

ATTACHMENT T

PERFORMANCE-BASED  
EVENT COMPLETION CRITERIA

April 16, 2007

**TDRS K&L MILESTONE COMPLETION CRITERIA**  
**Basic Requirement**

MILESTONE #1 - (B1)

TDRS K&L KICKOFF MEETING

1 month ARO

GENERAL

Describe the project organizational structure the relationships with other internal organizational units and the management approach with other corporate organizations that are involved in the TDRS-K Program effort. Discuss the approach toward requirements flow-down, traceability and verification & validation for both the flight and ground segment. Present and discuss in detail the Integrated Master Schedule (IMS) that reflects the development of the TDRS K&L spacecraft and required ground modifications.

SPECIFIC

The kick-off meeting shall be held at the contractor's facility with the major sub-contractors in attendance.

Thoroughly describe the organizational approach to managing a multiple spacecraft build including the ground system with allocation of all the identified work to accomplish the effort. Describe the facilities required to perform the TDRS-K Program effort and their availability. Describe any modifications required to accommodate the program. Identify any government resource dependencies where reliance on availability of Government Furnished Property (GFP), facilities, personnel, etc are in-line to achieve mission success. Show a staffing plan identifying the description and general qualifications for the principal positions required for the duration, approximate level of effort for each position ( $\frac{1}{4}$ ,  $\frac{1}{2}$ ,  $\frac{3}{4}$ , full time), and the start and stop months when the support is planned. Name all key individuals already on board. This plan must be complete enough to permit GSFC to determine the adequacy of support.

Describe in detail the systems engineering effort in the analyses of technical requirements, allocation of derived system, spacecraft, ground terminal and lower level requirements. Discuss the establishment and the maintenance of requirements traceability between all levels of the system, definition and maintenance of all interfaces. Present the approach for the support of the on-going risk management program, trending of appropriate system, subsystem, and unit parameters, conducting the program for formal and informal reviews, development and maintenance of spacecraft, ground, and launch vehicle performance budgets, and verification and validation of all defined and derived requirements.

Present the detailed Integrated Master Schedule (IMS) showing the critical path and addressing areas of risk through acceptance on orbit. Discuss in detail the IMS for the K and L spacecraft detailing how the K and L activities are phased with respect to each other. The schedule shall be presented at the subsystem level and shall include the internal relationships between events within the overall schedule, definition of the time duration of all tasks. Provide the planned start and completion date for all events and the target date for all milestones.

## MILESTONE #2 - (B2)

Conduct Preliminary Initial Baseline Review (IBR)

60 Days ARO

### GENERAL

The preliminary IBR, held at the contractor's facility, is jointly conducted by the TDRS project manager, his technical staff and the contractor. The objective is to verify the technical content of the performance measurement baseline (PMB) and the accuracy of the related resources (budgets) and schedules.

### SPECIFIC

The major activities of the IBR will include:

- a)** In-brief for the Review Team explaining the purpose of the review and providing the opportunity for the introduction of all team members;
- b)** An overview by the project - to familiarize the team with the characteristics of the earned value management system;
- c)** The review of Project planning data, including system data traces;
- d)** Discussions with CAM's identifying the basis on which the plan was established, ensuring that resources have been allocated and that appropriate performance measurement techniques have been identified;
- e)** An exception report addressing the review team's concerns and findings. All concerns requiring resolution should be identified and, if not already resolved prior to completion of the IBR, the estimated dates for resolution should be agreed; and
- f)** A joint exit briefing by the Review Team addressing the team's review findings.

The IBR objectives are to:

Ensure the technical content of work packages and cost accounts is consistent with the contract scope of work and WBS that there is a logical sequence of effort planned consistent with the contract schedule

Assess the validity of the allocated cost account and IPT budgets both in terms of total resources and time-phasing.

Conduct a technical assessment of the earned value methods to be utilized, to measure progress and to assure that objectives and meaningful performance data will be provided. Additionally, the IBR establishes a cost/schedule management process to ensure that baseline integrity is maintained throughout the life of the contract.

Ensure traceability throughout the system. If any inconsistencies or anomalies are apparent, they are to be addressed on the Control Account and CAM Evaluation Sheets.

Cost data at the preliminary IBR shall be at a WBS level 3. The contractor may provide lower WBS levels, 4 or greater, if the data exists.

The following documentation should be provided to the review team prior to the review and far enough in advance for the team to familiarize themselves with their content:

- Statement of Work (SOW)
- WBS & dictionary
- Project Organizational Structure.
- Responsibility Assignment Matrix
- Work Authorization Documents.
- Program Schedules, including Integrated Master Schedule and detail schedules that support control accounts.
- Control account plans or equivalent.
- Records documenting contractual changes and internal actions.
- Current earned value performance report; (if available at the time of the first review)
- Earned value management system procedural documents including System Description.
- List of major subcontractors and major vendors, including description of product, applicable WBS element, value of subcontracts/purchase orders, period of performance, and responsible control account manager.
- Basic contract and modifications

An IBR data package shall be submitted in accordance with the objectives stated above.

The contractor data package shall also contain the following:

- Program/Business Management and Control Account Notebooks that incorporates the data products requested by the Project Office
- The current base-lined electronic version of the Integrated Master Schedule
- The Contractor Earned Value Process Documentation
- 2 months of EV Performance data

The contractor shall be responsible for ensuring that its sub-contractors comply with the IBR requirements that have EVMS requirements.

### MILESTONE #3 – (B3)

Government Access to the Contractor's Program Information Systems and Electronic Libraries

90 Days ARO

#### GENERAL

The contractor shall have completed implementation of government access to program information systems and have implemented systems for communication with the government representatives, per the SOW.

#### SPECIFIC

A joint contractor/government working group shall have been established to define acceptable mechanisms for required TDRS-K Program data systems, including access via the internet, along with provision for protected email (which is suitable for transmission of contractor, subcontractor, vendor proprietary data, and NASA Sensitive But Unclassified (SBU) data between program elements and facilities. All such accesses, facilities, servers, and provisions shall be operational no later than three months after contract award. These systems shall have been implemented and demonstrated. Further all accounts and accesses shall have been established and shall be working.

The systems established for this program shall provide for segregation of any necessary data from other programs without impacting government real-time access to TDRS K Program data. Satisfactory designs shall have been established and access controls implemented.

The design and implementation of the systems shall be demonstrated to consist of all relevant program data, including: all reports, presentations, analyses, requirements documentation and traceability databases, internal technical memoranda, change requests, CDRL's, test data, failure/anomaly reports and discrepancy reports. Additionally, schedules, EVM data, logs, risk management documentation, and all other documents prepared by the Contractor for the TDRS K Program.

Compliance with all applicable security requirements shall have been established and documented.

## MILESTONE #4 – (B4)

Complete Systems Definition Review (SDR)

TBP months ARO

### GENERAL

The Systems Definition Review (SDR) shall be held at the completion of requirements allocation and system concept baseline freeze. In addition, the SDR establishes that the planning for the remaining project activities is adequate and that there are reasonable expectations that the project will accommodate any imposed constraints and meets its success criteria within the allocated resources. This review will be conducted by NASA on all elements of the TDRS-K Program by a Standing Review Board (SRB) for the purpose of reviewing plans and assessing performance.

### SPECIFIC

At the SDR, the contractor shall establish that the baseline mission requirements are clearly understood, the system definition is complete and that the allocation of requirements to each independent system element and their respective subsystems has been completed and is verifiable. Additionally, the contractor shall demonstrate that lower level requirements are traceable to the mission level requirements.

The Contractor shall demonstrate compliance with the SDR success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews. The contractor and their subcontractors, suppliers, and vendors shall provide support to successfully complete the review.

Action items will be closed or an approved action item closure plan is in place. In addition, CDRL documentation due at the review will be provided or an approved revised delivery date is in place.

The contractor shall develop and organize the presentation material to the NASA review team and provide copies of all the material presented as required by the CDRL.

The contractor shall support splinter meetings resulting from the review and produce timely written responses to recommendations and action items.

## MILESTONE #5 – (B5)

Complete Formal Initial Baseline Review (IBR)

Within 180 Days ARO

### GENERAL

The formal IBR, held at the contractor's facility, is jointly conducted by the TDRS project manager, his technical staff and the contractor. The objective is to verify the technical content of the performance measurement baseline (PMB) and the accuracy of the related resources (budgets) and schedules.

### SPECIFIC

The major activities of the IBR will include:

- a)** In-brief for the Review Team explaining the purpose of the review and providing the opportunity for the introduction of all team members;
- b)** An overview by the project - to familiarize the team with the characteristics of the earned value management system;
- c)** The review of Project planning data, including system data traces;
- d)** Discussions with CAM's identifying the basis on which the plan was established, ensuring that resources have been allocated and that appropriate performance measurement techniques have been identified;
- e)** An exception report addressing the review team's concerns and findings. All concerns requiring resolution should be identified and, if not already resolved prior to completion of the IBR, the estimated dates for resolution should be agreed; and
- f)** A joint exit briefing by the Review Team addressing the team's review findings.

The IBR objectives are to:

Ensure the technical content of work packages and cost accounts is consistent with the contract scope of work and WBS that there is a logical sequence of effort planned consistent with the contract schedule

Assess the validity of the allocated cost account and IPT budgets both in terms of total resources and time-phasing.

Conduct a technical assessment of the earned value methods to be utilized, to measure progress and to assure that objectives and meaningful performance data will be provided. Additionally, the IBR establishes a cost/schedule management process to ensure that baseline integrity is maintained throughout the life of the contract.

Cost data at the formal IBR is to WBS level 5. WBS levels 6 to 7 maybe required for the government to provide a final assessment against the IMS and contractor budgets.

Ensure traceability throughout the system. If any inconsistencies or anomalies are apparent, they are to be addressed on the Control Account and CAM Evaluation Sheets.

The following documentation should be provided to the review team prior to the review and far enough in advance for the team to familiarize themselves with their content:

- Statement of Work (SOW)
- WBS & dictionary
- Project Organizational Structure.
- Responsibility Assignment Matrix
- Work Authorization Documents.
- Program Schedules, including Integrated Master Schedule and detail schedules that support control accounts.
- Control account plans or equivalent.
- Records documenting contractual changes and internal actions.
- Current earned value performance report; (if available at the time of the first review)
- Earned value management system procedural documents including System Description.
- List of major subcontractors and major vendors, including description of product, applicable WBS element, value of subcontracts/purchase orders, period of performance, and responsible control account manager.
- Basic contract and modifications.

An IBR data package shall be submitted in accordance with the objectives stated above.

The contractor data package shall also contain the following:

- Program/Business Management and Control Account Notebooks that incorporates the data products requested by the Project Office
- A final base-lined electronic version of the Integrated Master Schedule
- The Contractor Earned Value Process Documentation
- All the months of EV Performance data after ARO

The contractor shall be responsible for ensuring that its sub-contractors comply with the IBR requirements that have EVMS requirements.

## MILESTONE #6 – (G6)

Complete Ground System Preliminary Design Review (GS-PDR)

TBP months ARO

### GENERAL

The Ground System Preliminary Design Review (GS-PDR) occurs early in the design phase prior to manufacturing or procuring hardware and performing the detailed design of associated software. Where applicable, the GS-PDR includes the results of breadboard testing and software prototyping. This review will be conducted by the TDRS project office for the purpose of reviewing plans and assessing performance.

### SPECIFIC

The Ground System PDR shall convey a credible and tractable design solution that meets all mission requirements. The Ground System PDR shall establish a credible and acceptable mission formulation and is prepared to proceed with the detailed design. In addition, Ground System PDR shall convey that the project is on-track to complete the system development within the identified cost and schedule constraints. The contractor shall complete drawings for new equipment and changes to commercial designs. Provide an overview of implementation issues, their potential impact, and risk mitigation plan. Specifically include any and all heritage issues from previous similar missions.

Provide detailed approach for backward compatibility with F1-F10. Present dependencies for WSC resources. Present details of factory environment and activities, with additional detail on subsequent WSC integration, test, and verification activities.

The Contractor shall demonstrate compliance with the PDR success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews. The contractor and their subcontractors, suppliers, and vendors shall provide support to the fullest extent necessary for successful completion.

The contractor shall support splinter meetings resulting from the review and produce timely written responses to recommendations and action items.

Action items will be closed or an approved action item closure plan is in place. In addition, CDRL documentation due at the review will be provided or an approved revised delivery date is in place.

All CDRL data item deliverables, for which delivery is required prior to this milestone, have been delivered and the requirements of the DIDs have been met. The government COTR has approved those data items requiring approval. The contractor shall generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), and submit any change requests needed.

The contractor shall develop and organize the presentation material to the NASA review team (don't think this is a standard review board review....Project only) and

provide copies of all the material presented as required by the CDRL. All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #7 – (B7)

Complete System/Spacecraft Preliminary Design Reviews (System/SC-PDR)

TBP months ARO

### GENERAL

The System/Spacecraft Preliminary Design Review (PDR) occurs early in the design phase, prior to manufacturing engineering hardware and performing the detailed design of associated software. Where applicable, the System/Spacecraft PDR includes the results of test bedding breadboard testing and software prototyping. This review will be conducted by NASA on all elements of the TDRS K Program by a Standing Review Board (SRB) for the purpose of reviewing plans and assessing performance.

### SPECIFIC

The System/Spacecraft Preliminary Design Review (PDR) shall convey a credible and tractable design solution that meets all mission requirements. The System/Spacecraft PDR shall establish a credible and acceptable mission formulation and is prepared to proceed with the detailed design. In addition, System/Spacecraft PDR shall convey that the project is on-track to complete the system development within the identified cost and schedule constraints. The contractor shall complete drawings for new equipment and changes to commercial designs in preparation for in-house fabrication. Provide an overview of implementation issues, their potential impact, and risk mitigation plan. Specifically include any and all heritage issues from previous similar missions.

The contractor shall demonstrate compliance with the PDR success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews. The contractor and their subcontractors, suppliers, and vendors shall provide support to ensure successful completion.

The contractor shall support splinter meetings resulting from the review and produce timely written responses to recommendations and action items.

Action items will be closed or an approved action item closure plan is in place. In addition, CDRL documentation due at the review will be provided or an approved revised delivery date is in place.

All CDRL data item deliverables, for which delivery is required prior to this milestone, have been delivered and the requirements of the DIDs have been met. The government COTR has approved those data items requiring approval. The contractor shall generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), and submit any change requests needed.

The contractor shall develop and organize the presentation material to the NASA review team and provide copies of all the material presented as required by the CDRL.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #8 – (G8)

Complete Ground System Critical Design Review (GS-CDR)/Ground Detailed Design Review (GDDR)

TBP months ARO

### GENERAL

The Ground System CDR occurs after the design completion and before software coding and component manufacturing. It emphasizes implementing design approaches and test plans for ground system and includes the results of engineering model testing. This review will be conducted by the TDRS Project office for the purpose of reviewing plans and assessing performance.

### SPECIFIC

The Ground System CDR establishes that the maturity of the design and the required development effort to proceed with full scale implementation activities. It shall demonstrate that the project is on-track to complete the ground system development and meet mission performance requirements within the identified cost and schedule constraints. The Ground CDR shall be conducted near the completion of final design and after completion of any engineering model evaluation.

The contractor shall present design modifications required for WSC such that the ground station is capable of operating the spacecraft and as a system are able to provide all required telecommunications services. Demonstrate capability in management of the TDRS K ground baseline. Provide complete product verification and product validation details, identifying comprehensive testing approach(es) and details of plans for the factory development, test, and WSC integration activities.

The contractor shall demonstrate compliance with the CDR success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews. The contractor and their subcontractors, suppliers, and vendors shall provide support to ensure successful completion of the review.

The contractor shall support splinter meetings resulting from the review and produce timely written responses to recommendations and action items.

Action items will be closed or an approved action item closure plan is in place. In addition, CDRL documentation due at the review will be provided or an approved revised delivery date is in place.

All CDRL data item deliverables, for which delivery is required prior to this milestone, have been delivered and the requirements of the DIDs have been met. The government COTR has approved those data items requiring approval. The contractor shall generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), and submit any change requests needed.

The contractor shall develop and organize the presentation material to the NASA review team and provide copies of all the material presented as required by the CDRL. All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #9 – (B9)

Complete System/Spacecraft Critical Design Review (CDR)

TBP months ARO

### GENERAL

The System/Spacecraft CDR establishes the design baseline for all system elements (spacecraft, mission, ground, and launch) and demonstrates compliance with all requirements, and analysis to validate the design. The contractor shall prepare sufficient documentation to assess the requirements, design, and verification of the program. This review will be conducted by NASA on all elements of the TDRS K Program by a Standing Review Board (SRB) for the purpose of reviewing plans and assessing performance.

### SPECIFIC

The contractor shall establish at the System/Spacecraft CDR that the maturity of the design and the development effort are appropriate to support proceeding with full scale fabrication activities. That the project is on-track to complete the system's development to meet mission performance requirements within the identified cost and schedule constraints. The System/Spacecraft CDR shall be conducted near the completion of final design and after completion of engineering model evaluation and breadboard development and testing.

System/Spacecraft CDR documentation shall identify any areas of significant implementation or operational risk to the program. For each identified risk, the contractor shall identify methods to be used to mitigate the overall risk to the program. During the review, open issues shall be identified and plans for resolving these issues shall be documented and subsequently tracked through the program review process. Provide an update of implementation issues, their potential impact, and risk mitigation plan. Specifically include any and all heritage issues from previous similar missions. Identify all performance margins and metrics.

The contractor shall demonstrate compliance with the System/Spacecraft CDR success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews. The contractor and their subcontractors, suppliers, and vendors shall provide support to successfully complete the review. The contractor shall support splinter meetings resulting from the review and produce timely written responses to recommendations and action items.

Successful completion of the System/Spacecraft CDR is contingent on satisfactory close-out of action items from any standalone sub-system CDR's, PDR's, and completion of detailed design for new or modified equipment.

Action items will be closed or an approved action item closure plan is in place. In addition, CDRL documentation due at the review will be provided or an approved revised delivery date is in place.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. Generate a

resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), submit any change requests needed to incorporate the resulting modifications or completions.

The contractor shall develop and organize the presentation material to the NASA review team and provide copies of all the material presented as required by the CDRL.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #10 – (K10, L10, M10, N10)

### Spacecraft Bus Structure Assembly with Propulsion System Integration

TBP months ARO

#### GENERAL

The primary bus structure has completed fabrication. The propulsion system has been manufactured, accepted and delivered for assembly onto the structure.

#### SPECIFIC

The Contractor shall demonstrate through I&T records that the core structure build is finished and the propulsion system has completed fabrication, acceptance and assembly onto the structure. This work or effort includes any corner posts, shear panels, nadir and zenith decks any internal structure that required assembly and integration. Demonstration of completion, at a minimum, shall be all applicable assembly procedures, QA acceptance processes, any associated final walk downs instructions and closeout photographs.

Provide an update of implementation issues, their potential impact, and resolution plan. Specifically include any and all heritage issues from previous similar missions.

All action items from the previous milestone are closed. Present a plan for the prompt close-out of all new action items.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #11 – (G11)

Ground Test Readiness Review – GTRR (Prior to Level 2 Testing at the Factory)

TBP months ARO

### GENERAL

The GTRR ensures that the TDRS K configuration items, test facility, support personnel, and test procedures are ready for testing and data acquisition, reduction, and control.

### SPECIFIC

The contractor shall demonstrate thru developed plans and test procedures the ability to conduct testing and verify allocated Configured Items requirements for compliance with allocated requirements and the TDRS K Spacecraft Specification, 454-KP-SYS-SPEC-001, the TDRS K WSC Ground Terminal Requirements 454-KP-GRD-SPEC-001, TDRS-K Tools Specification 454-KP-GRD-SPEC-002 and associated interface requirements as well as the TDRS-K Program Verification and Validation Requirements document 454-KP-SYS-RQT-001.

The contractor shall demonstrate compliance with the TRR success criteria of NPR 7123.1A.

The contractor shall identify and characterize the items under test and present a schedule for the test activities along with the test environment and planned verification activities with supporting documentation (i.e., plans, procedures, etc.)

The contractor shall demonstrate requirements compliance in accordance with the SOW and the 454-KP-GRD-SPEC-001, TDRS K Ground System Requirements Specification.

Action items will be closed or an approved action item closure plan is in place. In addition, CDRL documentation due at the review will be provided or an approved revised delivery date is in place.

## MILESTONE #12 – (K12, L12, M12, N12)

Complete Bus Module Integration & Test

TBP months ARO

### GENERAL

Bus module and sub-system integration & test have been successfully completed with a comprehensive performance test (CPT). Show that the bus is ready for payload integration.

### SPECIFIC

The contractor shall demonstrate through I&T records the successful completion of bus module and sub-system integration & testing. The bus I&T program shall verify through testing that the bus design meets all of the requirements, specifications, and interfaces identified in the TDRS K Spacecraft Specification, 454-KP-SYS-SPEC-001, as well as, the TDRS-K Program Verification and Validation Requirements document 454-KP-SYS-RQT-001.

The contractor shall demonstrate successful completion of a bus comprehensive performance test (CPT) prior to the integration of the payload. Plans and procedures for integration of the payload module shall be reviewed and approved by the applicable organizations.

Demonstration of completion, at a minimum, shall be all applicable assembly procedures, as run test procedures, QA acceptance information, any associated final walk down instructions, closeout photographs and data records that support the development and completion of the System Requirements Traceability Database and Performance Verification Matrix (CDRL/DID SE-33).

All anomaly / problem failure reports and action items from the bus I&T program shall be closed. Present a plan for the prompt close-out of all payload module integration readiness review action items. All exceedances shall be documented in the I&T records with supplied working dispositions.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DIDs have been met, and the COTR has approved those data items requiring Government approval.

All previous milestones have been met and payment has been approved by the CO.

MILESTONE #13 – (K13, L13, M13, N13)

Complete Payload Module Integration & Test

TBP months ARO

GENERAL

Successfully complete payload module integration and testing.

SPECIFIC

The Contractor shall demonstrate through the use of I&T records the successful completion of payload module integration and testing. The test program shall include any required software and ground support hardware (GSE). The contractor shall verify through testing that the payload module design meets all of the requirements, specifications, and interfaces identified in the TDRS K Spacecraft Specification, 454-KP-SYS-SPEC-001 and the listed Applicable Documents as well as, the TDRS-K Program Verification and Validation Requirements document 454-KP-SYS-RQT-001.

Demonstration of completion, at a minimum, shall be all applicable assembly procedures, as run test procedures, QA acceptance information and data records that support the development and completion of the System Requirements Traceability Database and Performance Verification Matrix (CDRL/DID SE-33)

Provide an update of implementation issues, their potential impact, and resolution plan. Specifically include any and all heritage issues from previous similar missions.

All anomaly / problem failure reports and action items from the Payload Module I&T program shall be closed.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DiDs have been met, and the COTR has approved those data items requiring Government approval. Generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), submit any change requests needed to incorporate the resulting modifications or completions.

All applicable action items, anomaly and problem failure reports are closed.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #14 – (K14, L14, M14, N14)

### Complete Systems Integration Review (SIR)

TBP months ARO

#### GENERAL

The SIR establishes that the system is ready to be integrated. Segments, components, and subsystems are available and ready to be integrated into the system. Integration facilities, support personnel, and integration plans and procedures are ready for integration. This review will be conducted by NASA a Standing Review Board (SRB) for the purpose of reviewing plans and assessing performance.

#### SPECIFIC

The contractor shall demonstrate compliance with the System Integration Review (SIR) success criteria of NPR 7123.1A. The contractor shall provide an update of integration risks, their potential impact, and mitigation / resolution plan. Include any and all heritage issues from previous similar missions.

The contractor shall have completed the verification & validation plans, integration plans, and test plans and demonstrate that the Bus and payload modules (hardware/software), test facilities, support personnel, and test procedures are ready for testing and data acquisition, reduction, and control have been established. The results of Bus Module I&T and Payload Module I&T shall be reviewed

The plans for test readiness reviews and test data reviews will be established and qualification status of all items will be presented. The PVM will be reviewed and the plans for collecting the required data will be reviewed.

The status of all open test anomalies, software anomalies, and process anomalies shall be reviewed and dispositioned or a plan to close the anomalies have been generated. All flight hardware and software failure and nonconformance reports shall be reviewed.

Action items will be closed or an approved action item closure plan is in place. In addition, CDRL documentation due at the review will be provided or an approved revised delivery date is in place.

## MILESTONE #15 – (B15)

Complete Mission Operations Review (MOR)

TBP months ARO

### GENERAL

The MOR establishes the comprehensive status of its mission operations planning in order to demonstrate that the requirements for all phases and modes of mission operations, data processing, and analysis are thoroughly understood. This review will be conducted by NASA by a Standing Review Board (SRB) for the purpose of reviewing plans and assessing performance.

### SPECIFIC

The contractor shall identify the full scope of the ground system's involvement in the mission and has incorporated all aspects of flight and ground operations into the plans and schedules necessary to support all required activities at the flight system integration site and the launch site, as well as launch, transfer orbit phase, and on-orbit acceptance phase of the mission.

The contractor shall demonstrate compliance with the Mission Operations Review success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews.

The contractor shall demonstrate that the

- (a) mission requirements are fully understood and supported by the mission operations concept, the ground system architecture, and the organizational and staffing approach.
- (b) the linkage of mission requirements to the ground system support requirements and subsequent flow-down to performing personnel and elements within the ground system is complete, traceable, and verifiable;
- (c) planning is compatible with applicable policies and procedures associated with asset protection considerations such as, but not limited to, IT and physical security;
- (d) considerations regarding mission operations personnel are complete with respect to organization, roles and responsibilities, staffing and training;
- (e) implementation activity associated with the design and development of mission unique elements as well as the adaptation of institutional elements will meet mission requirements.
- (f) plans for comprehensive verification and validation of ground system elements are complete and include independent execution of mission readiness testing and interactive testing with the flight system;
- (g) the scope and approach for maintaining appropriate mission system elements (such as flight and ground software) throughout their operational lifetime are well understood.

Action items will be closed or an approved action item closure plan is in place. In addition, CDRL documentation due at the review will be provided or an approved revised delivery date is in place.

## MILESTONE #16 – (G16)

Complete WSC Ground Terminal Pre-Ship Review for HW & SW (GTPSR)

TBP months ARO

### GENERAL

The contractor shall conduct GT Pre-Ship Review prior to transfer of TDRS K ground segment items for initial I&T activities at WSC.

### SPECIFIC

The GT-PSR documentation shall be sufficient in detail to assess that the program requirements allocated to factory testing have been verified and validated. The contractor shall demonstrate compliance through test data and verification records (PVM) with the TDRS K Spacecraft Specification, 454-KP-SYS-SPEC-001, the TDRS K WSC Ground Terminal Requirements 454-KP-GRD-SPEC-001, TDRS-K Tools Specification 454-KP-GRD-SPEC-002 and associated interface requirements as well as the TDRS-K Program Verification and Validation Requirements document 454-KP-SYS-RQT-001.

The contractor shall clearly define the content of shipment scope. The documentation shall identify any outstanding areas of significant implementation or operational risk to the program. For each identified risk, the contractor shall identify methods to be used to mitigate the overall impact to the program. For this review, the contractor shall provide details of WSC integration and transition activity including planned use and/or dependencies on WSC resources (SMTF, HMD, personnel, SGLT, STTC, etc). Required and relevant material and plans demonstrating understanding and compliance with WSC processes for receipt and install / integration of shipment shall be provided.

The contractor shall demonstrate compliance with the Pre-Ship Review success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews & NPR 7123.1A.

Details of contractor shipped hardware and the integration plans (with schedule) for moving to the next phase of the activity at WSC shall be outlined at the review.

The contractor shall demonstrate requirements compliance in accordance with the SOW and the 454-KP-GRD-SPEC-001, TDRS K Ground System Requirements Specification.

Provide an update of integration issues, their potential impact, and resolution plan. Specifically include any and all heritage issues from previous similar missions.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DIDs have been met, and the COTR has approved those data items requiring Government approval.

All action items from the previous reviews are closed.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #17 – (G17)

Complete Shadow Beam-Forming Tests with MA Equipment (F1-F7 S/C Signals)

TBP months ARO

### GENERAL

The contractor shall provide specific MA Return Ground Based Beam-forming verification tests that include F1-F7 MA signals for each TDRS K modified SGLT.

### SPECIFIC

The contractor shall successfully perform shadow multiple access return service beam-forming tests with TDRS K MA equipment utilizing spacecraft signals from F1 to F7 for each TDRS K modified SGLT. Details of test results shall be provided, including verification activities and records.

The contractor shall deliver a Ground Segment Verification and Acceptance Plan, per CDRL/DID GR-21.

The contractor shall demonstrate compliance through test data and verification records (PVM) with the applicable sections of the TDRS-K Program Verification and Validation Requirements, 454-KP-SYS-RQT-001, TDRS K Spacecraft Specification, 454-KP-SYS-SPEC-001, and TDRS K WSC Ground Terminal Requirements 454-KP-GRD-SPEC-001.

All performance liens, waivers, action items, anomaly reports (AR's), problem failure reports (PFR's), malfunction reports and open items should be closed or dispositioned.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. Generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc) submit any change requests needed to incorporate the resulting modifications or completions.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #18 – (G18)

Complete Ka End-to-End Service Tests (with F8-F10 Spacecraft)

TBP months ARO

### GENERAL

The contractor shall demonstrate successful Ka End-to-End Test Service for each TDRS-K modified SGLT.

### SPECIFIC

The contractor shall demonstrate, with testing and subsequent verification records, successful Ka ETE service tests, both forward and return, utilizing one or more second generation TDRS (F8-F10) spacecraft for each modified SGLT prior to the first launch of a TDRS K Program spacecraft. Per the SOW, 454-KP-PM-SOW-001, the contractor shall implement and deliver an automated Ka-Band End-to-End Test service capability at both STGT and WSGT for exercising on-orbit Ka-Band test service capability with function and performance compliant with specifications.

The contractor shall demonstrate compliance through test data verification records (PVM) with the applicable sections of the TDRS-K Program Verification and Validation Requirements, 454-KP-SYS-RQT-001, TDRS K Spacecraft Specification, 454-KP-SYS-SPEC-001 , and TDRS K WSC Ground Terminal Requirements 454-KP-GRD-SPEC-001.

All performance liens, waivers, action items, anomaly reports (AR's), problem failure reports (PFR's), malfunction reports and open items should be closed or dispositioned. Present a plan for the prompt close-out of any open items.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. Generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), submit any change requests needed to incorporate the resulting modifications or completions.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #19 – (G19)

Complete 1<sup>st</sup> WSC SGLT Integration Testing

TBP months ARO

### GENERAL

All elements of the TDRS K Modifications to WSC have been integrated, tested, and verified into the first SGLT, SMTF and WSC in accordance with specifications. The first SGLT is capable to support F1-F10 and TDRS K spacecraft and services.

### SPECIFIC

The contractor shall demonstrate through I&T and verification records that the TDRS-K WSC modifications to the first WSC Space to Ground Link Terminal have been integrated, tested, and verified. Testing has verified TDRS-K requirements for the first SGLT. TDRS-K SGLT COMSEC capabilities have been verified. TDRS-K SGLT MAR service capabilities have been verified. Beam-forming capability of MAR equipment has been verified for both TDRS K and F1-F7. SGLT Ka-Band EET service with F8-F10 spacecraft has been verified. DAS service interface and capabilities have been verified. WSC End-to-End Compatibility test with TDRS K Spacecraft shall be successfully demonstrated in accordance with TDRS K Program Statement of Work (SOW) and applicable specifications. Backward compatibility of the SGLT for TDRS F1-F10 function, performance and operation has been demonstrated and measured without adverse impact.

All delivery and integration into station infrastructure (e.g. SMTF, HMD, TOCC, etc.) for support of the SGLT has been completed. All applicable training and documentation have been provided.

The contractor shall demonstrate compliance through test data and verification records (PVM) with the TDRS K Spacecraft Specification, 454-KP-SYS-SPEC-001, the TDRS K WSC Ground Terminal Requirements 454-KP-GRD-SPEC-001, TDRS-K Tools Specification 454-KP-GRD-SPEC-002 and applicable interface requirements as well as the TDRS-K Program Verification and Validation Requirements document 454-KP-SYS-RQT-001.

Provide an update of any outstanding I&T and verification issues, their potential impact, and resolution plan. Provide plan and schedule for the next phase of WSC integration and testing. Specifically include any and all heritage issues from previous similar missions.

All performance liens, waivers, action items, anomaly reports (AR's), problem failure reports (PFR's), malfunction reports and open items should be closed or dispositioned.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval.

All previous milestones have been met and payment has been approved by the CO.

NASA will plan to provide provisional acceptance for completed items upon successful completion of this milestone.

## MILESTONE #20 – (K20, L20, M20, N20)

### Complete Spacecraft Integration & Test

TBP months ARO

#### GENERAL

The contractor shall have demonstrated a successful bus, payload and S/C I&T program. This completion criteria applies prior to the start of S/C environmental testing.

#### SPECIFIC

The contractor shall demonstrate through I&T records the successful completion of bus, payload module and spacecraft integration and testing. S/C level aliveness, functional and comprehensive performance tests (CPT) shall have been performed successfully with no outstanding anomalies or failures. The contractor shall verify through testing that the Spacecraft meets the requirements, specifications, and interfaces identified in the TDRS K Spacecraft Specification, 454-KP-SYS-SPEC-001. The contractor shall demonstrate that the requirements as specified by the TDRS K Statement of Work (SOW), 454-KP-PM-SOW-001 have been verified and validated. The contractor shall verify that the integrated spacecraft meets the requirements specified in the TDRS-K Verification and Validation Requirements Document, 454-KP-SYS-RQT-001.

Demonstration of completion, at a minimum, shall be all applicable assembly procedures, as run test procedures, QA acceptance information, any associated final walk down instructions, closeout photographs and data records that support the development and completion of the System Requirements Traceability Database and Performance Verification Matrix (CDRL/DID SE-33).

The contractor shall provide an update of integration risks, their potential impact, and mitigation / resolution plan. Include any and all heritage issues from previous similar missions.

All anomaly/problem failure reports and action items from the S/C I&T program shall be closed. All exceedances shall be documented in the I&T records with supplied working dispositions.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DIDs have been met, and the COTR has approved those data items requiring Government approval.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #21 – (G21)

Complete 1<sup>st</sup> WSC Ground Terminal Integration Testing

TBP months ARO

### GENERAL

All elements of the TDRS K Modifications to WSC have been integrated, tested, and verified into the first WSC Ground Terminal. The SMTF, modified WSC Ground Terminal 2 Space to Ground Link Terminals (SGLT), 1 S-Band Telemetry, Tracking and Command (STTC), 1 Ka-Band ETE, and applicable RCTS and TSE are capable to support F1-F10 and TDRS K spacecraft and services including external interface compatibility.

### SPECIFIC

The contractor shall demonstrate through I&T and verification records that the TDRS-K WSC modifications to the first WSC Ground Terminal (2 SGLT, one STTC, and all station infrastructures including compatibility with external interfaces (e.g. NCCDS, FDF, etc) have been integrated, tested, and verified. The contractor shall have verified by test the TDRS-K requirements for the two SGLT's and STTC in the first WSC Ground Terminal. The TDRS-K SGLT and STTC COMSEC capabilities have been verified. TDRS-K SGLT MAR service capabilities have been verified.

Beam-forming capability of MAR equipment has been shown for both TDRS K and F1-F7. SGLT Ka-Band EET service with F8-F10 spacecraft has been verified. DAS service interface and capabilities have been verified. Backward compatibility of the SGLT's and STTC for TDRS F1-F10 function, performance and operation has been demonstrated and measured without adverse impact. Compatibility with external interfaces has been verified for the first WSC Ground Terminal. RCTS and TSE have been integrated and verified.

Contractor delivery and integration into station infrastructure (e.g. SMTF, HMD, TOCC, etc.) for support of the first Ground Terminal has been completed. The contractor shall provide all applicable training and documentation.

The contractor shall demonstrate compliance through test data and verification records (PVM) with the TDRS K Spacecraft Specification, 454-KP-SYS-SPEC-001, the TDRS K WSC Ground Terminal Requirements 454-KP-GRD-SPEC-001, TDRS-K Tools Specification 454-KP-GRD-SPEC-002 and applicable interface requirements as well as the TDRS-K Program Verification and Validation Requirements document 454-KP-SYS-RQT-001.

Provide an update of any outstanding I&T and verification issues, their potential impact, and resolution plan. Provide plan and schedule for the next phase of WSC integration and testing. Specifically include any and all heritage issues from previous similar missions.

Identify plans for WSC training, support, documentation, and other activities for launch of first TDRS K spacecraft. Identify dependencies and planned use of WSC resources for launch of first TDRS K spacecraft.

All performance liens, waivers, action items, anomaly reports (AR's), problem failure reports (PFR's), malfunction reports and open items should be closed or dispositioned.

All CDRL data item deliverables for which delivery is required prior to this

milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. All previous milestones have been met and payment has been approved by the CO.

NASA will plan to provide incremental provisional acceptance for items within this milestone upon successful completion.

## MILESTONE #22 – (K22, L22, M22, N22)

### Complete Spacecraft to WSC End-to-End Compatibility Test

TBP months ARO

#### GENERAL

The contractor shall demonstrate Spacecraft/WSC compatibility Through End-to-End Testing.

#### SPECIFIC

The contractor shall execute a verification test program that demonstrates proper operation of the spacecraft to WSC end-to-end interfaces. The contractor shall demonstrate, by test, compatibility of the spacecraft TT&C subsystem RF and digital design with the WSC.

The contractor shall successfully perform a pre-ship "over-the-air" "high-bay" WSC compatibility test. This test shall use the spacecraft S-band TT&C system and corresponding WSC like S-band transmitter/modulator and receiver/demodulator. WSC software, command generator, telemetry processor, encryption/decryption equipment shall interface via NISN provided circuits.

The contractor shall demonstrate compliance with the applicable sections and corresponding documents of the TDRS-K Program Verifications and Validation Requirements, 454-KP-SYS-RQT-001.

Verification records & data presented shall be compliant with NASA-STD-1000 guidelines.

All anomalies, problem failure reports and action items from S/C to WSC compatibility testing shall be closed.

Provide an update of integration issues, their potential impact, and resolution plan and include any heritage issues from previous/similar missions.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DIDs have been met, and the COTR has approved those data items requiring Government approval.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #23 – (K23, L23, M23, N23)

### Spacecraft Pre-Environmental Review (PER)

TBP months ARO

#### GENERAL

Through the complete and comprehensive evaluation of the project's status, the PER establishes readiness to proceed with the environmental testing of the integrated flight system. The contractor and their subcontractors, suppliers, and vendors shall support the review to ensure its successful completion. This review will be conducted by NASA on all elements of the TDRS K Program by a Standing Review Board (SRB) for the purpose of reviewing plans and assessing performance.

#### SPECIFIC

The contractor shall address the planned test/calibration program and test flow to demonstrate that it meets the program needs and to assure the proper baseline of performance of the spacecraft to be tested. Also, the contractor shall demonstrate that the spacecraft is ready to begin a qualification test program to validate end-to-end or system performance. The review shall address compatibility test results with the WSC and the Network to be used for transfer orbit; the test verification matrix, including measurement tolerances, stimuli, contamination control; and results from the Comprehensive Performance Tests (CPT) along with the final results of any life tests. Identify all performance margins and metrics. The contractor shall demonstrate the readiness of all required environmental facilities and essential MGSE & EGSE to support operations.

The contractor shall successfully complete Spacecraft to WSC End-to-End Compatibility Testing.

The contractor shall demonstrate that the project is on-track to complete the flight and ground system development along with mission operations to meet mission performance requirements within allocated cost and schedule resources.

All performance liens, open items, waivers, malfunctions, anomaly and problem failure reports shall be closed or dispositioned. The contractor shall summarize Could-Not-Duplicate (CNDs) and discuss the overall risk assessment, results of any fault tree analysis, possible causes, testing/on-orbit impacts, as well as "can we see it" in the follow-on test phases.

The PER shall identify areas of implementation or operational risk to the program. For each identified risk, the contractor shall identify methods to be used to mitigate the overall risk to the program.

The contractor shall demonstrate compliance with the Pre-Environmental Review (PER) success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews.

All action items from the S/C Pre-Environmental Review are closed that apply to flight hardware.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. Generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), submit any change requests needed to incorporate the resulting modifications or completions.

The contractor shall develop and organize the presentation material to the NASA review team and provide copies of all the material presented as required by the CDRL.

The contractor shall support splinter meetings resulting from the review and produce timely written responses to recommendations and action items.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #24 – (G24)

Complete 2<sup>nd</sup> WSC Ground Terminal Integration Testing and Ground Terminal Provisional Acceptance Review (GTPAR)

TBP months ARO

### GENERAL

The TDRS K Modifications to WSC are complete. All elements have been integrated, tested, and verified. The WSC Ground Terminals with modifications (4 Space to Ground Link (SGLT) Terminals, 2 S-Band Telemetry Tracking and Command (STTC), SMTF, RTMS, TSE, 2 Ka-ETE with supporting WSC infrastructure) are capable to support F1-F10 and TDRS K spacecraft and services including external interface compatibility.

### SPECIFIC

The contractor has demonstrated through I&T and verification records that the TDRS-K WSC modifications to both WSC Ground Terminals (four SGLT, two STTC, and all station infrastructure) including compatibility with external interfaces (e.g. NCCDS, FDF, etc) have been integrated, tested, and verified. Testing has verified TDRS-K requirements for the WSC SGLT, STTC, and ground terminal TDRS K requirements. TDRS-K SGLT and STTC COMSEC capabilities have been verified for each WSC Ground Terminal (GT). TDRS-K SGLT MAR service capabilities have been verified in each modified SGLT. Beam-forming capability of MAR equipment has been shown for both TDRS K and F1-F7 in all modified SGLT's. SGLT Ka-Band EET service using F8-F10 spacecraft has been verified for all modified SGLT's. DAS service interface and capabilities have been verified in all modified SGLT's. Backward compatibility of all SGLT's, STTC, and WSC Ground Terminal for TDRS F1-F10 function, performance and operation has been demonstrated and measured without adverse impact.

If NASA exercises the option for the 5<sup>th</sup> SGLT at award, then all 5 SGLT's shall apply to this milestone.

Compatibility with external interfaces has been verified for both WSC Ground Terminals, RCTS and TSE have been integrated and verified. Delivery and integration into station infrastructure (e.g., SMTF, HMD, TOCC, etc.) for support of both WSC Ground Terminals has been completed and satisfied. All applicable training and documentation have been provided.

The contractor shall demonstrate compliance through test data and verification records (PVM) with the TDRS K Spacecraft Specification 454-KP-SYS-SPEC-001 , the TDRS K WSC Ground Terminal Requirements 454-KP-GRD-SPEC-001, TDRS-K Tools Specification 454-KP-GRD-SPEC-002 and applicable interface requirements as well as the TDRS-K Program Verification and Validation Requirements document 454-KP-SYS-RQT-001. Requirements pending on-orbit testing to complete verification shall be clearly identified.

The contractor shall demonstrate compliance with the System Acceptance Review (SAR) success criteria of NPR 7123.1A.

Identify any outstanding I&T and verification issues, their potential impact, and resolution plan. Provide WSC modifications support plan through end of contract for TDRS K program. Specifically include any and all heritage issues from previous similar missions.

Identify plans for WSC training, support, documentation, and other activities for launch of first TDRS K spacecraft. Provide WSC support plan with roles and responsibilities clearly identified and schedule for WSC training, support, and activities through launch of first TDRS K spacecraft. Identify dependencies and planned use of WSC resources for launch of first TDRS K spacecraft.

All performance liens, waivers, action items, anomaly reports (AR's), problem failure reports (PFR's), malfunction reports and open items shall be closed or dispositioned. All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval.

All previous milestones have been met and payment has been approved by the CO.

NASA will plan to provide incremental provisional acceptance for items within this milestone upon successful completion.

## MILESTONE #25 – (K25, L25, M25, N25)

Complete Spacecraft Environmental Testing

TBP months ARO

### GENERAL

The contractor shall demonstrate a successful environmental testing program for each spacecraft and establish the proper baseline of performance.

### SPECIFIC

The contractor shall demonstrate, through environmental and performance verification records, that each s/c successfully completed the base lined test program. Additionally, the contractor shall demonstrate that the environmental test program met the functional and performance requirements, per the TDRS K Verification and Validation (V&V) Requirements, 454-KP-SYS-RQT-001. The contractor shall demonstrate successful flight software performance during the environmental test program. The contractor shall demonstrate each S/C successfully completing aliveness, functional and comprehensive performance tests (CPT) with no outstanding anomalies or failures.

A complete mass properties report for each spacecraft shall be delivered per the CDRL. The report shall also include the appropriate mass contingency for the current stage of hardware development.

Demonstration of completion, at a minimum, shall be all as run test procedures, QA acceptance data, associated hardware inspections and data records that support the development and completion of the System Requirements Traceability Database and Performance Verification Matrix (CDRL/DID SE-33).

All performance liens, waivers, action items, anomaly reports (AR's), problem failure reports (PFR's), malfunction reports and open items shall be closed or dispositioned.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. Generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), submit any change requests needed to incorporate the resulting modifications or completions.

All previous milestones have been met and payment has been approved by the CO.

MILESTONE #26 – (K26, M26, N26)

Flight Ops Training & Manuals Complete

TBP months ARO

GENERAL

Provide all ground and flight operations manuals/materials and complete all flight operations team training.

SPECIFIC

The contractor shall provide all required training materials and conduct flight operations team training. The contractor shall certify that the flight operations team is ready for launch.

The contractor shall provide all ground and flight operations manuals.

The contractor shall provide an update of implementation issues, their potential impact, and resolution plan. Specifically include any and all heritage issues from previous similar missions.

All action items from flight operations training shall be closed.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. The contractor shall generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc) and submit any change requests needed to incorporate the resulting modifications or completions.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #27 – (K27, L27, M27, N27)

Complete Operational Readiness Review (ORR)/Flight Operations Review (FOR)

TBP months ARO

### GENERAL

The ORR/FOR establishes the project's readiness to execute a successful launch and transfer orbit campaign. The ORR/FOR shall be conducted before the shipment of each spacecraft to the launch site.

### SPECIFIC

The contractor shall demonstrate the readiness of the WSC to support the On-orbit test program and post-acceptance service operations. Present the readiness of all elements required to support the launch, transfer orbit mission plans, on-orbit test program which includes deployments, activation, calibration and transition to mission operations, and post-acceptance operations. The contractor shall confirm the readiness of all operations products and facilities, both at WSC, the network provider, and the contractor's facilities. The contractor shall demonstrate the readiness of contingency plans and training of all personnel and their readiness. The contractor shall provide status of all action items, preparations, and close-out activities.

The contractor shall demonstrate compliance with the Flight Operations Review success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews & Operational Readiness Review of NPR 7123.1A.

The contractor and their subcontractors, suppliers, and vendors shall provide support to ensure successful completion

The documentation shall identify any areas of significant implementation or operational risk to the program. For each identified risk, the contractor shall identify methods to be used to mitigate the overall risk to the program. During the reviews, open issues shall be identified and plans for resolving these issues shall be documented and subsequently tracked through the program review process.

All action items from the ORR/FOR are closed

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. The contractor shall generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), submit any change requests needed to incorporate the resulting modifications or completions.

All previous milestones have been met and payment has been approved by the CO

## MILESTONE #28 – (K28, L28, M28, N28)

Complete Spacecraft Pre-Ship Review (S/C - PSR) / System Acceptance Review (SAR)

TBP months ARO

### GENERAL

The S/C-PSR/SAR shall be conducted prior to shipment of flight system elements to the launch site. Additionally, the S/C PSR/SAR establishes that all flight and ground system verification activities have been successfully completed. This review will be conducted by NASA on all elements of the TDRS K Program by a Standing Review Board (SRB) for the purpose of reviewing plans and assessing performance.

### SPECIFIC

The contractor shall demonstrate, with verification and I&T records, that the design of the spacecraft has been validated through the environmental qualification and/or acceptance test program. The contractor shall demonstrate that each S/C is compliant with NASA-STD-1000 guidelines. The contractor shall demonstrate successful completion of all verification activities including functional performance testing as well as ground system and network compatibility testing. The results of system testing, alignment, calibration and end item performance are to be demonstrated and documented. The solutions to all problems encountered during the environmental test and validation program and the solution rationale are to be presented. Demonstrate that the spacecraft, along with all the required documentation, operation procedures, etc., is ready for shipment.

Completion of the 2<sup>nd</sup> WSC Ground Terminal Integration Testing and Ground Terminal Provisional Acceptance Review (GTPAR) shall be successfully completed prior to shipment to the ETR.

All anomaly reports (AR's), problem failure reports (PFR's), malfunction reports, deviations, waivers and open items have been satisfactorily dispositioned. All action items from the S/C Pre-Ship Review are closed.

The contractor shall demonstrate from test data records the development and completion of the System Requirements Traceability Database and Performance Verification Matrix (CDRL/DID SE-33).

The contractor shall demonstrate compliance with the S/C-PSR / SAR success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews & NPR 7123.1A.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. Generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), submit any change requests needed to incorporate the resulting modifications or completions.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #29 – (K29, L29, M29, N29)

Complete Spacecraft Final CPT at Eastern Test Range (ETR)

TBP months ARO

### GENERAL

The Contractor shall perform a successful S/C level comprehensive performance tests (CPT's) at the Eastern Test Range.

### SPECIFIC

The Contractor shall demonstrate through I&T records the successful completion of S/C level aliveness, limited and comprehensive performance tests (CPT's) with no outstanding anomalies or failures. Data/material presented shall be compliant with NASA-STD-1000 guidelines.

Demonstration of completion, at a minimum, shall be all applicable assembly procedures, as run test procedures, QA acceptance information, any associated final walk down instructions, closeout photographs and data records that support completion of the System Requirements Traceability Database and Performance Verification Matrix (CDRL/DID SE-33).

The contractor shall provide any residual mission risks, their potential impact, and mitigation/resolution plan. Include any and all heritage issues from previous similar missions.

All anomaly reports (AR's), problem failure reports (PFR's), liens, waivers, malfunction reports, deviations and open items have been satisfactorily dispositioned

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. Generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), submit any change requests needed to incorporate the resulting modifications or completions.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #30 – (K30, L30, M30, N30)

### On-Orbit Acceptance Review (OOAR)

TBP months ARO

### GENERAL

The On-Orbit Acceptance Review shall assess the satisfactory completion of the On-Orbit Acceptance Milestone for each spacecraft. The On-Orbit Acceptance Review for the first spacecraft shall also be the Final Acceptance Review for the Ground Segment.

### SPECIFIC

The contractor shall demonstrate on-orbit acceptance of each spacecraft, using on-orbit test data and supporting analyses, to validate and verify spacecraft health, performance, and functionality. Specifically, this shall include demonstration of successful and complete activation and calibration, deployment of all appendages, demonstration of specification compliance of all telecommunications services requirements and successful completion of all end-to-end service tests. The contractor shall demonstrate compliance with the TDRS-K On-Orbit Acceptance Test Specification, 454-KP-SYS-TEST-001.

The contractor shall demonstrate compliance with the S/C-PSR / SAR success criteria of GSFC-STD-1001, Criteria for Project Flight Critical Milestone Reviews & NPR 7123.1A.

On-orbit acceptance shall be made when the review package is complete, per requirements above and all actions from the review are satisfactorily closed. If any off-nominal conditions (with the exception of launch vehicle Interface Control Document (ICD) performance exceedances) or spacecraft anomalies have been experienced since ignition, additional tests/or analyses shall be required by the government to establish spacecraft acceptability

All performance liens, waivers, action items, anomaly reports (AR's), problem failure reports (PFR's), malfunction reports and open items should be closed or dispositioned.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. Generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc) and submit any change requests needed to incorporate the resulting modifications or completions.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #31 – (B31)

Complete Sustaining Engineering Transition to WSC

TBP months ARO

### GENERAL

The contractor shall provide for sustaining engineering support for the period required by the contract until transitioning control to WSC.

### SPECIFIC

The contractor shall meet the requirements in the Sustaining Engineering and Transition Plan (CDRL/DID SE-35). The Sustaining Engineering & Transition Plan shall describe all activities required to maintain hardware and software deliverables that were developed to support the operation of the TDRS K spacecraft. This plan shall also describe the transition of these activities to NASA from the contractor.

All performance liens, waivers, action items, anomaly reports (AR's), problem failure reports (PFR's), malfunction reports and open items should be closed or dispositioned.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those data items requiring Government approval. Generate a resolution plan (item, responsibility, closure date) for all open items (e.g. TBD, TBR, TBS, etc), submit any change requests needed to incorporate the resulting modifications or completions.

All previous milestones have been met and payment has been approved by the CO.

## MILESTONE #32 – (G32)

WSC Ground Terminal Acceptance Review (WGTAR)

TBP months ARO

### GENERAL

The TDRS K Modifications to the WSC are complete and verified with the TDRS-K Spacecraft. The WSC Ground Terminals with modifications (4 Space to Ground Link (SGLT) Terminals, 2 S-Band Telemetry, Tracking, and Command (STTC), with supporting WSC infrastructure) are capable to support F1-F10 and at least one SGLT and one STTC terminal, one RCTS and one TSE have demonstrated support to the on-orbit TDRS-K including service provision tests requiring external interfaces.

### SPECIFIC

The contractor shall certify the WSC ready for operation with the TDRS on-orbit fleet of spacecraft.

The contractor shall demonstrate that all criteria for the Ground Terminal Provisional Acceptance (GTPAR, Milestone #24) and the On-Orbit Acceptance Review (OOAR, Milestone #30) have been successfully completed.

All performance liens, waivers, action items, anomaly reports (AR's), problem failure reports (PFR's), malfunction reports and open items are closed and dispositioned.

All CDRL data item deliverables for which delivery is required prior to this milestone have been delivered and the requirements of the DID's have been met, and the COTR has approved those items requiring Government approval.

WSC training and support for the first TDRS-K spacecraft has been completed, delivered, and verified. All documentation, procedures, software, and databases for the operation of the first TDRS-K spacecraft have been delivered, installed and verified with TDRS-K. All additional tests and analyses required by the Government in response to a spacecraft or operational anomaly, have been completed to the Government's satisfaction. All modifications to flight and ground software, procedures, documentation, and databases in response to a spacecraft or operational anomaly have been delivered and verified with spacecraft operations.

Required previous milestones have been met and, payment has been approved by the CO.