

Department of the Interior  
U.S. Geological Survey

# **LANDSAT**

## **Ground Station Operations and Maintenance**

**September 2009**



## **Task Order – Landsat - Ground Station**

### **A. Task Assumptions and General Notes**

- This task is managed and operated at EROS near Sioux Falls, SD.
- Support functions such as database administration, systems administration and configuration management are outside the scope of this sample task with exception to some LGS equipment such as the Programmable Telemetry and Command Processor (PTP) where hardware engineers install vendor specific patches.
- The sponsor for this work is the Landsat Remote Sensing Program managed at USGS Headquarters in Reston, VA. Stakeholders include NASA which is a partner in the overall management of the Landsat Program and other Federal Agencies which utilize Landsat data and International Cooperators that collect, archive, process and distribute Landsat data over their local coverage areas.

### **B. References**

- See bidder's library

### **C. Background**

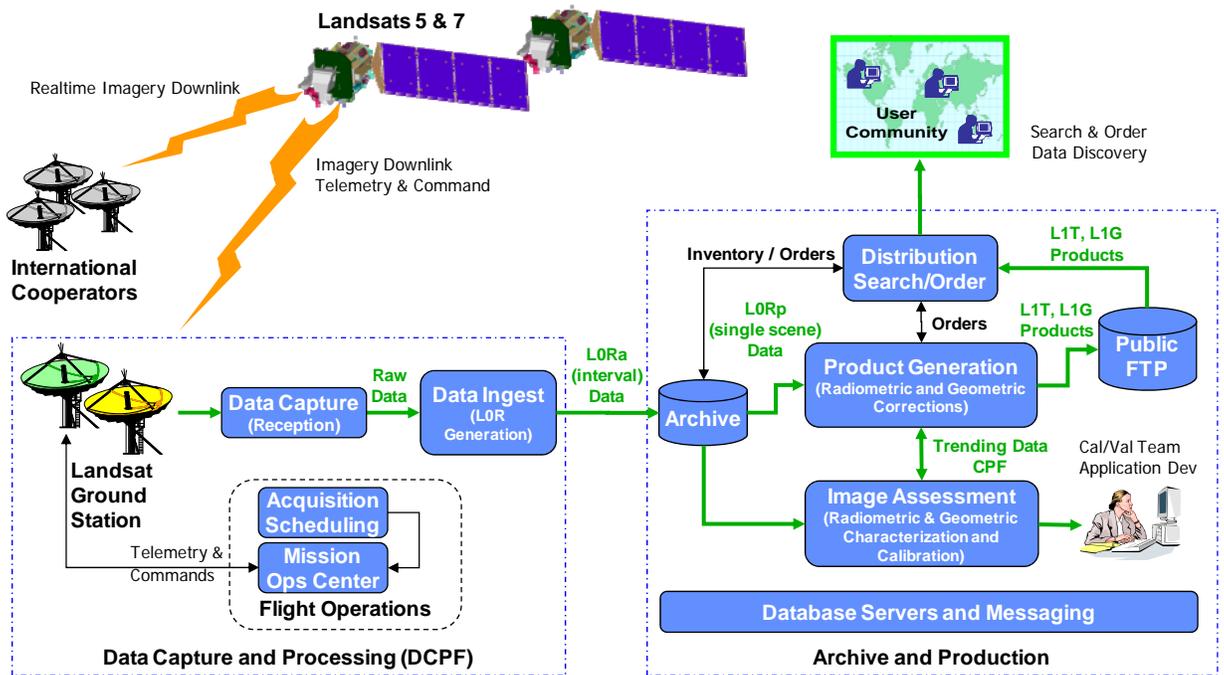
One of the key strategic goals of the USGS Land Remote Sensing (LRS) Project is to observe the Earth at all scales using remote sensing to understand the human and environmental dynamics of land change. The Landsat project supports this through strategic goals that include:

- provide daily management of all operations, maintenance, and engineering for the Landsat spacecraft and ground systems using sound project management, engineering, and operations best practices;
- maintain a reliable and secure system infrastructure and avoid system obsolescence;
- minimize data loss;
- enhance the USGS' position as a globally recognized leader in data capture and acquisition;
- preserve the Landsat archive and employ consistent data management practices;
- generate products that are useful and consistent to the Landsat user community and improve the availability and utility of Landsat data;
- employ methods to improve information access and reporting for managing the Project;
- position the USGS to operate and maintain future Landsat Missions;
- develop and support agreements with cooperative agencies that further the Landsat Mission;
- optimize global utilization of Landsat data by providing an efficient means for managing user acquisition requests;
- review and enhance Landsat's global acquisition plan;
- advance sensor and image calibration across all Landsat data sets and provide calibration information to its user community;
- guide and demonstrate technical excellence in Landsat sensor and image calibration;
- support its customers, promote new data uses, and retain its customer base;
- provide various methods of ordering and distributing Landsat data;

- enhance communications with its user community;
- establish and support agreements with foreign governments to acquire and provide data to the global Landsat user community;
- optimize global utilization of Landsat data by providing an efficient means for managing International Cooperator (IC) acquisition requests;
- promote and participate in data sharing across its International Cooperators (ICs) using standard data formats.
- make all Landsat products available for electronic download at no-charge to the user (web enable Landsat data)

The USGS Landsat Project is responsible for two active satellite missions and data from the previous missions. This responsibility includes daily management and long term sustainment of all operations, maintenance, and engineering for the Landsat 5 and Landsat 7 spacecraft systems, Flight Operations located in Maryland, and Landsat Ground Segment Operations, located at the USGS EROS in Sioux Falls, SD. Beside the two active missions, the current Ground Segment systems also support data archives for MSS and TM data collected from the Landsat 1-5 missions.

Figure 1 shows the overall data flow of the Landsat ground system. The Landsat ground segment is composed of the Data Capture and Processing Facility (DCPF) and the Archive and Production (A&P) area. All of the ground segment components reside at EROS although the Flight Operations activities listed within the DCPF in this diagram are operated and controlled in Maryland.



**Figure 1 Landsat System Architecture - Data Flow**

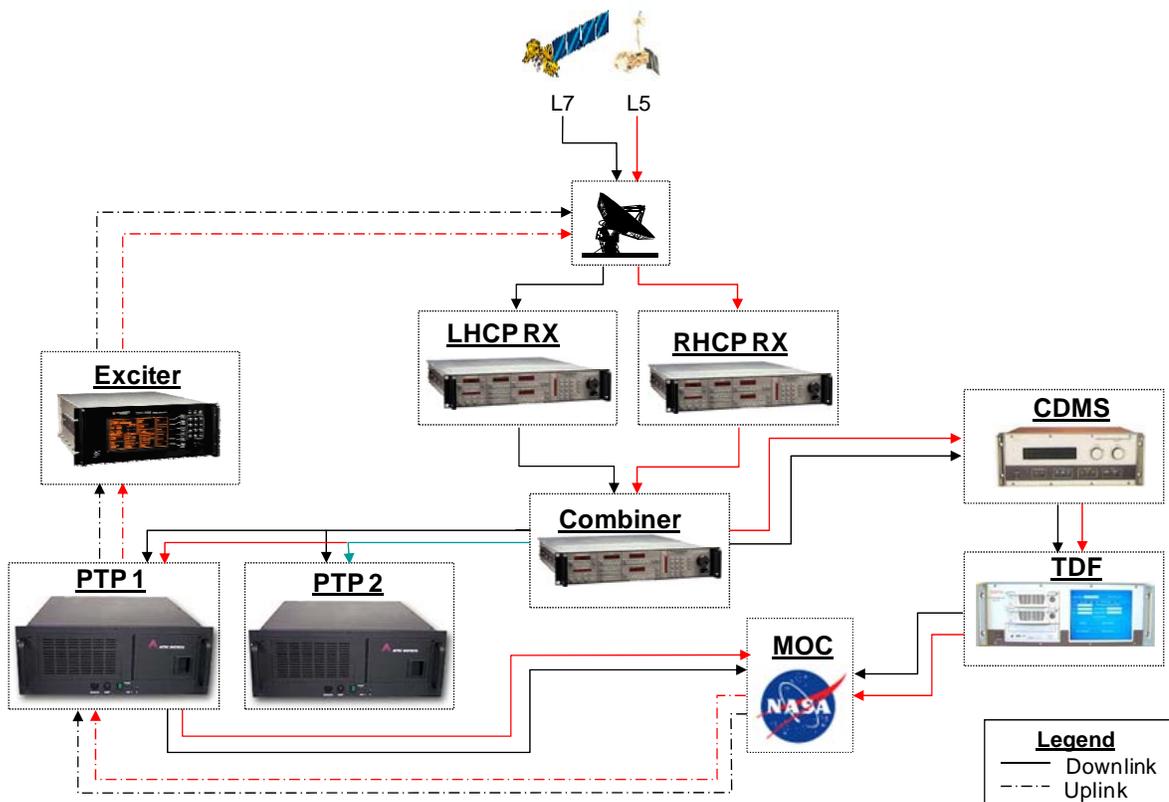
*Landsat Ground Station (LGS)*

The LGS is the focal point for all space to ground communications. LGS includes a primary (10-Meter) and a back-up (5.4-Meter) antenna and numerous pieces of satellite communications equipment.

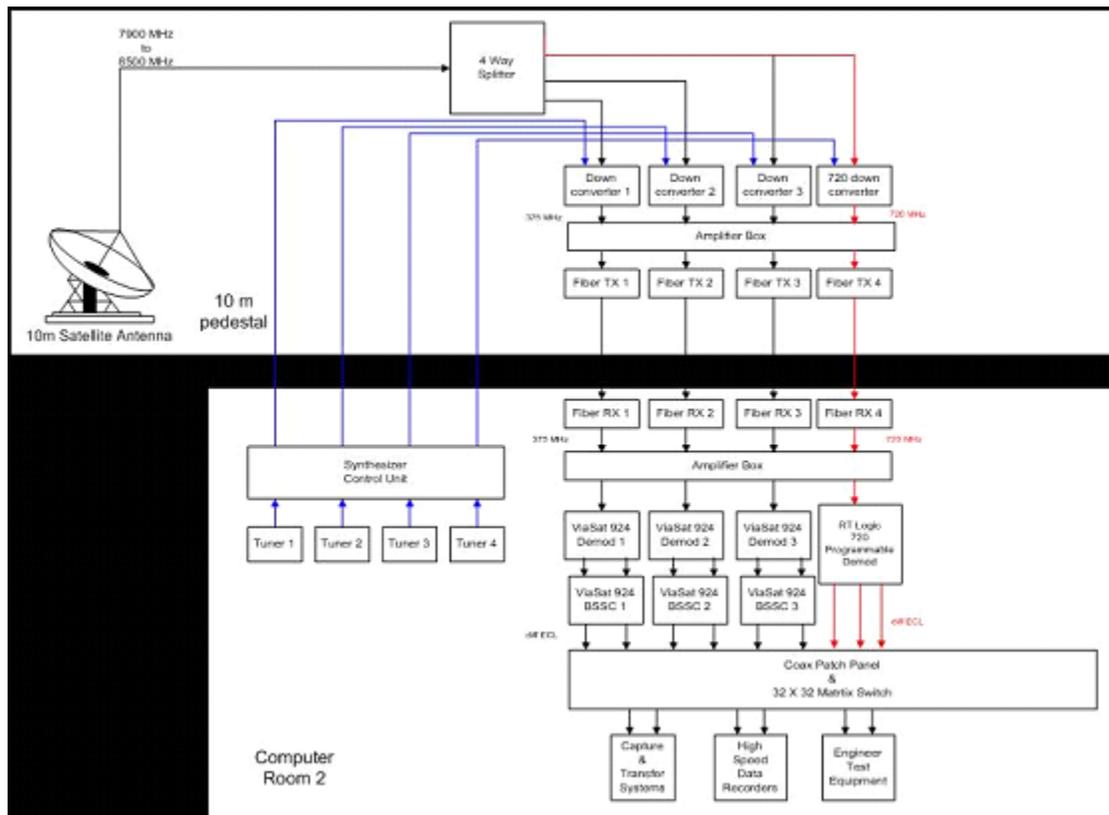
The LGS is composed of X-Band and S-Band equipment that support the 10 meter and 5 meter antennas. Much of the equipment necessary to operate the multivendor solutions are maintained through time-and-materials contracts and extended warranty and maintenance contracts. The bulleted list below identifies the equipment that is currently maintained through extended warranty and maintenance contracts. In nearly all cases, the engineers under this task are expected to work with the vendor to isolate the problem and coordinate the repair of the specific piece of equipment.

- 10-Meter Datron Antenna Phone Support and Yearly Preventative Maintenance (PM)
- 5-Meter ViaSat Antenna Email Support and Yearly Preventative Maintenance (PM)
- 5-Meter and 10-Meter UPS Maintenance
- 2 Avtec Programmable Demodulators
- 2 Avtec Programmable Telemetry Processor (PTP) Software Support
- 1 RT-Logic Programmable Demodulator
- 2 Summation Research S-Band Exciters

The diagrams below list a summary of the data flow and equipment for S-Band and X-Band.



**Figure 2 S-Band Data Flow**

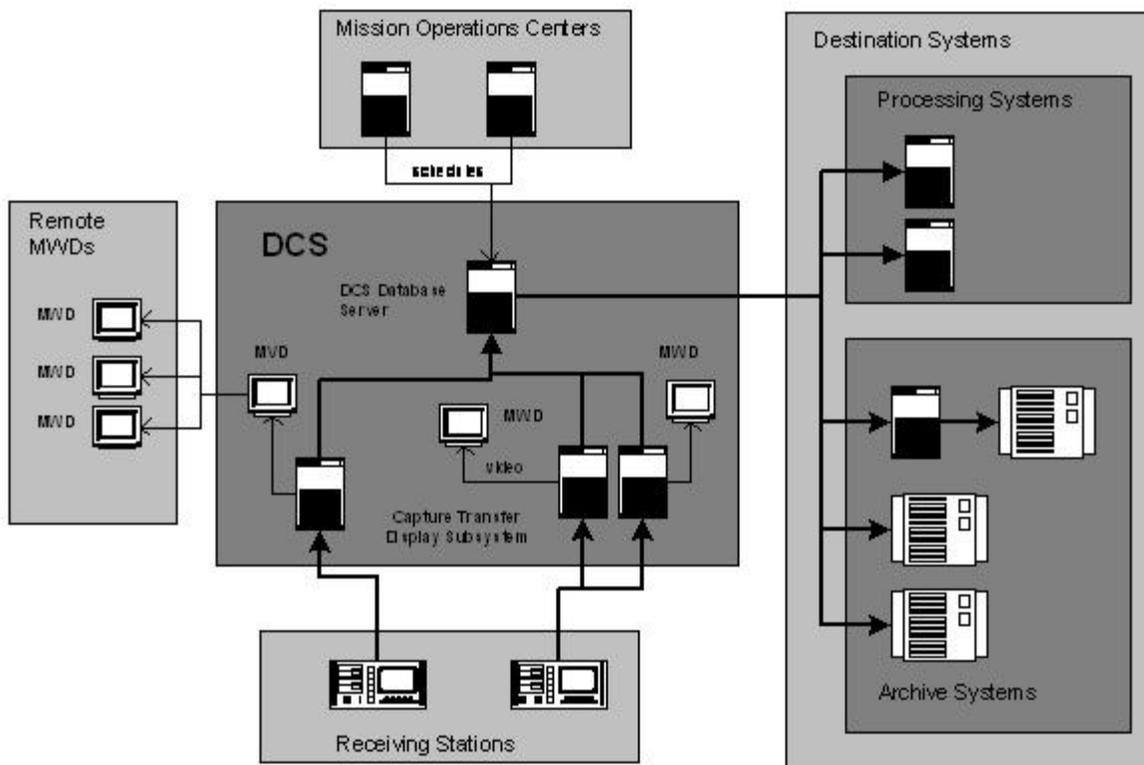


**Figure 3 - 10 Meter Equipment**

### *Data Capture (Reception)*

The Data Capture System (DCS) is a multi-mission data capture and distribution system that acquires the raw image data funneled through the LGS during real-time contacts, temporarily stores the data and makes it available to the appropriate processing and or archiving system(s).

The DCS has two basic subsystems: the DCS Database Subsystem (DDS) and one or more Capture Transfer Subsystems (CTS). The DDS serves as the primary operator station for the entire DCS and also tracks raw file delivery to destination systems and/or to back-up tapes (for contingencies). Each CTS also can have an optional Capture Transfer Display (CTD) subsystem which can be used to show a Moving Window Display of imagery during raw data capture. Each CTS will receive and temporarily store one to four raw wideband data streams obtained from a receiving station (such as a satellite receiving station). The raw data streams will be captured onto the subsystem's local storage using one or two high-speed dual channel serial capture devices. During capture, the raw data is also buffered and made available for an optional Moving Window Display (MWD).



**Figure 4 DCS Environment**

The Moving Window Display is useful for monitoring data quality during capture. The CTD displays video imagery as the CTS captures it to disk. The CTD can also redistribute the video to other, remotely connected MWDs.

After the wideband data is captured, the CTS will transfer the data to the DDS for distribution to mission-defined destination systems. Destination systems are defined as either processing or archiving systems. The main difference to DCS is that archiving systems will permanently store the raw data, whereas the processing systems do not. This is important for DCS automated and manual clean-up operations. DCS will ensure that either all archiving systems have received a raw file or the file is backed up to tape before it is automatically deleted from local storage. Processing systems that need to process a file that is no longer in the DCS inventory (on-line or on tape) will need to request the tape from the corresponding mission's archiving system. Each CTS will also have the ability to function stand-alone (i.e. without the DDS). In stand-alone mode, operational setup is performed via editing text files and the wideband data will be transferred to tape for transport. These tapes can then be ingested onto the DDS for distribution to the destination system(s).

The DDS will be used to temporarily store the captured wideband data for retrieval by the destination systems. The wideband data will be received from the CTS(s) via network transfer or from tape (for ingest of data from the CTSs operating in stand-alone mode). Normally, the raw data is then transferred by the appropriate network-connected destination system(s). The transfer is initiated and carried out by the destination systems. DDS operators can also copy selected raw data to tape in atypical operation.

Each mission will have a mission operations center (MOC) that will deliver mission-specific contact schedules to the DDS. The contacts defined in the schedule are for live automated captures at EDC. No data is transferred from the DDS to the MOCs.

The DCS hardware currently consist of commodity Intel based Linux servers. The DDS COTS software consists of a small Oracle database, QT, and EGFTP libraries.

*Control and Schedule Interface (CSIS)*

The CSIS receives contact schedules and ephemeris for the Landsat 5 and Landsat 7 missions from their respective Mission Operations Centers (MOCs). It processes them, if necessary, and distributes them to other systems involved in the downlink process (specifically the Ground Station Controller (GSC) and Tracking Data Formatter (TDF)). In summary the CSIS performs the following:

- Ingesting contact schedules and ephemeris files from the Landsat 5 (L5) / Landsat 7 (L7) Mission Operations Centers (MOCs)
- Re-formatting schedules and ephemeris
- Providing schedules and ephemeris to other LGS systems
- The Ground Station Controller and Tracking Data Formatter need the CSIS because they require the files in slightly different formats.

**D. Scope of Work**

The scope of work is to provide ground station services at EROS for space to ground data reception of Landsat 5 and Landsat 7 data. This includes the operations and maintenance of the LGS and DCS within the DCPF. This does not include any other components such as the Flight Operations or Archive and Production Scope.

Under this task, the contractor shall provide the skills necessary to manage and perform all work.

The contractor shall follow configuration management practices as specified in the Landsat Ground Segment Configuration Change Process (CCP) CM-04.

**E. Description of Work**

The two tasks included below account for a portion of the overall ground system operations and maintenance activities within the Landsat project. These will become part of the overall Landsat body of work. Once the contract is issued, the Landsat project plans to issue two task orders: 1) Ground System Operations 2) Ground System Maintenance. Each of these task orders will include additional tasks for other operational and maintenance activities.

**1. Task 1: Operate the Landsat Ground Station and Data Capture System**

This task requires the contractor to operate the DCPF to successfully downlink and capture Landsat 5 and Landsat 7 data. Relating to this task, the contractor shall:

- provide staff coverage 7-days a week by 19.5-hour/day schedule to support six real-time contacts of Landsat 7 and Landsat 5 each daily. Landsat 7 passes consist of both X and S band. Landsat 5 includes three passes of X and S band and three passes of S band only.

- maintain, establish as necessary, and follow operational procedures for the LGS and DCS
- track all ground system anomalies
- track capture success ratio (CSR) monthly
- make data available to processing and archive systems
- process and handle contact schedules
- maintain the ground station technician (GST) certification plan
- conduct training and GST testing as required
- track any system issues through configuration management processes including hardware change requests (HCRs) and configuration change requests (CCRs)
- ingest data from International Ground Stations (IGS) or other Landsat ground stations in support of a global Landsat archive. This activity is performed between Landsat data X and S band contacts. On average one contact per day is ingested into the DCS system accounting for an average of 25 Landsat scenes per contact.
- Track system up and downtimes.

*Deliverables:*

- Report CSR and capture statistics monthly.
- Report S-Band availability monthly
- Report GST staff certification levels as staff changes occur
- Standard operational procedures checked into the USGS document management system. A list of standard operational procedures is reported quarterly
- Provide GST coverage for all shifts unless a waiver by the government
- Anomaly reports and image impact reports are checked into the USGS document management system as necessary.
- Download to marketable timeline report is delivered
- Report IGS data received monthly
- Report system up and downtimes monthly

*Key Performance Metrics:*

- Maintain and capture success ratio (CSR) greater than 98%.
- Provide S-Band capability for all scheduled Landsat passes greater than 98% of the time.
- Make data available for order within 24 hours of acquisition.

2. **Task 2:** Maintain the Landsat Ground Station (LGS) and Data Capture System (DCS)

This task requires the contractor to provide sustaining engineering services for the DCPF to successfully downlink and capture Landsat 5 and Landsat 7 data. Relating to this task, the contractor shall:

- provide 24x7 on-call hardware engineering support for the LGS and DCS
- provide nominal 8x5 staff hardware engineering support for the LGS and DCS
- provide software maintenance engineering services for the DCS and the Control and Schedule Interface System (CSIS)

- provide schedules for system and software maintenance activities
- update LGS architecture and design artifacts as necessary
- support spacecraft, LGS, and international cooperator tests as approved by the USGS
- ensure that the LGS and DCS are able to collect a minimum of 98% of the scheduled Landsat data
- maintain all LGS equipment including all necessary S-band and X-band equipment to downlink and capture Landsat data
- configuration changes are tracked using configuration control processes including HCRs and CCRs
- manage a shelf spare inventory to effectively meet capture success ratio expectations
- request new shelf spare inventory as necessary
- coordinate and participate in vendor preventive maintenance activities for both the 5 meter (Viasat) and 10 meter (Datron) antennas and other vendor maintained equipment.
- ensure LGS systems are updated to meet NASA IONET, USGS, and DOI IT security policies
- participate in LDCM design, implementation and operational planning discussions concerning the LGS, DCS and scheduling systems
- provide risks, impacts and effort necessary to incorporate LDCM systems into the Landsat operational LGS environment
- follow the Landsat Ground Segment Configuration Change Process for all changes to the system including LDCM integration efforts.
- maintain DCS and CSIS requirements (managed in DOORS) and design documents

NOTE: Support functions such as database administration, systems administration and configuration management are outside the scope of this task with exception to some LGS equipment such as the Programmable Telemetry and Command Processor (PTP) where hardware engineers install vendor specific patches.

*Deliverables:*

- Report system anomalies, specific equipment downtimes, and impacts.
- Equipment shelf spare inventory is made available and maintained in the USGS document management system.
- On-call procedures are documented and checked into the USGS document management system.
- LGS architecture or system high-level design is delivered as changes are identified.
- LDCM risks, impacts, and tasks necessary are reported monthly.

*Key Performance Metrics:*

- Maintain and capture success ratio (CSR) greater than 98%.
- Provide S-Band capability for all scheduled Landsat passes greater than 98% of the time
- All changes are approved by the Landsat CCB and documented as HCRs or CCRs.

- Provide a schedule for and meet schedule milestones for hardware and software changes.

**F. Deliverables**

See *Deliverables* in Section E (above) within each task’s description of work.

**G. Period of Performance**

*One year from start of the task.* (task on-going throughout the year barring unforeseen circumstances such as loss of mission)

**H. Acceptance Criteria**

- Reports are approved by the Landsat Mission Management Office at EROS
- Accuracy – Work Products shall be accurate in presentation, technical content, and adherence to accepted elements of style.
- Clarity – Work Products shall be clear and concise. Any/All diagrams shall be easy to understand and be relevant to supporting narrative.
- Consistency to Requirements – All work products shall satisfy the requirements of this contract.
- File Editing – All text and diagrammatic files shall be editable by the Government.
- Format – Work Products shall be submitted in hard copy (where applicable) and in media mutually agreed upon prior to submission, unless otherwise specified herein. Hard copy formats shall follow any specified Directives or Manuals.
- Timeliness – Work Products shall be submitted on or before the due date specified herein or submitted in accordance with the scheduled date included in the approved Task Order.
- The Task Order Manager or designated inspector will review for completeness, preliminary or draft documentation that the Contractor submits, and may return it to the Contractor for correction. Absence of any comments will not relieve the Contractor of the responsibility for complying with the requirements of the Task Order. Final approval and acceptance of documentation required herein shall be by letter of approval and acceptance by the Task Order Manager. The Contractor shall not construe any letter of acknowledgement of receipt material as a waiver of review, or as an acknowledgement that the material is in conformance with this Task Order. Any approval given during preparation of the documentation shall not guarantee the final acceptance of the completed documentation.