collection Planning

The Contractor shall perform mission planning activities and generate command and schedule loads for all Observatory activities on a daily (TBR) basis. These daily mission planning and load building activities include, but are not limited to, scheduling of ground communications contacts, instrument activities, science data collection, and calibration observations.

Accordingly, the Contractor shall develop daily contact schedules (TBR) and other products necessary for real-time spacecraft operations. The Contractor shall also interface with International Cooperators (ICs), and generate scheduling products for their use. For additional

information see the Landsat Operations Agreement between the International Ground Stations (IGS) and the Mission Operations Center.

The Contractor shall maintain the observatory and ground system analytical modeling capability in support of routine operations, contingency operations, changes in science acquisition requirements, and special studies (refer to section 3.4). The Contractor shall operate the analytical modeling capability and perform related analyses, generating reports as necessary.. The Contractor shall make all modeling results and analysis (including graphical displays if applicable) available to the Government. The Contractor shall maintain the analytical modeling software and any peripheral tools as a stand-alone capability which meets the requirements in the MOCRD. The Contractor shall ensure analyses conforms to all instrument and spacecraft constraints and operating limits.

Infrastructure Support

8.12.1 Facilities

The MOC facility structure and environmental control will be provided by the Government as will all external network connections. The Contractor shall provide all other hardware and system software necessary to support flight operations activities and interfaces. The Contractor shall monitor the environment of the mission operations and equipment rooms and provide other services not covered by Government facility engineers or contracts that are described in the USGS EROS to NASA GSFC Interagency Agreement for Communications – Statement of Work (TBD).

The Contractor shall support basic facility modifications in the Government MOC facilities including power and data communications cabling and support hardware installation.

The bMOC facility structure and environmental control will be provided by the Government as will all external network connections. The Contractor shall provide all other hardware and system software necessary to support back-up flight operations activities and interfaces. The Contractor shall monitor the environment of the back-up mission operations and equipment rooms and provide required maintenance services.

The Contractor shall support basic facility modifications in the bMOC facility including required power and data communications cabling and support hardware installation.

For all facility activities, the Contractor shall maintain the appropriate safety training and equipment that is utilized for the lifting, installation, delivery, and relocation of heavy materials and equipment, including but not limited to servers, racks, consoles, packages, and crates.

8.12.2 Equipment Preventative Maintenance and Support

The Contractor shall perform routine preventative maintenance and support for the MOC/bMOC equipment as recommended by vendors and established standards. The Contractor shall implement improvements to MOC/bMOC infrastructure services to improve reliability, efficiency, and IT security compliance.

The Contractor shall provide support to the Landsat 9 MOC/bMOC to maintain the availability and reliability of the MOC/bMOC systems. This also includes troubleshooting problems,

escalating as necessary and tracking issues that may affect operational activities through completion and resolution.

The Contractor shall support the FSM in gathering utilization statistics for MOC/bMOC hardware. The Contractor shall work with the FSM or the FSM delegate to define a report structure that contains statistics such as system load averages and peak utilization periods.

8.12.3 Database Administration

The Contractor shall maintain all databases within the MOC/bMOC. This includes the command and telemetry database, software databases, configuration management databases, and any other Contractor developed database used to satisfy the MOC/bMOC requirements and this SOW.

8.12.4 Network Infrastructure Support

The Contractor shall maintain the MOC, bMOC, and LSR IT infrastructure to support the MOC and bMOC systems, connectivity, data flows, external interfaces and IT Security requirements. The Contractor shall coordinate with the FSM regarding any interactions with CSO. The Contractor shall support the configuration and operations of connectivity into the MOC environments and ensure that the MOC network infrastructure supports mission activities.

The Contractor shall provide sustaining engineering and network engineering support of the MOC, bMOC, and LSR Network Infrastructure and Services, in order to maintain availability and reliability of services. The Contractor shall coordinate with the FSM to manage and troubleshoot MOC Infrastructure Services; configure infrastructure to accommodate new features, capabilities, and requirements; provide MOC and bMOC account management; interface with CSO for troubleshooting and new requirements; perform daily IT Security log reviews; and update design and as-built network infrastructure documentation. The Contractor shall develop and implement improvements to MOC Infrastructure services to enhance reliability, efficiency, and IT Security compliance.

8.12.5 IT Security

The Contractor shall provide technical and IT Security expertise to support Landsat 9 Flight Systems Management. The Contractor shall interpret, implement, and comply with USGS, DOI, and NASA Federal IT security requirements. The Contractor shall serve as the Alternate Computer Security Official for Landsat 9 mission operations, representing Landsat 9 flight operations to, and coordinating security activities with, USGS EROS Center IT Security personnel. The Contractor shall maintain the MOC and bMOC IT Security implementation and documentation, facilitate center and agency reporting requirements, and perform annual IT Security Assessments and assessments for new configurations. The Contractor shall lead the coordination effort with all MOC and bMOC system vendors to maintain network compatibility and adherence with MOC IT Security requirements.

The Contractor shall maintain the L9 MOC IT Security Compliance Matrix CDRL (TBD) in sustainment and operations of the MOC and bMOC. The Government will review and approve the compliance matrix and the Contractor's implementation of IT security requirements. The Contractor shall coordinate the implementation of IT security requirements with the Government. The Contractor shall maintain the MOC System Security Plan in accordance with

CDRL (TBD) which includes, but is not limited to, the overall MOC security approach, risk assessments and contingency security plans.

The Contractor shall perform periodic credentialed scans, perform intrusion detection and prevention, configure and monitor firewalls, and coordinate enforcement of security risk mitigations within the Contractor-managed networks as described in section 5.1.2. The Contractor shall maintain systems security posture to include but not limited to: patching and software updates of systems on a periodic basis or as directed by the Government; implementation of scan resolutions; monitoring of system logs; inventory and electronic delivery of Contractor-managed system configuration in accordance with SSP.

The Contractor shall install, operate and support the following Government-furnished security tools: Tenable Security Center (TBR), the Government-furnished scanning software tool; LogRhythm (TBR), the Government-furnished log-monitoring appliance; KACE (TBR), the Government-furnished system configuration inventory tool to ensure proper population of NASA (TBR) agency databases. Government-furnished security tool support includes, but is not limited to: provision of hardware to run the tools if applicable, tool installation, tool configuration, configuration and adjustment of associated firewall rules to allow egress of tool-generated network traffic, and support of related troubleshooting activities.

The Contractor shall document any deviations, POAMs, or findings as a result of scans, and implement any corrective actions following Government approval. The Contractor shall report computer security incidents to the Government in accordance with the DOI Computer Security Incident Response Handbook (Document # TBD). The Contractor shall periodically generate and deliver IT security status reports to the Government on a monthly basis at a minimum as part of the monthly project status review CDRL (TBD).

The Contractor shall interface as necessary with the LSDS Security team to report security scan results, and security activities.

8.12.6 Electrostatic Discharge (ESD) Protected Area (EPA)

The Contractor shall provide routine monitoring and maintain the certification for the Electrostatic Discharge (ESD) Protected Area (EPA) containing the Spacecraft Simulator (TBR). Personnel shall be familiar with ESD precautions for working around ESD sensitive equipment.

8.12.7 Logistics and Property Management

The Contractor shall provide administrative support, including property management, procurement, and managing vendor service agreements. The Contractor shall procure equipment, materials, and vendor service agreements as required by the Government.

The Contractor shall work closely with the USGS Landsat Receiving Officer/Property Clerk (ROPC) and Landsat Custodial Property Officer (CPO) to maintain the hardware inventory, process new hardware, process removal and disposition of old hardware, and the exchange of repaired components.

The Contractor shall work within the Flight Operations Configuration Change Request process, but, in addition, maintains supplemental material, including redlines, network diagrams, detailed installation plans, and installation notes. The Contractor shall maintain an electronic media and

paper documentation library for MOC/bMOC vendor and COTS software and hardware deliveries.

8.12.8 Office Automation Workstation Management

Office automation workstations utilized by MOC staff will be supplied and supported remotely by the Government. The Contractor shall perform system administration on these systems as directed by Contracting Officer through the COR.

8.12.9 Simulator and Flight Software (FSW) Management

The Contractor shall configure the local simulators to support special operations, contingencies, or FOT proficiency tests. The simulator configurations (spacecraft and instruments) shall be managed so they match the flight FSW configurations where possible, and where not possible the known differences are to be documented. The Contractor shall support testing of any FSW modifications or patches on the simulator prior to uplink to the Observatory. The Contractor shall notify the FSM of any configuration discrepancies between the FSW simulator and the observatory. Any noted deviations between the ground and flight FSW images are to be explained and resolved, and tracked by the Contractor.

The Contractor shall maintain documentation on how to configure the simulators and the ground system to interface with the simulators. Known simulator limitations shall be documented by the Contractor and reported in the MSR.

8.13 Procurement Activities

8.13.1 Consumables

The Contractor shall procure all office supplies and consumables used in the daily execution of this contract.

8.13.2 Equipment / Software and Maintenance

The Contractor shall develop an initial hardware and software maintenance plan and update it annually. The plan shall include a detailed list of software and hardware maintenance contracts that will be renewed, the renewal dates, the number of licenses (where appropriate), and a budgetary estimate. The plan must be approved by the USGS Landsat Project Manager or delegate.

For Contractor acquisition of hardware and software in support of activities contained in this SOW, the Contractor shall acquire hardware and software as authorized through the Work Authorization (WA) process.

For Government acquisition of hardware and software, the Contractor shall provide support for the technical hardware and software specifications and preparation of acquisition documentation.

The Contractor shall establish and manage MOC/bMOC equipment and software maintenance agreements necessary to ensure availability and operability of MOC/bMOC-located assets. Equipment procured through Landsat 8 maintenance contract vehicles may be purchased by the Contractor. A list of GFE equipment and software to be maintained is provided as Attachment A

of this SOW. The Contractor shall annually update and provide a list of all vendor warranty and maintenance agreements, including expiration dates. This may also include any recommended efficiencies for improvement of maintenance or cost savings. In some cases, it may be advantageous to spare certain hardware rather than maintain it. The Contractor shall maintain a hardware sparing plan.

8.13.3 Emergency Equipment Requirements

On an emergency basis, equipment may be purchased through the Contractor. An emergency procurement can only be initiated if the Flight Systems Manager (FSM) or designated Contracting Officer's Representative (COR), with approval from the Contracting Officer (CO), declares the need for an expedited procurement to ensure the health and safety of the Landsat mission and its ability to meet programmatic objectives.

8.13.4 Contract Transition Plan

Within ten calendar days after contract award, the Contractor shall present to the USGS the Transition Plan as proposed, updated to reflect the activities and schedule required to achieve operational readiness. There shall be a Transition Readiness Review two weeks prior to the operational turnover to evaluate the Contractor's transition status and assess their ability to assume operational responsibility for the Landsat spacecraft and flight system's ground support equipment.

8.13.5 Security Requirements

Contract employees, who are providing Information Technology (IT) hardware/software or services, who will have access to DOI information or who will develop custom applications are subject to background investigation. The level/complexity of background investigations must be the same as for a Federal employee holding a similar position. DM441, Chapter 3, provides guidance for the appropriate background investigations based on types of access. Work cannot begin on the DOI system until the background investigation has at least been initiated. Therefore, background investigations for all affected employees should be submitted as soon as possible during the transition phase.

All Contractor employees must complete USGS IT Security Training before being allowed access to USGS systems. In addition, Contractor employees are required to take additional mandatory DOI training, such as end-user computer security awareness training, on a periodic basis.

Immediately following the start of the contract, USGS will work with the Contractor to ensure compliance of the remaining Applicable IT Security requirements.

For personnel stationed at MOC/bMOC locations such as NASA Goddard or a Contractor-provided location, Contract employees shall meet all required security requirements stipulated by the host facility to gain regular access to the facilities and IT infrastructure necessary to perform the management and technical activities specified in this document. This may include additional background investigations and/or IT security training and certification.

8.13.6 Contract Phase-out

The Contractor shall support a smooth and orderly transition to a successor organization upon expiration of this contract in accordance with Federal Acquisition Regulation (FAR) Clause 52.237-3 Continuity of Services.

8.14 Maintenance and Sustainment Engineering

The Contractor shall modernize, enhance and/or resolve discrepancies for systems utilized in the MOC/bMOC as authorized through the Work Authorization (WA) or special studies process. As part of this task, the Contractor shall perform software development/discrepancy resolution activities and test the associated software release/patch so that it is ready for integration into the operational system.

The Contractor shall be solely responsible for discrepancy resolutions or enhancements of all MOC/bMOC systems. In the event that the system or code is proprietary, the Contractor shall subcontract with the appropriate vendor to obtain the support necessary to sustain and enhance the system.

8.14.1 MOC System Deliveries

The Contractor shall use the Work Authorization and Configuration Management process for MOC system deliveries, including updates, patches, or releases for discrepancy resolutions and enhancements to software utilized by the MOC/bMOC as described in section 8.5.

8.14.2 MOC Systems Studies

The Contractor shall support special studies authorized by the Government through the Work Authorization process in support of automation, modernization, and enhancements to the MOC and bMOC systems. Additionally, the Contractor may propose special studies to the Government in support of automation, modernization, and enhancements to the MOC and bMOC systems.

8.15 Mission Activity Performance Metrics

The following metrics are intended as example indicators of Landsat 9 mission operations accomplishments and performance relative to mission requirements and objectives.

- a. Spacecraft contacts successfully supported is a key element of measurement, reflecting the frequency and nature of Landsat 9 contacts that are routinely and successfully supported on a daily basis.
- b. Successful versus unsuccessful preparation and execution of command and control sequences reflects performance of the FOT with regard to accuracy and timeliness of the process to formulate and execute instructions to the on-orbit asset.
- c. Scenes requested and acquired (U.S. and international) is a measure of the effectiveness of the management of the long-term acquisition plan, the translation of that plan to daily command sequences, and the effectiveness of delivering data acquired by the instrument to the designated ground receiving facilities (TBD).

- d. Scenes requested but not acquired (U.S. and international) are a measure of the problems encountered in attempting to fill out a data acquisition schedule, and of the operational practice of identifying and documenting failures in daily acquisition management.
- e. International ground stations supported is a measure of operational effectiveness of the flight operations team in coordinating and executing the daily interactions with the international network of ground stations.
- f. Anomalies detected, analyzed, reported and resolved is a measure of the operational response to ad hoc situations and unexpected occurrences, and the performance of the Contractor in responding to these demands.
- g. Interface coordination activities are a measure of the effectiveness of coordinating and communicating with the various operational elements of the Landsat 9 system required to carry out daily operational activities.
- h. State of documentation (procedures, operating instruction, etc.) is a measure of the attention to detail and the thoroughness applied to maintaining documentation files regarding the state of the systems and operational procedures employed in flight operations.
- i. Adherence to existing and developed configuration control mechanisms will be an indication of the procedural discipline enforced by the Contractor and their commitment to sound engineering and operational practices.
- j. Subcontract management reflects the attention placed on establishing and maintaining subcontract agreements with the various suppliers of sustaining engineering services regarding the various sub-elements of the space and ground systems employed in flight operations.
- k. The smooth operation of the Landsat 9 system relies on a well-trained and motivated FOT. On a monthly basis, the Contractor shall report on the status of staffing levels, training and certification activities and identify any known areas of future attrition.

The performance metrics defined in general terms here shall be reported through regular monthly meetings, reports, and briefings presented by the flight operations Contractor and reviewed by the USGS FSM and USGS COR.

Glossary/Acronyms

bMOC	Backup MOC
CCB	Configuration Control Board
CCR	Configuration Change Request
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CERR	Critical Event Readiness Review
CIIL	Configuration Item Identifier List
CM	Configuration Management
CNNS	Committee on National Security Service
COMSEC	Communications Security
COTR	Contracting Officer's Technical Representative
COTS	Commercial Off-The Shelf
CRM	Continuous Risk Management
CSO	Communications Service Office
CSS	Central Security Service
DR	Design Review
EPR	Engineering Peer Review
FEP	Front End Processor
FOR	Flight Operations Review
FOT	Flight Operations Team
FRR	Flight Readiness Review
FSM	Flight Systems Manager
GN	Ground Network
GOTS	Government Off-The-Shelf
GPR	Goddard Procedural Requirements
GS	Ground System
GS-CDR	GS-Critical Design Review
GSFC	Goddard Space Flight Center
GSIT	Ground System Integration
GSRD	Ground System Requirements Document
ICDR	Instrument Critical Design Review
IDD	Interface Definition Document
IMS	Integrated Master Schedules
ISA	Interconnection Security Agreement

ISF	Instrument Support Facility
ISP	Internet Service Provider
IV&V	Independent Verification and Validation
LEO	Launch and Early Orbit
LMO	Landsat Mission Operations
LSIMSS	Landsat Scalable Integrated Multi-mission Simulator System
LSR	Launch Support Room
M-CDR	MOC Critical Design Review
M-PDR	MOC Preliminary Design Review
M-SIR	MOC System Integration Review
M-SRR	MOC System Requirements Review
MAR	Mission Assurance Requirements
MOC	Mission Operations Center
MOR	Mission Operations Review
MOTS	Modified Off-The-Shelf
MPSR	Monthly Project Status Report
MRT	Mission Readiness Testing
NIST	National Institute of Standards and Technology
NIST FIPS	NIST Federal Information Processing Standards
NIST PUB	NIST Publication
NPR	NASA Procedural Requirements
NSA	National Security Agency
OAR	Operational Acceptance Review
ORR	Operational Readiness Review
OTS	Off-The-Shelf
P&S	Planning & Scheduling
PDB	Project Database
PDR	Preliminary Design Review
PLAR	Post-Launch Assessment Review
PMRT	Post-Mission Readiness Testing
POAM	Plans of Action and Milestones
RMP	Risk Management Plan
SCDR	Spacecraft Critical Design Review
SDMP	Software Development and Management Plan
SIPS	Landsat 9 Science Investigator-led Processing System
SIR	System Integration Review
SMSR	Safety and Mission Success Review

SNAS	Space Network Access System
SOW	Statement of Work
SPDR	Spacecraft Preliminary Design Review
SRD	Systems Requirements Document
SSRR	Spacecraft System Requirements Review
T&C	Telemetry and Command
TIM	Technical Interchange Meeting
VDD	Version Description Document
WOTIS	Wallops Orbital and Tracking Information System

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