DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-001**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Project Management Plan

7. **DESCRIPTION/USE**: To provide an overall description of the process and methods planned for accomplishing the Statement of Work.

8. **OPR**: CS40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraph 3.2.1

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Project Management Plan provides the basic planning document which describes the contractor's overall plan for performing the contracted scope of work.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Project Management Plan shall provide a description of the contractor's management concepts, practices, approaches, plans, and schedules necessary for accomplishing (managing and controlling) the project tasks described in the Statement of Work. In addition, the plan shall present those management systems to be utilized to define and delegate task assignments and shall define the organizational relationships of the contractor, subcontractors, and the Government.

Management Overview - A brief description of the project objectives, the system to be furnished, and the equipment (systems), and software that is to be provided. Include a concise summary of the contractor's management organization responsible for performance of the contract, including interrelationships with the Work Breakdown Structure (WBS), within the company and with other contractors, and proposed relationships with the NASA project management.

Management Systems - This plan shall briefly describe how the various management systems are to be integrated and used for the overall project management and reporting of:

a. Project management.
b. Contract management.
c. Financial management.
d. Data requirements management.
e. Schedules (planning and control).
f. Performance management (cost/schedule/technical).
g. Configuration management.
h. Engineering management.
i. Logistics management.
j. Test/verification management.
k. Subcontractor/vendor management.

DRD Continuation Sheet

TITLE: Project Management Plan **DRD NO.**: **1145MA-001**
DATA TYPE: 1 **PAGE**: 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

l. Procurement management.
m. Government furnished property (GFP) management.
n. Systems engineering management.
o. Safety, reliability, maintainability, quality assurance.
p. Automated information management systems.
q. Communications.
r. Support equipment management.
s. Spares philosophy and planning.
t. Facilities utilization and management.
u. Project reviews.
v. Environmental impact management.

NOTE: It is not intended that this plan duplicate other plans called for in the Data Requirements List. This plan should summarize the overall project and reference or summarize other plans where appropriate and shall reference contractor internal procedures where applicable.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-002**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Cost Analysis Data Requirement (CADRe)

7. **DESCRIPTION/USE**: To document the programmatic, technical, and life cycle cost information in one document that is updated at each Key Decision Point (KDP) throughout the project life cycle. It typically contains the same programmatic and descriptive information as the full CADRe, but the technical data will be at the system or subsystem level of detail.

8. **OPR**: CS50 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix.

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to NASA Cost Estimating Handbook (www.ceh.nasa.gov); DoD 5000.4M (CARD); DI-MGMT-81466; CPR DID; DD Forms 2734/1-5 (CPR Formats) (www.dior.whs.mil)
14. **INTERRELATIONSHIP**: DRDs 1145MA-004, Integrated Master Schedule; 1145MA-005, Work Breakdown Structure (WBS) and WBS Dictionary; 1145MA-006, Continuous Risk Management, and 1145MA-008, Financial Management Reports (533M and 533Q) and 1145MA-011, Cost Performance Report. SOW paragraph 3.2.1

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Cost Analysis Data Requirement (CADRe) documents the programmatic, technical, and life cycle cost information in one document that is updated at each Key Decision Point (KDP) throughout the project life cycle. Typical projects will make five CADRe submissions across the project life cycle. The NASA project manager is responsible for CADRe (Part A, B, and C) within the Project Office. The project manager should use the CADRe to obtain source information from the prime and major subcontractors.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Cost Analysis Data Requirement (CADRe) shall consist of three distinct parts. Part A which is written by the Project Office contains general descriptive information of the project. Part B is written by the Contractor contains hardware and software technical parameters necessary to estimate the project's life cycle cost. The parameters are entered into the attached Microsoft Excel Workbook. Part C contains the project's life cycle cost estimate (LCCE) within an agreed WBS. The contractor shall provide cost estimates for those WBS elements for which he is responsible within the Workbook. The government project manager shall use this information to develop and deliver a complete LCCE in the government submitted CADRe. The contractor shall map their WBS to the Project WBS as specified in the CADRe. The CADRe shall include the following:

a. Part A - General Descriptive Information shall include:
   1. Description - provide a top-level description of the system, including functions to be performed, measurements to be obtained and key performance parameters. A functional block diagram and/or photograph or drawing of the system (with major elements identified) shall be provided.

DRD Continuation Sheet

TITLE: Cost Analysis Data Requirement (CADRe) **DRD NO.:** **1145MA-002**
DATA TYPE: 1 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

2. Subsystem Description - summarize and describe the key features, interfaces and operations of the various subsystems including Structures, Propulsion, Thermal, Power, Avionics, Telecom, Attitude Control and Software.
3. Project Level Description - provide descriptions and summarize the primary responsibilities for Project Management, Systems Engineering, Science Team, Mission Assurance, Education and Public Outreach, ATLO, Test beds, Risk Assessment, and Acquisition Plan.
4. Heritage - provide at a summary level, any heritage or analogous systems that are being used to reduce development/production costs. Describe any ECP/ECO (Engineering Change Proposal/Engineering Change Order) activity that modified original system performance requirements from the previous CADRe submission (in order to understand requirements creep/evolution). Lower-level WBS heritage is documented in Part B.
5. Significant Changes since previous CADRe Submission - summarize changes made since submission of the previous CADRe. If no changes occurred since the last submission, the Contractor is not required to resubmit, but to notify the Distribution list provided earlier. The CADRe shall document evolution in the project, specifically addressing changes in cost drivers and cost.

b. Part B - Technical Data shall include a comprised of an Excel workbook (attached) broken into worksheets containing system level and appropriate subsystem level elements.

c. Part C – Life Cycle Cost Estimate shall be a separate Excel Workbook (attached). This shall reflect total cost estimate to date and the estimate for completion for the project and be consistent with the technical parameters presented in Part B. The project's WBS and dictionary, as well as details of the recurring and non-recurring cost must be included in the Part C Excel file. Part C also must include a map from the project's WBS to the NASA Cost Estimating WBS (www.ceh.nasa.gov).

15.4 **FORMAT:** Submission of the deliverables in 15.3 shall be by electronic media utilizing the Excel templates provided.

15.5 **MAINTENANCE:** None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-003**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/1

6. **TITLE**: Program Operating Plan (POP)

7. **DESCRIPTION/USE**: To provide contractor input to NASA Program Operating Plan (POP).

8. **OPR**: JP30 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraph 3.2.1

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Program Operating Plan (POP) establishes content and format for preparation and submittal of the contractor's input to the semiannual NASA Program Operating Plan. Although the bulk of the semiannual report may preclude transmission by Data Link, the report will be formatted for electronic transmission to allow updates to be transmitted by this means.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Program Operating Plan (POP) shall estimate cost for the current Government fiscal year (GFY), broken down by month, and estimated costs for the succeeding five years (GFY) shall be presented for each subdivision or project covered by the contract.

a. Breakdown of costs shall be as follows:
   1. NASA Equivalent People - Program Administration, Manufacturing, and Other.
   2. Hours - Program Administration, Manufacturing and Other.

b. Costs in Dollars.
   1. Direct Cost - Program Administration, Manufacturing Labor, and Other Labor.
      (a) Total Labor.
      (b) Subcontracts, Materials and Other Direct Costs.
      (c) Total Direct.
   2. Indirect Cost - Program Administration and Manufacturing Overhead.
      (a) Other Overhead.
      (b) Total Overhead.
      (c) Division General, G&A, COM, Base Fee and Award Fee.
      (d) Total Indirect.
   3. Total Cost and Fee.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-004**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Integrated Master Schedule

7. **DESCRIPTION/USE**: To provide the contractor's time-phased plan, current status, key milestones, task interdependencies, and major development phases necessary to accomplish the total scope of work. This schedule will be used to provide management insight into contractor status, potential problem areas, and critical path identification, which will serve as the basis for evaluating contractor performance.

8. **OPR**: CS40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: The schedule will be baselined at some point after ATP as agreed to by both parties and not to exceed 90 days after ATP. Reference is made to NPR 7120.5 (Current Revision), *NASA Program and Project Management Processes and Requirements.* This document shall be used as a guide in preparation of the schedules.

14. **INTERRELATIONSHIP**: DRDs 1145MA-005, *Work Breakdown Structure and WBS Dictionary* and 1145MA-001, *Project Management Plan*. SOW paragraph 3.1.5

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Integrated Master Schedule provides data for the assessment of contract schedule and logic network of the tasks to be performed.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Integrated Master Schedule shall include tasks necessary to accomplish the total scope of work as defined in the work breakdown structure (WBS). The schedule shall also include all logical relationships (interdependencies) between tasks. Schedules shall contain the approved baseline schedule as well as current forecasted dates and shall be traceable to the approved Work Breakdown Structure (WBS). All key milestones shall be clearly identified and logically linked to related tasks. The program/project schedule shall be created and maintained in management software that supports automated time phasing of tasks, a logic driven critical path, schedule assessment, and trend analysis capabilities. Program/Project Schedules and the Logic Network shall be reported in four sections. The following deliverables shall be extractions from the automated logic network database. All data contained in the sections shall be consistent, statused monthly and based on the same cutoff date.

a. Summary Schedule - One page, top level, Gantt-type summary document arranged by WBS that reflects all contract and controlled milestones, major program/project phases (i.e., design, fabrication, integration, assembly, etc.) and all end item deliveries.

DRD Continuation Sheet

TITLE: Integrated Master Schedule **DRD NO.:** 1145MA-004
DATA TYPE: 2 **PAGE:** 2/2

15 **DATA PREPARATION INFORMATION (CONTINUED):**

b. Logic Network Database - an automated logic network database consisting of schedule data for all WBS elements. The entire scope of work shall be broken into schedule tasks and milestones at a consistent level of detail to allow discrete progress measurement and visibility into the overall development, fabrication, integration, assembly, test, and delivery phase of each end item deliverable. Additionally, all schedule tasks/milestones shall be integrated with the appropriate sequence relationships to provide a total end-to-end logic network leading to each end-item delivery. This database shall contain all contract and controlled milestones, key subcontractor milestones, end item delivery dates, key data delivery dates, and key Government Furnished Property (GFP) need dates. The database shall contain the appropriate task coding attributes necessary to provide sort, select, and summarization capabilities for, but not limited to, WBS element, program/project phase, and level-of-effort tasks. The logic network database serves as the basis for identification of program/project critical paths as well as critical schedule analysis.

c. Critical Path Report - This report shall be an extract from the Logic Network Database and include all tasks and milestones with 10 workdays or less of total slack (float). The report shall be submitted in a waterfall format and organized in manner such that the path with the least amount of slack is delineated first and followed by each successive path according to total slack values.

d. Contractor Schedule Assessment Report - This report shall contain a count of the total number of tasks, milestones and non-detail (e.g., summary, hammock, rollup, etc.) activities contained in the schedule, a count of the number of completed tasks and milestones, a count of the number of tasks and milestones to be completed, a count of the number of tasks and milestones that have no predecessor and/or no successor relationships, a count of the total number of tasks and milestones that have a total float (slack) value greater than 25% of the remaining duration of the total program/project schedule, a count of the total number of non-detail (e.g., summary, hammock, rollup, etc.) activities that have any predecessor or successor logical relationships, a count of the total number of tasks and milestones that have forced or fixed dates. The report shall contain critical path narratives explaining changes and impacts to the critical paths listed in section c above. The report shall contain narrative explanations for contract milestones and significant project milestones that have moved more that 45 calendar days into the future from their baseline dates. Program/Project milestones shall be identified and negotiated with the project office. These narratives shall include a proposed work-around schedule detailing how the contractor plans to recover the lost schedule time.

15.4 **FORMAT**: Submission of the deliverables in 15.3 shall be by standard hardcopy and electronic media. Electronic media submittals shall be in native file format utilizing schedule management software approved by the MSFC project office. A legend identifying the contractor's schedule symbols used and their meaning shall be provided.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-005**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Work Breakdown Structure (WBS) and WBS Dictionary

7. **DESCRIPTION/USE**: To establish a product-oriented framework for reporting program cost, schedule, and technical performance. To provide a basis for uniform planning, reporting status, program visibility, and assignment of responsibilities.

8. **OPR**: CS40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: NPD 7120.4 (Current Revision), *Program/Project Management*, and NPR 7120.5 (Current Revision), *NASA Program and Project Management Processes and Requirements*, and MIL-HDBK-881, *Department of Defense Handbook Work Breakdown Structure*, shall be used as guides in the preparation of the WBS and the WBS dictionary.

14. **INTERRELATIONSHIP**: SOW paragraph 3.1.6

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Work Breakdown Structure (WBS) establishes a product-oriented logical subdivision of hardware, software, services, facilities, etc., that make up the total project scope of work. The WBS Dictionary provides a narrative description of the tasks and effort to be performed in each WBS element.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The WBS and WBS Dictionary are two distinct project documents used for defining the approved project scope of work. The contents of each document are detailed in the following paragraphs:

a. WBS - A logical, hierarchical display of the subdivision of all project work to be completed. The WBS shall include the approved element title and element number.

b. WBS Dictionary - The WBS dictionary shall describe and document the work content of every WBS element and relevant efforts associated with each element (e.g., design, development, manufacturing). The WBS dictionary shall be arranged in the same order as the contract WBS. The WBS dictionary shall include the following for each WBS element:

1. WBS element title.
2. WBS element code.
3. WBS element content description (including quantities, relevant associated work, and contract end items where applicable).
4. WBS Index.

DRD Continuation Sheet

TITLE: Work Breakdown Structure (WBS) and WBS Dictionary **DRD NO.: 1145MA-005**
DATA TYPE: 2 **PAGE**: 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

5. SOW paragraph number.
6. Specification (number and title) associated with the WBS element (if applicable).
7. Contract line item associated with the WBS element.
8. Date, revision number, revision authorization and approved changes.
9. Contract Identification Number.
10. Budget and reporting number (i.e., Charge Code).

15.4 **FORMAT**: The WBS shall be in a chart format showing element relationships, arranged in the same order as the WBS provided in the Request for Proposal. The WBS Dictionary shall be ordered in consonance with the WBS index and shall reference each WBS element by its identifier and name.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-006**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Continuous Risk Management

7. **DESCRIPTION/USE**: To provide a baseline document for planning, management, control, and implementation of the contractor's risk management program.

8. **OPR**: QD40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to the following documents:

NPD 8700.1	*NASA Policy for Safety and Mission Success*
Notice 97-58	*NASA Procurement Notice for Risk-Based Acquisition Management (R-BAM)*
MWI 7120.6	*Program and Project Continuous Risk Management*

14. **INTERRELATIONSHIP**: SOW paragraphs 4.4 and 4.5

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: Continuous Risk Management addresses how NASA risk management requirements are to be implemented throughout the program's life cycle.

15.2 **APPLICABLE DOCUMENTS**:

NPR 7120.5	*Program and Project Management Processes and Requirements*
NPR 8000.4	*Risk Management Procedural Requirements*

15.3 **CONTENTS**: The Continuous Risk Management shall specify how the contractor will satisfy the risk management requirements of NPR 7120.5 by using the risk management procedures and guidelines specified in NPR 8000.4 in a manner that is compatible with the Project Office's Risk Management Plan. The plan shall specify how the contractor will document risk management activities and how the contractor will communicate risk issues and concerns to the Government.

The Risk List shall identify program risks with regards to budget, cost, safety, schedule, and technical risks.

The Risk Analysis shall contain the following data: 1) References to source data for identified risk areas such as test data, lessons learned, Failure Modes Effects Analysis (FMEA), hazard analysis and technical analysis; 2) Catalog of all program/project risks; 3) Risk evaluation data that identifies the impact, probability and time frame for each risk; 4) Risk classification and prioritization data.

The Risk Tracking Report shall contain the following data: 1) Status of all risks and risk metrics; 2) Risk mitigation plans and verification of completed mitigation plans; 3) Risk decision summaries that will document re-planning of unsuccessful mitigation plans and risk acceptance/closures. 4) Risk Database shall be IRMA / ARM compatible.

DRD Continuation Sheet

TITLE: Continuous Risk Management **DRD NO.: 1145MA-006**
DATA TYPE: 2 **PAGE**: 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

Lessons Learned Search Reports shall specify how the contractor has satisfied the requirements of NPR 7120.5 by incorporating lessons learned. They shall contain the following data: 1.) Guidelines used to determine relevant searches; 2.) Details of searches that were performed, together with accompanying rationale; 3.) A list of relevant articles returned, source, and relevance to the project; and 4.) How the project plans to incorporate relevant lessons learned.

Lessons Learned Submittals shall include: 1.) Description of the driving event; 2.) Description of the lessons learned and any corrective action that may have resulted; 3.) Recommended changes to specifications or procedures.

15.4 **FORMAT**: Contractor format is acceptable unless specified by the Program Risk Management Plan.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-007**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/3
6. **TITLE**: Major Review Documentation
7. **DESCRIPTION/USE**: Used for conduct of formal technical reviews to evaluate design and status, document baselines, and monitor disposition of action items and Review Item Discrepancies (RIDs).
8. **OPR**: JP30 9. **DM**: JP30
10. **DISTRIBUTION**: See Attachment 2
11. **INITIAL SUBMISSION**: See Attachment 2
12. **SUBMISSION FREQUENCY**: Per technical review
13. **REMARKS**:
14. **INTERRELATIONSHIP**: SOW paragraphs 4.3, 5.3, 6.3, 7.3 and 8.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: Major Review Documentation contains all of the required documentation necessary to support major technical reviews.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: Documentation required for the following technical reviews shall be provided as described in Attachment 1.

Additional documentation to be provided are:

a. Agenda - The agenda shall specify the time and place for the scheduled review, specific review items, supporting documentation, and key participants. Submit approved copies at the review. See Attachment 2.
b. Presentation Charts - Presentation charts shall be submitted at the review. They shall summarize the details contained in the data package and should identify compliance with the contract requirements. See Attachment 2 for distribution and availability of data.
c. Minutes - The minutes shall contain a description of the review with sufficient detail to enable the review to be made a matter of record. The minutes shall include the presentation charts, a listing of RIDs, action items with actionee and suspense (closure) data. See Attachment 2 for distribution and availability of data.
d. RIDs - RIDs showing action items, actionees, suspense dates and closure status shall be submitted. See Attachment 2 for distribution and availability of data.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: As required to correct errors and to maintain RID closure status.

1. Preliminary Design Review (PDR)
   Per Data Rrequirements Matrix

2. Critical Design Review (CDR)
   Per Data Requirements Matrix

3. Design Certification Review (DCR)
   Per Data Requirements Matrix

4. Acceptance Review (AR)
   Per Data Requirements Matrix

5. Systems Requirements Review (SRR)
   Per Data Requirements Matrix

6. Flight Readiness Review
   Per Data Requirements Matrix

ATTACHMENT 2

Technical Review Documentation
Distribution and Availability of Data

Document	Type	Design Reviews PDR, CDR, DCR, FRR (Copies/Availability)	AR (Copies/Availability)
Agenda	2	One/15 days prior to review Approved copies at review	One/15 days prior to review Approved copies at review
Data Package	3	Electronic Deliver /two weeks prior to review	Electronic Deliver/two weeks prior to review
Presentation Charts	3	One to each attendee at review	One to each attendee at review
Minutes	2	One to each board member/ Within two weeks	One to each board member/ Within two weeks after review
RIDs (Generated at Review)	2	Within seven days of closure date	Within one day of closure date

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-008**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/2
6. **TITLE**: Financial Management Report (533M and 533Q)
7. **DESCRIPTION/USE**: To provide quarterly and monthly financial reports for monitoring program costs. The 533M and 533Q reports are the official cost documents used at NASA for cost type, price redetermination, and fixed price incentive contracts.
8. **OPR**: CS40 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: The data contained in the reports shall be auditable using Generally Accepted Accounting Principles.
14. **INTERRELATIONSHIP**: DRD 1145MA-011, *Cost Performance Report.* NFS 1852.242-73, *NASA Contractor Financial Management Reporting,* (November 2004). SOW paragraph 3.2.1
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Financial Management Report provides data on accumulated costs and funding projections for management of the contract.

15.2 **APPLICABLE DOCUMENTS:**

NPR 9501.2D *NASA Contractor Financial Management Reporting*

15.3 **CONTENTS**: The elements of cost for financial reporting shall be mutually agreed by the contractor and NASA project office. The Financial Management Reports (533M and 533Q) shall be prepared in accordance with the detailed instructions provided on the reverse side of the NASA Forms 533M and 533Q and the supplementary instructions set forth in NPR 9501.2D, Chapter 3.

a. 533Q Quarterly Report shall include actual cost and cost projections at the total contract level. The initial 533Q report shall reflect the original contract value detailed by negotiated reporting categories and serve as the original baseline plan.
b. 533M Monthly Report shall include actual cost and cost projections at the total contract level.

A summary level page reflecting cumulative total contract cost since inception shall be included. Reconciliation between the 533M/533Q and the Cost Performance Report (CPR) or Modified Cost Performance Report (M/CPR) shall be submitted as an attachment to the 533M/533Q Report.

DRD Continuation Sheet

TITLE: Financial Management Report (533M and 533Q) **DRD NO.: 1145MA-008**
DATA TYPE: 3 **PAGE**: 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

15.4 **FORMAT**: Contractor internal automated printout reports may be substituted for 533M/533Q forms (with NASA Contracting Officer's approval) provided that the contractor report contains all of the data elements required by NASA Forms 533M and 533Q. Electronic submission of contractor data is strongly encouraged (reference NPR 9501.2, paragraph 3.7).

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-009**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Badged Employee and Remote IT User Listing
7. **DESCRIPTION/USE**: To assist NASA in conducting contractor floor checks and to determine if the employees meet the minimum background investigation requirements.
8. **OPR**: AS50 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter. One copy each shall go to MSFC's Protective Services Office and Facilities Planning and Business Management Office.
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Reference is made to Federal Acquisition Regulation (FAR) Clause, FAR 52.215-2, *Audit and Records--Negotiations* (June 1999), NPR 1600.1, *NASA Security Program Procedural Requirements*.
14. **INTERRELATIONSHIP**: SOW paragraph 3.1
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Badged Employee and Remote IT User Listing provides NASA with a list of all MSFC and MAF badged contractor employees, as well as, any contractor remote IT users who will have access to the MSFC or MAF IT systems.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Badged Employee and Remote IT User Listing shall include the following information for each employee: employee's full name (first and middle names must be birth names), last four digits of the Social Security Number (SSN), date of birth, place of birth, duty position, duty location (building/room number), shift assignment, and supervisor's name. Additionally, if applicable, the type of security background check already completed (NACLC or SSBI) and the date it was completed.

15.4 **FORMAT**: Contractor format using Excel Spreadsheet is acceptable.

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-010**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1

6. **TITLE**: Contractor Employee Clearance Document

7. **DESCRIPTION/USE**: To ensure that MSFC and MAF badged contractor employees who no longer require MSFC or MAF access properly clear all accounts when the access is no longer needed.

8. **OPR**: AS50 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraph 3.1

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Contractor Employee Clearance Document provides verification that all MSFC badged employees have properly cleared all accounts when the access is no longer needed.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Contractor Employee Clearance Document shall contain all the information required by MSFC Form 383-1.

15.4 **FORMAT**: MSFC Form 383-1, "Contractor Employee Clearance Document".

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-011**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/3

6. **TITLE**: Cost Performance Report

7. **DESCRIPTION/USE**: To provide information for: (1) integrating cost and schedule performance data with technical performance measures, (2) assessing the magnitude and impact of actual and potential problem areas causing significant cost and schedule variances, and (3) providing valid, timely project status information to higher management.

8. **OPR**: CS40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: The *Financial Management Reports* (DRD 1145MA-008) shall include a reconciliation between the 533M/533Q and the Cost Performance Report, which shall be submitted as an attachment to the 533M/533Q reports. The CPR reporting levels and frequency shall be in accordance with the Contract *Work Breakdown Structure* (DRD 1145MA-005) and contract provisions and shall be consistent with the CADRe requirements. SOW paragraph 3.2.1

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Cost Performance Report (CPR) includes data to measure cost and schedule performance.

15.2 **APPLICABLE DOCUMENTS**:

DI-MGMT-81466 *Data Item Description for Cost Performance Report* (available at:https://www.acq.osd.mil/pm/currentpolicy/cpr_cfsr/CPR%20Final%203-30-05.pdf)

15.3 **CONTENTS**: The Cost Performance Report shall include data pertaining to all authorized contract work, including both priced and unpriced effort, that has been authorized at a not-to-exceed amount in accordance with the Contracting Officer's direction. The CPR shall separate direct and indirect costs and identify elements of cost for all direct reporting elements. The CPR shall consist of:

a. Format 1, Work Breakdown Structure (WBS): Format 1 shall provide data to measure cost and schedule performance by summary level WBS elements, and the hardware, software, and services NASA is buying. Critical/major subcontractor summary level performance measurement data shall be included as an attachment to Format 1. Subcontractor Cost Performance Report (CPR) or Cost/Schedule Status Report (C/SSR) are acceptable.

b. Format 2, Organizational Categories: Format 2 provides the same data as Format 1, sorted by the contractor organization. If the contractor is organized by product, Format 2 is optional. Organizational category reporting shall be to the first level of the program's organizational structure.

DRD Continuation Sheet

TITLE: Cost Performance Report **DRD NO.:** 1145MA-011
DATA TYPE: 3 **PAGE:** 2/3

15. **DATA PREPARATION INFORMATION (CONTINUED):**

c. Format 3, Baseline: Format 3 provides the budget baseline plan against which performance is measured. It is the baseline report used to track all changes to the Performance Measurement Baseline (PMB). Format 3 shall contain baseline manpower forecasts for two 3-month periods (columns 10 and 11), two subsequent 12-month periods (columns 12 and 13), and the remainder of the contract for the last period (column 14).

d. Format 4, Staffing: Format 4 shall provide manpower staffing forecasts for correlation with the budget plan and cost estimates and contain the manpower baseline which shall be updated and submitted whenever the Performance Measurement Baseline changes. Organizational category reporting shall be to the first level of the program's organizational structure. Format 4 shall contain baseline and manpower forecasts for two 3-month periods (columns 10 and 11), two subsequent 12-month periods (columns 12 and 13), and the remainder of the contract for the last period (column 14).

e. Format 5, Explanations and Problem Analyses: Format 5 shall be a narrative report used to explain significant cost and schedule variances and other identified contract problems. Subcontractor variance analyses (determined by the prime contractor) and a discussion of the prime contractor's analysis of the subcontractor's performance shall be provided in Format 5. In the initial submission of the CPR (Format 5), the contractor shall rank, in descending order of criticality (i.e., the most critical elements will be at the top of the list and the least critical will be at the bottom), all reporting level WBS elements anticipated (as determined by the contractor project manager) to be schedule drivers, and all WBS elements (in a similar ranking) anticipated to be the cost drivers on the project. The contractor shall submit an updated list of the rankings every six months, based on performance to date. The Government reserves the right to modify this ranking based on Government perception of criticality. If the contractor uses "critical path" scheduling techniques, identification of the critical path by WBS element shall meet the schedule drivers' requirement. Ranking of the critical path cost drivers shall also be provided. These critical elements shall reconcile to the Master Schedule submitted to the Government.

f. Variance Analysis: The Variance Analysis shall be a narrative report addressing the following:

1. Reporting elements that equate to 50% of the list of the schedule drivers (i.e., if 20 schedule drivers are listed, the 10 most critical schedule driver variances over $100k shall be addressed). If there are 10 or less schedule driver variances, all variances over $100k shall be addressed.
2. Reporting elements that comprise the top 50% of the cost drivers (i.e., if 20 cost drivers are listed, the top 10 most critical cost driver variances over $100k). If there are 10 or less cost driver variances, all cost variances over $100k shall be addressed.
3. Impact to the contract Estimate-at-Complete (EAC) for all cost and schedule driver variances addressed.
4. Explanation for all variances at completion over $500k.
5. Corrective Action Plan, as applicable.

DRD Continuation Sheet

TITLE: Cost Performance Report **DRD NO.:** 1145MA-011

DATA TYPE: 3 **PAGE:** 3/3

15. **DATA PREPARATION INFORMATION (CONTINUED):**

15.4 **FORMAT**: CPR formats shall be completed according to the instructions outlined in DI-MGMT-81466 and the following forms: Format 1 (DD Form 2734/1); Format 2 (DD Form 2734/2); Format 3 (DD Form 2734/3); Format 4 (DD Form 2734/4); and Format 5 (DD Form 2734/5). Images of the CPR forms are located at: http://www.acq.osd.mil/pm/currentpolicy/cpr_cfsr/CPR%20Final%203-30-05.pdf. Contractor format shall be substituted for CPR formats whenever they contain all the required data elements at the specified reporting levels in a form suitable for NASA management use. The CPR shall be submitted electronically using the American National Standards Institute (ANSI) X12 standards (transaction sets 839) and followed up with a signed paper copy, or XML using WINST.DTD format (format can be found at http://www.c-si.com/support/). The WBS level of reporting must be approved by NASA prior to initial submit.

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-012**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1

6. **TITLE**: Position Risk Designation for Non-NASA Employee Form

7. **DESCRIPTION/USE**: To ensure that MSFC and MAF on-site contractor employees are screened to an appropriate risk determination in accordance with NPR 1600.1, *NASA Security Program Procedural Requirements*, Chapter 4.

8. **OPR**: AS50 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter. One copy shall go to MSFC Protective Services Office.

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraph 3.1

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Position Risk Designation for Non-NASA Employee Form provides information necessary to determine the type of investigation required and how closely an individual is screened for a position.

15.2 **APPLICABLE DOCUMENTS**:

NPR 1600.1 *NASA Security Program Procedural Requirements*

15.3 **CONTENTS**: The Position Risk Designation for Non-NASA Employee Form shall contain all the information required by NASA Form 1760 in accordance with NPR 1600.1, NASA Security Program Procedural Requirements.

15.4 **FORMAT**: NASA Form 1760, "Position Risk Designation for Non-NASA Employee".

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MA-013**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1

6. **TITLE**: Still Photographs, Video, and Motion Pictures

7. **DESCRIPTION/USE**: Provides NASA with the contractor's visual/audio, still and motion picture, and video coverage of significant contractor and NASA project events and milestones or used to support other activities such as management reviews public affairs, productions, and technical records made during development, assembly, fabrication, integration, and testing.

8. **OPR**: IS30 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: These submittals in the original recording media are independent of their use in preparing other contractual submittals.

14. **INTERRELATIONSHIP**: SOW paragraphs 5.3, 6.3, 7.3, 8.3, 9.3 and 12.5

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: These data shall provide complete visual coverage of all MSFC and contractor significant events.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The contractor shall provide photographic and video data documenting significant progress or milestones as well as of facilities or operations utilized in the design, fabrication, verification, hardware closeouts and data required to support program activities. Each data item submitted shall be distinctly identified and be accompanied by log sheets or similar records which fully describe the item, when produced.

15.4 **FORMAT**: Data formats shall be consistent with standard industry practices unless otherwise instructed by MSFC. Contractor log formats (or their equivalent) used to control and retrieve data shall be mutually agreed to by the contractor and MSFC. Data items produced for NASA release shall comply with agency production, identification, and logging requirement as furnished by MSFC.

15.5 **MAINTENANCE**: Information shall be kept current using standard industry or NASA practices. Submittal documents shall state if the data replaces, updates, or is in addition to data previously submitted for the documented event.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE:** RFP
2. **DRD NO.**: **1145MA-014**
3. **DATA TYPE**: 3
4. **DATE REVISED:**
5. **PAGE**: 1/2

6. **TITLE**: Subcontractor and Geographic Data Collection

7. **DESCRIPTION/USE**: To provide subcontractor and geographical economic impact data used to respond to NASA and Congressional requests.

8. **OPR**: JP30 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter (To include NASA HQ Office of Legislative Affairs)

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraph 3.2.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Prime Contractor, Subcontractor and Geographic Data Collection requirement provides geographical economic impact data for each fiscal year per the breakouts shown in Attachment A.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Prime Contractor, Subcontractor and Geographic Data Collection shall document geographical economic impact data provided in Attachment A.

15.4 **FORMATS**: Contractor format is acceptable in Microsoft Excel.

15.5 **MAINTENANCE**: None required

Attachment A

Award ID:

Prime Contractor Name: _____
Prime Contract Number: _____
Subcontract Number: _____

Dates (mm/dd/yy)
Date Signed _____
Completion Date _____

Amounts
Subcontractor Obligated Amt: $_____
Completed Award? _____

Subcontractor Information:
Name: _____
Doing Business As Name: _____
Street: _____
City: _____
Zip: _____
Country: _____
Phone: _____
DUNS No: _____

Congressional District: _____

Principal Place of Performance:
Street: _____
City: _____
State: _____
Nine-Digit Zip Code: _____
Country: _____

Product or Service Information
Product/Service: _____
NAICS Code: _____
Place of Manufacture: _____

Description of Requirements:

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MP-001**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Contamination Control Plan (CCP)

7. **DESCRIPTION/USE**: To define implementation measures to control contamination of flight hardware and fluid systems during manufacturing, assembly, test, transportation, launch site processing, and post-flight refurbishment.

8. **OPR**: EM03 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: DRDs 1145MP-002, *Materials and Processes Identification and Usage List (MIUL)*, 1145MP-003, *Manufacturing and Assembly Plan* 1145MP-004, *Materials and Processes Selection, Implementation, and Control Plan* and 1145MP-005, *Material Usage Agreements*. SOW paragraph 5.3, 6.3, 7.3, 8.3 and 13.2

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Contamination Control Plan shall be generated in accordance with the guidelines of JPG 5322.1, Contamination Control Requirements Manual (as specified by NASA-STD-6016) and shall include:

a. A FOD control plan to prevent damage to flight hardware and injury to the flight crew by foreign object debris (FOD) during manufacture, assembly, test, transportation, launch site processing, operation, repair, modification, refurbishment and maintenance. The FOD prevention program shall conform to NAS 412, Foreign Object Damage/ Foreign Object Debris (FOD) Prevention, as specified by NASA-STD-6016.

b. Definition of cleanliness level acceptance limits and verification methods for fluid systems, and for general flight hardware internal and external surfaces. The plan shall also contain a list identifying all system fluids, together with the fluid specifications (for procurement or custom mixing) and the required cleanliness levels for the fluid system.

15.2 **APPLICABLE DOCUMENTS**:

NASA-STD-6016	*Standard Manned Spacecraft Requirements for Materials and Processes*
JPG 5322.1	*Contamination Control Requirements Manual*
NAS 412	*Foreign Object Damage/ Foreign Object Debris (FOD) Prevention*

15.3 **CONTENTS**: The FOD Contamination Control Plan shall address the following elements:

a. Identification of probable FOD sources.
b. Early design considerations for FOD prevention, resistance to damage, foreign object entrapment, etc.
c. Manufacturing planning for minimizing FOD generation and cleaning up whatever FOD is generated.
d. FOD control methods.

DRD Continuation Sheet

TITLE: Contamination Control Plan (CCP) **DRD NO.:** **1145MP-001**

DATA TYPE: 1 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

e. FOD Awareness and Prevention Training.
f. Metrics - Measuring techniques for analysis, trending, and feedback.
g. Incident investigation/reporting, "lessons learned."
h. Awareness/Employee Feedback.

The contractor shall define cleanliness level acceptance limits and verification methods for fluid systems, and for general flight hardware internal and external surfaces. The contractor shall also provide a list identifying all system fluids, together with the fluid specifications (for procurement or custom mixing) and the required cleanliness levels for the fluid system.

15.4 **FORMAT**: Electronic and Word-compatible document or Adobe PDF.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MP-002**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Materials Identification and Usage List (MIUL)

7. **DESCRIPTION/USE**: To identify all Material and Processes (M&P) usages contained in the end item, excluding piece part electronics, for evaluation of the acceptability of M&P selected and utilized.

8. **OPR**: EM03 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: DRDs 1145CM-007, *Engineering Drawings and Associated Lists*, 1145MP-001, *Contamination ControlPlan (CCP)*, 1145MP-004, *Materials and Processes Selection, Implementation, and Control Plan* and 1145MP-005, *Material Usage Agreements*. SOW paragraphs 5.3, 6.3, 7.3, 8.3, 9.3 and 13.2.1

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: Materials Identification and Usage List (MIUL) identifies all M&P usages contained in the end item and shall be documented in an electronic searchable parts list or separate electronic searchable MIUL. The procedures and formats for documentation of materials and processes usage will depend upon specific hardware but shall cover the final design. The system used shall be an integral part of the engineering configuration control/release system. A copy of the stored data shall be provided to NASA in a form compatible with the Materials and Processes Technical Information System (MAPTIS).

15.2 **APPLICABLE DOCUMENTS**:

NASA-STD-6016	*Standard Manned Spacecraft Requirements for Materials and Processes*
MSFC-STD-3029	*Guidelines for Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments*
MSFC-SPEC-250	*Protective Finishes for Space Vehicle Structures and Associated Flight Equipment, General Specification for*
MAPTIS-II database	http://maptis.nasa.gov/ *Electronic Materials Selection list for Space Hardware Systems*
SP-R-022A	*General Specification, Vacuum Stability Requirements of Polymeric Materials for Spacecraft Operations*
NASA-STD-6001	*Flammability, Odor, Offgassing and Compatability Requirements and Test Procedures for Materials in Environments that Support Combustion*
MSFC-PROC-1301	*Guidelines for Implementation of Required Materials Control Procedures*

DRD Continuation Sheet

TITLE: Materials Identification and Usage List (MIUL) **DRD NO.**: **1145MP-002**

DATA TYPE: 1 **PAGE**: 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

15.3 **CONTENTS**: Development of the MIUL shall conform to the format described in NASA-STD-6016 which includes but is not limited to the following documents; MSFC-STD-3029, MSFC-SPEC-250, the MAPTIS-II database, SP-R-022A, NASA-STD-6001, and MSFC-PROC-1301.

a. Detail drawing and dash number.
b. Next assembly and dash number.
c. Change letter designation.
d. Drawing source (contractor or vendor).
e. Material form.
f. Material manufacturer.
g. Material manufacturer's designation.
h. Material specification.
i. Process specification.
j. Environment.
k. Weight.
l. Material code.
m. Standard/commercial part number.
n. Contractor.
o. System.
p. Subsystem.
q. Maximum temperature.
r. Minimum temperature.
s. Fluid type.
t. Surface Area.
u. Associate contractor number.
v. Project.
w. Document title.
x. Criticality.
y. Line number.
z. Overall evaluation.
aa. Overall Configuration test.
bb. Maximum pressure.
cc. Minimum pressure.
dd. Test MUA Document.
ee. Cure codes.

15.4 **FORMAT**: Contractor format is acceptable. However, contractor format for electronic submittal of MIUL data shall be compatible with the NASA Materials and Processes Technical Information System (MAPTIS) database.

15.5 **MAINTENANCE**: Contractor updates to the MIUL shall be submitted to NASA for approval. Complete re-issue of the document is not required.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MP-003**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Manufacturing and Assembly Plan

7. **DESCRIPTION/USE**: To establish the requirements for the Manufacturing and Assembly Plan so that the program can scope the entire magnitude of the task to be accomplished and provide technically sound, efficient, and cost effective plan of action to ensure projected schedules can be maintained. The plan shall define the make-or-buy process, including objectives, criteria, management, logic, and results.

8. **OPR**: EM03 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: DRDs 1145CM-007, *Engineering Drawings and Associated Lists*, 1145MP-001, *Contamination Control Plan (CCP)* and 1145MP-004, *Materials and Processes Selection, Implementation, and Control Plan*. SOW paragraphs 4.5.4, 5.3, 6.3, 7.3, 8.3, 9.3 and 13.2

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Manufacturing and Assembly Plan is applicable to hardware developer(s), subcontractor(s), and vendor(s).

15.2 **APPLICABLE DOCUMENTS**:

MSFC-STD-506 *Standard, Materials and Processes Control*

15.3 **CONTENTS**: This plan shall define the objective, methods and procedures to be used in the manufacture and assembly of the deliverable hardware. Specifically the plan shall contain:

a. Organization - A description of the manufacturing and assembly organizations and policies, as well as the organizational relationships between these and the other key organizations supporting the deliverable hardware manufacturing effort.

b. Systems and Controls - The systems and controls to be used by the fabrication and assembly organization for procurements, inspection and testing, nonconformance reporting, material control, configuration control, manufacturing and assembly documentation shall be defined.

   1. Procurements - Major components and assemblies to be procured rather than manufactured and/or assembled in-house, long lead time procurements, and risks associated with sole or proprietary sources shall be identified.
   2. Inspection and Test - Requirements for inspection and test stations, as well as procedures shall be provided for each control point in the manufacturing and assembly sequence.

c. Producibility Plan - The plan shall define the producibility analysis process to be used in the development of deliverable hardware. Flight hardware design documentation shall be reviewed to assure the ability to fabricate, inspect, and assemble hardware as depicted by the engineering design drawings.

DRD Continuation Sheet

TITLE: Manufacturing and Assembly Plan **DRD NO.:** **1145MP-003**
DATA TYPE: 1 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

d. Manufacturing and Assembly Flow - The methods, procedures, and operations of control points used to plan, manufacture, and monitor the fabrication and assembly of the deliverable hardware shall be defined.

1. Critical Processes - All processes, methods, facilities, tooling, or skills critical to success or where quality cannot be ensured by inspection of articles alone shall be identified. These processes include, but are not limited to, metallurgical, and chemical processes, metal joining processes, bonding processes, plastics, TPS application, plating and coating processes and surface treating processes. In addition, processes such as radiography, ultrasonics, liquid penetrant, and magnetic particle, shall be controlled to ensure that the results indicate the article or material quality levels. **NOTE**: NASA concurrence will be required on all processes designated as critical.
2. The Manufacturing and Assembly Plan shall include as a minimum for critical processes:
   (a) Process Controls:
      (1) Applicable processing requirements with detailed performance and control provisions
      (2) Process preparation requirements.
      (3) Detailed processing operations
      (4) Conditions to be maintained during each phase of the process including environmental controls.
      (5) Methods for verifying the adequacy of the processing materials, solutions, equipment, environments, and their associated control parameters.
      (6) Required records for documenting the results of the process inspection, test, and verification.
   (b) Equipment Certifications:
      (1) Records certifying that tests have been performed and how the results of such tests shall be maintained.
      (2) Plans for recertifying equipment as required by quality surveys, inspections, or tests, or when changes are made which may affect process integrity.
   (c) Tooling - A listing and planned usage of tooling and support equipment required to fabricate and assemble deliverable hardware shall be described.
   (d) Assembly Sequence - A time correlated sequence of operations necessary to assemble the hardware, including assembly requirements, constraints, and operations to be performed shall be described.
   (e) Schedules - The detailed development and maintenance of manufacturing and assembly schedules showing milestones and completion dates necessary to ensure that deliverable end items shall be met.
   (f) Capabilities and Facilities - The facilities and capabilities required for fabrication, manufacturing, and assembly shall be described.
   (g) Major Subsystems - The major subsystems of deliverable hardware to be manufactured and assembled by the fabrication organization shall be identified.

15.4 **FORMAT**: Contractor format is acceptable and shall be consistent with contents of paragraph 15.3 of this DRD.

15.5 **MAINTENANCE**: Changes shall be incorporated by change by change page or complete reissue and the process controls shall be maintained as required to keep the information current.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MP-004**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Materials and Processes Selection, Implementation, and Control Plan

7. **DESCRIPTION/USE**: To document the degree of conformance and method of implementation for each requirement in this standard, identifying applicable in-house specifications used to comply with the requirement. It shall also describe the methods used to control compliance with these requirements by subcontractors and vendors. The Materials and Processes Selection, Control, and Implementation Plan, upon approval by the procuring activity shall become the Materials and Processes implementation document used for verification.

8. **OPR**: EM03 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: DRDs 1145MP-001, *Contamination Control Plan (CCP)*, 1145MP-002, *Materials and Processes Identification and Usage List (MIUL)*, 1145MP-003, *Manufacturing and Assembly Plan* 1145MP-005, *Material Usage Agreements* and 1145MP-006, *Nondestructive Test (NDT) Plan*. SOW paragraphs 5.3, 6.3, 7.3, 8.3, 9.3 and 13.2

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Materials and Processes Selection, Control, and Implementation Plan shall describe the hardware developer's activities involved in the identification, evaluation, documentation, and reporting of materials and processes usage in space flight hardware, support hardware and ground support equipment.

15.2 **APPLICABLE DOCUMENTS**:

NASA-STD-6016 *Standard Manned Spacecraft Requirements for Materials and Processes*

15.3 **CONTENTS**: The Materials and Processes Selection, Implementation, and Control Plan necessary interfaces with procuring activity in the operation of this plan shall be defined. The method for materials control and verification of subcontractors and vendors shall be included in the hardware developer's plan. As a minimum and as applicable, the plan shall address the following:

a. Conformance - The Plan shall address each applicable paragraph of NASA-STD-6016 and describe the method of implementation and degree of conformance for each applicable requirement. If tailoring of the requirements is planned or necessary, alternate approaches to NASA-STD-6016 may be submitted in this plan, which meet or exceed the stated requirements. This tailoring approach will allow for NASA approval of alternate requirements.

b. Hardware Developer's Organization - Authority shall be assigned to an individual or group who shall be responsible for review and approval of all M&P specified prior to release of engineering documentation.

c. Materials and Processes Identification - Identification and documentation of the M&P used, both in the original design and in any changes shall be contained in 1145 MP-MIUL, *Material and Process Identification and Usage List.*

d. Testing - Logic, procedures and data documentation for any proposed test program to support materials screening and verification testing. Any material process testing to be performed by the hardware developer shall require prior NASA approval.

DRD Continuation Sheet

TITLE: Materials and Processes Selection, Implementation, and Control Plan DRD NO.: **1145MP-004**

DATA TYPE: 1 PAGE: 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

e. Materials Usage Agreement (MUA) Procedures - Logic, procedures and documentation involved in documenting and approving materials/processes as indicated in NASA-STD-6016 shall be defined, including those that do not meet the established requirements, but are proposed for use due to lack of replacement materials/processes or other considerations and shall be contained in 1145 MP-MUA, *Materials Usage Agreement.*

f. Material Design Properties – The plan shall contain the philosophy describing how material properties will be determined, and if those properties do not exist, how the material properties will be developed including, but not limited to the statistical approaches to be employed.

g. Process Controls – The plan shall identify all process specifications used to implement specific requirements in NASA-STD-6016. All materials processes used in manufacturing shall be documented in process specifications and all applicable process specifications shall be identified on the engineering drawing. Each processing step in the process specification shall be identified in a level of detail that ensures the process is repeatable.

15.4 **FORMAT**: Electronic, Word-compatible document or Adobe PDF. For each paragraph in sections 4 and 5 of NASA-STD-6016, the plan shall state the requirement from NASA-STD-6016, identify the degree of conformance under the subheading "Degree of Conformance," and identify the method of implementation under the subheading "Method of Implementation."

15.5 **MAINTENANCE**: Contractor-proposed changes to document shall be submitted to NASA for approval. Complete re-issue of the document is required.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.: 1145** **ISSUE**: RFP 2. **DRD NO.: 1145MP-005**
3. **DATA TYPE**: 1 (Category I and II MUAs) 4. **DATE REVISED**:
2 (Category III MUAs) 5. **PAGE**: 1/2

6. **TITLE**: Materials Usage Agreements (MUAs)

7. **DESCRIPTION/USE**: MUAs shall be submitted for all materials and processes that are technically acceptable but do not meet the technical requirements of NASA-STD-6016, as implemented by the approved Materials and Processes Selection, Control, and Implementation Plan. [The use of materials and processes that do not comply with the technical requirements of this standard may be technically acceptable if hardware reliability and vehicle safety are not affected.]

8. **OPR**: EM03 9. **DM:** JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:
14. **INTERRELATIONSHIP**: DRDs 1145MP-001, *Contamination Control Plan* (CCP), 1145MP-002, *Materials and Processes Identification and Usage List* (MIUL), 1145MP-003, *Manufacturing and Assembly Plan*, 1145MP-004, *Materials and Processes Selection, Implemetation, and Control Plan* (MPCP) *and* 1145MP-006, *Nondestructive Evaluation (NDE) Plan*. SOW paragraphs 5.3, 6.3, 7.3, 8.3, 9.3 and 13.2.1

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: MUAs will be submitted as described below.

a. Category I MUAs - Category I MUAs are those that involve material/processes usage that could affect the safety of the mission, crew, or vehicle or affect the mission success, but must be used for functional reasons. Approval by the responsible NASA Materials and Processes organization and the NASA Program/Project Office shall be required.

b. Category II MUAs - Category II MUAs are those that involve material/processes usage that fails a screening of Material and Processes requirements and is not considered a hazard in its use application but for which no Category III rationale code exists. Approval by the responsible NASA Materials and Processes organization shall be required.

c. Category III MUAs - Category III MUAs are those that involve materials or processes that have not been shown to meet these requirements but have an approved rationale code listed in Appendix D of NASA-STD-6016. They are evaluated and determined to be acceptable at the configuration/part level. Category III MUAs shall be reported in the Materials Identification and Usage List (MIUL) system or electronic data system utilizing the approved rationale codes in Appendix C. A key may be provided to correlate contractor Category III MUA database codes to the codes in Appendix C. No MUA form is submitted. [Category III MUAs are identified here for completeness, but are not required until after PDR.]

DRD Continuation Sheet

TITLE: Material Usage Agreements (MUAs) **DRD NO.:** **1145MP-005**
DATA TYPE: 1 **PAGE:** 2/4

15. **DATA PREPARATION INFORMATION (CONTINUED):**

15.2 **APPLICABLE DOCUMENTS:**

NASA-STD-6016	*Standard Manned Spacecraft Requirements for Materials and Processes*
MSFC-STD-3029	*Guidelines for Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments*
MSFC-SPEC-250	*Protective Finishes for Space Vehicle Structures and Associated Flight Equipment, General Specification for*
MAPTIS-II database	http://maptis.nasa.gov/ Electronic Materials Selection list for Space Hardware Systems
ASTM E595	*Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment*
NASA-STD-6001	*Flammability, Odor, Offgassing and Compatability Requirements and Test Procedures for Materials in Environments that Support Combustion*
MSFC-PROC-1301	*Guidelines for Implementation of Required Materials ControlProcedures*

15.3 **CONTENTS**: The MUA package shall include all technical information required to justify the application. MUAs for stress corrosion shall include a Stress Corrosion Cracking Evaluation Form per MSFC-STD-3029 and a stress analysis. MUA shall follow guidelines set forth in NASA-STD-6016, which includes but is not limited to the following documents; MSFC-SPEC-250, the MAPTIS-II database, ASTM E595, NASA-STD-6001, and MSFC-PROC-1301.

15.4 **FORMAT:** MUA's shall be submitted electronically. A sample MUA form is provided in NASA-STD-6016; however, Contractor format is acceptable. The complete MUA package shall be provided in Adobe PDF format; the MUA form shall also be provided in a format that is compatible with the NASA Materials and Processes Technical Information System (MAPTIS) database.

15.5 **MAINTENANCE**: Contractor updates to the Category I and Category II MUAs shall be submitted to NASA for approval. Complete re-issue of the MUA is required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145MP-006**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/3

6. **TITLE**: Nondestructive Test (NDT) Plan

7. **DESCRIPTION/USE**: To identify all NDT and Nondestructive Evaluation (NDE) procedures and specifications employed in the inspection of materials.

8. **OPR**: EM03 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to JSC 62809, *NASA Human Rated Spacecraft Pyrotechnic Specification.*

14. **INTERRELATIONSHIP**: DRDs 1145CM-007, *Engineering Drawings and Associated Lists*, 1145DE-005, *Fracture Control Plan*, 1145MP-001, *Contamination Control Plan (CCP)*, 1145MP-003, *Manufacturing and Assembly Plan*, 1145MP-004, *Materials and Processes Selection, Implementation, and Control Plan* and 1145MP-005, *Material Usage Agreements*. SOW paragraphs 5.3, 6.3, 7.3, 8.3, 9.3 and 13.2

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The NDT Plan describes the NDT/NDE analysis, requirements and reporting system proposed for use.

15.2 **APPLICABLE DOCUMENTS**:

MSFC-STD-506	*Standard, Materials and Processes Control*
MIL-I-6870	*Inspection Program Requirements, Nondestructive for Aircraft and Missile Materials and Parts*
MIL-STD-410	*Nondestructive Testing Personnel Qualification and Certification*
MIL-STD-6866	*Inspection, Liquid Penetrant*
MIL-STD-1949	*Inspection, Magnetic Particle*
MIL-STD-0453	*Inspection, Radiographic*
MIL-STD-2154	*Inspection, Ultrasonic, Wrought Metals, Process for*
MSFC-STD-1249	*Standard, NDE Guidelines and Requirements for Fracture Control Programs*
ASTM E1001	*Standard Practice for Detection and Evaluation of Discontinuities by the Immersed Pulse-Echo Ultrasonic Method Using Longitudinal Waves*
ASTM E426	*Standard Practice for Electromagnetic (Eddy - Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys*
ASTM E164	*Standard Practice for Ultrasonic Contact Examination of Weldments*

DRD Continuation Sheet

TITLE: Nondestructive Test (NDT) Plan **DRD NO.: 1145MP-006**

DATA TYPE: 1 **PAGE**: 2/3

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

15.3 **CONTENTS**: A Nondestructive Test (NDT) Plan shall be submitted in accordance with MIL-I-6870 describing the process for establishment, implementation, execution and control of NDT inspections. The NDT Plan shall implement the requirements of MSFC-STD-1249, MSFC-STD-506 and the applicable program Fracture Control Plan. The plan shall define NDT planning and requirements to include the following:

a. Design Requirements - The NDT plan shall include a well defined and disciplined system to assure all designs are reviewed to establish appropriate NDT inspection requirements and acceptance criteria.
   1. The design and design review process shall be the responsibility of the Product Development Team (PDT) which has a multifunctional representation including Engineering, Manufacturing, Materials, Quality Assurance, and NDT as a minimum.
   2. Designs not utilizing PDT's, shall be coordinated with the Engineering Manufacturing, Materials, Quality Assurance and NDT representatives during design and at design completion.
   3. Final design approval by all reviewing organizations shall be accomplished to signify agreement with the specified engineering, manufacturing, materials, processing, NDT, and quality requirements and that the part is producible and inspectable or is subject to process controls.
   4. Establishment of NDT requirements shall consider NDT inspectability, capability and reliability; materials and processes; manufacturing and inspection history for similar processes; prior or similar service history; material, process or part criticality; design analysis and critical initial flaw size(s) (CIFS).
   5. NDT Inspection requirements to be considered shall include but not be limited to fluorescent penetrant, magnetic particle, and eddy current for surface oriented flaw detection. Other methods such as X-Ray for hidden surfaces or ultrasonic inspection, etc. may be appropriate for some design configurations. Where subsurface inspections are required, X-Ray or Ultrasonic inspections shall be utilized. Other methods may be used, if appropriate, and if demonstrated to reliably detect CIFS.
   6. NDT inspections shall be required to verify integrity of material and processes, as appropriate.
   7. NDT requirements shall assure products meet the design intent with special attention to Fracture Critical Parts and associated NDT reliability demonstration requirements and safety of flight considerations.

b. NDT Requirements Implementation - Coordination with the appropriate manufacturing and quality assurance organization shall be done to assure the development and/or acquisition of needed inspection technology and resources to meet the specified design and quality assurance requirements.
   1. NDT Inspection requirements and sequencing shall give consideration to the specific manufacturing processes with emphasis on optimizing inspection reliability and early flaw detection before unnecessary processing costs are incurred and/or performing processes which may significantly reduce flaw detection capability.
   2. Etch before Fluorescent Penetrant Inspection (FPI) shall be required when metal will be smeared by machining process and the smearing will adversely compromise the purpose of the inspection.
   3. Etch-FPI may be considered in either a semi-machined or finished machined configuration as appropriate for the specific materials and processes involved.

DRD Continuation Sheet

TITLE: Nondestructive Test (NDT) Plan **DRD NO.:** **1145MP-006**

DATA TYPE: 1 **PAGE:** 3/3

15. **DATA PREPARATION INFORMATION (CONTINUED):**

c. NDT Certification - Flaw detection NDT Inspections for FPI, Magnetic Particle Inspection (MPI), Eddy Current Inspection (ECI), X-Ray and Ultrasonic (UT) (as a minimum) shall require formal training and certification using MIL-STD-410 as a guideline. Training and certification requirements for other methods shall be established.

d. NDT Reliability Requirements for Fracture Critical Parts - NDT inspections for surface crack or crack like defects on parts designated as Fracture Critical shall reliably detect the design specified Critical Initial Flaw (CIF) size with 90% probability of detection (POD) and 95% lower confidence bound (LCB).

1. NDT methods applied for CIF sizes equal or greater than those specified in MSFC-STD-1249 have been reliably demonstrated within industry. Demonstration of reliability shall be required when the inspection method adversely differs from standard industry and government practices described in the referenced specifications.
2. Application of NDT methods for detection of cracks or crack like flaws smaller than those defined in MSFC-STD-1249 shall require a reliability demonstration. Such NDT methods are referred to as "Special NDT".
3. NDT Reliability demonstration requirements shall be satisfied using prior NDT reliability demonstrations where the NDT methods, systems and applications are deemed similar.

e. NDT Inspection Specifications and Standards - NDT Inspection specifications and acceptance standards shall be prepared in accordance with NASA practices. NDT Inspection Specifications shall provide inspection capabilities and reliabilities comparable to the following referenced Military Standards, MSFC Standards, or Industry Specifications: MIL-I-6870, MIL-STD-410, MIL-STD-6866, MIL-STD-1949, MIL-STD-0453, MIL-STD-2154, MSFC-STD-1249, ASTM E1001, ASTM E426, and ASTM E164.

f. Reporting System Description- The plan shall describe the NDT/NDE requirements and reporting system used and shall provide a comprehensive description of all NDT/NDE activities, in accordance with the requirements of MIL-I-6870, MSFC-STD-1249 and MSFC-STD-506. The plan shall include, but not be limited to, the following:

1. Means of coordinating design requirements such as critical crack size and NDT capabilities.
2. Means of implementing NDT specifications and procedures, including personnel and facilities certification.
3. Means of coordinating NDT procedures and specifications with NASA.
4. Description of the implementation of automation of NDT.
5. Reporting of and actions taken in regards to NDT results.
6. Means of developing accept/reject criteria.

15.4 **FORMAT**: Contractor format is acceptable and shall be consistent with contents of 15.3 of this DRD.

15.4 **MAINTENANCE**: Shall be revised to maintain current. Changes shall be incorporated by change by change page or complete reissue, with changes denoted by a bar.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145OP-001**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Post Flight Reports and Data
7. **DESCRIPTION/USE**: To document engineering results of the mission.
8. **OPR**: JP30 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**:
14. **INTERRELATIONSHIP**: SOW paragraph 12.5
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Post Flight Reports and Data provide post flight information relative to Upper Stage performance, mission success, problems encountered, and recommendations for improvement.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Post Flight Reports and Data shall include information for determination of improvements to and reduction of problems for future flights for integration and re-flight. The report shall include the following:

a. Brief description of the success of operation and the degree to which expected results were achieved.
b. Description of any problems encountered with accommodations, resources, or interfaces provided with regard to the flight.
c. Any recommendations for improving accommodations, resources, or interfaces.
d. Any other information deemed appropriate.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145OP-002**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1

6. **TITLE**: Operations and Maintenance Manuals

7. **DESCRIPTION/USE**: To provide operation and maintenance instructions for deliverable flight hardware and ground support equipment (GSE).

8. **OPR**: JP30/ED03 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraphs 4.8.1, 5.2, 6.2, 7.2, 8.2, 9.2, 12.2 and 12.5

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Operations and Maintenance Manuals define operating and maintenance instructions for flight hardware and associated GSE, including detailed operating procedures and any preventive and corrective maintenance procedures which may be required effectively operate and maintain the system.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Operations and Maintenance Manuals shall contain:

a. Hardware description.
b. Detailed operation procedures for each item.
c. Periodic and preventive maintenance requirements and procedures.
d. Troubleshooting instructions and associated schematics.
e. Identification of required tool and equipment.
f. Storage, handling, and transportation constraints.
g. Identification of hazards and associated safety precautions.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145QE-001**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Quality Plan

7. **DESCRIPTION/USE**: To define the contractor's planned methods for accomplishing the applicable tasks required to satisfy the quality requirements of NPD 8730.5, and the Quality Assurance requirements of CxP 70059, for the specific Flight and/or Flight associated hardware being procured.

8. **OPR**: QD10 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to CxP 70055, *Constellation Safety, Reliability and Quality Assurance Plan.*

14. **INTERRELATIONSHIP**: SOW paragraph 4.5.4

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Quality Plan shall identify, as applicable, the specific quality activities (implementation) related to the design and development, procurement of materials/subcomponents, fabrication, test, shipping, flight operations, refurbishment, and reuse to assure the quality of the items delivered. The plan shall reference the contractor's quality manual and procedures as necessary to fully describe the contractor's quality system. The Quality Plan shall reflect that the Contractor shall support the NDT Quality Engineering activity. In addition, the Contractor's quality system shall assure that all processes are capable of delivering products that meet design specifications through the right mix of process design and integrated process controls including process characterization, such as Cp and Cpk best practices, process monitoring, process improvements and process sampling.

15.2 **APPLICABLE DOCUMENTS**:

ANSI/ISO/ASQ Q9001-2000	*American National Standard Quality Management Systems Requirements*
ISO/IEC 17025	*General Requirements for the Competence of Testing and Calibration Laboratories*
SAE AS9100	*Quality Systems Aerospace - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing*
SAE AS9003	*Inspection and Test Quality System*
NPD 8730.5	*NASA Quality Assurance Program Policy*
CxP 70059	Constellation Program Safety, Reliability and Quality Assurance Requirements

15.3 **CONTENTS**: Each quality element of SAE AS9100, Revision B, and as applicable the NASA Quality Assurance requirements per CxP 70059, or as applicable either ANSI/ISO/ASQ Q9001-2000 or SAE AS9003, shall be addressed to describe the philosophy and approach for implementation. This can be satisfied by contractor's existing quality manual and procedures. A copy of the Quality System Manual and 1st tier procedures shall be submitted with any required quality plan.

DRD Continuation Sheet

TITLE: Quality Plan DRD NO.: 1145QE-001
DATA TYPE: 1 PAGE: 2/2

15. DATA PREPARATION INFORMATION (CONTINUED):

As a minimum, the subparagraphs below shall be addressed by the present documented quality management system or subsequent submittal of a quality plan to include details of responsibilities and controls to adequately describe the specific quality assurance activities related to hardware being procured by MSFC:

a. Customer quality requirements - include hardware specific quality requirements imposed by contract or component/equipment specification (i.e., traceability requirements, specific inspection points, specific quality activities including Government surveillance and inspection processing).

b. Responsibilities - describe which contractor organizations will be responsible to perform the applicable quality management system activities.

c. Article, Material, and Service Controls - describe the level of article, material, and service control including traceability requirements invoked by the contractor for the articles, materials, and/or services used in or performed as part of the hardware design and maintenance criteria, including how quality is assured for each material, part, assembly, and/or service performed.

d. Procurement - include the procurement quality requirements for all materials/parts/components the contractor purchases and the level of control exercised over the suppliers including how suppliers are approved, monitored, and maintained with controls for supplier nonconformances processing.

e. Milestone Reviews - describe how the contractor's quality system will support milestone reviews.

f. Configuration Assurance - describe how the configuration of the hardware build is compared and verified to the approved design baseline drawings and specifications. Describe how the configuration of Government Furnished Property/Equipment is maintained.

g. Special Process Controls - describe special process controls implemented for in-house processes and, if applicable, for sub-tier supplier processes.

h. Inspection and Test (describe who will be responsible to perform inspections to include any restrictions) - include: how the quality of purchased items is validated at receiving inspection or at sub-tier suppliers facilities, specific in-process (manufacturing) inspections performed, details of final inspection, functional and environmental test monitoring details, and pre-ship inspections. When applicable, provisions shall be included for development of site quality plans for major end item test and flight test.

i. Nonconforming Product (Material Review Board Process) - describe the process of convening a nonconforming product material review board to disposition nonconforming product using a defined board of qualified personnel including contractor quality assurance personnel and customer representatives. MRB limitations within the Statement of Work (SOW) and membership qualification shall be defined. An MRB membership listing shall be submitted within the quality plan or by contract letter.

j. Flight Operations, Refurbishment, and Reuse - when applicable, describe how the contractor's quality assurance system is implemented for flight operations, refurbishment and reuse.

k. Record retention - for those records not delivered to MSFC, specify which records are required to be kept, who keeps them, for how long, and how they are to be dispositioned at the end of the retention period, and/or as specified in the contract.

15.4 FORMAT: Contractor format is acceptable.

15.5 MAINTENANCE: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145QE-002**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/1

6. **TITLE**: Software Assurance Plan

7. **DESCRIPTION/USE**: To document the activities associated with the software assurance disciplines.

8. **OPR**: QD40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to NPR 7150.2, *NASA Software Engineering Requirements.*

14. **INTERRELATIONSHIP**: DRDs 1145RM-001, Reliability and Maintainability Program Plan, 1145SA-003, Systems Safety Plan, and 1145SW-001, Software Requirements Specification. SOW paragraph 4.5.5

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Software Assurance Plan covers activities associated with software quality, reliability, safety, verification and validation and independent verification and validation.

15.2 **APPLICABLE DOCUMENTS**:

NASA-STD-8739.8	*NASA Software Assurance Standard*
NASA -STD-8719.13	*NASA Software Safety Standard*
IEEE 730	*IEEE Standard for Software Quality Assurance Plans*

15.3 **CONTENTS**: In accordance with NASA-STD-8739.8, the Software Assurance Plan shall include:

a. Software Assurance Organization.
b. Software Quality Assurance Activities per IEEE 730.
c. Software Safety Activities per NASA-STD-8719.13.
d. Software Reliability Activities.
e. Software Verification and Validation Activities.
f. Software Independent Verification and Validation Activities.
g. Documentation.
h. Problem Reporting and Corrective Action.
i. Risk Management.
j. Software Assurance Program Metrics.
k. Software Assurance Records.
l. Training.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue. Update as required, to maintain current with program changes.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145QE-003**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2
6. **TITLE**: Certification Approval Request
7. **DESCRIPTION/USE**: The Certification Approval Request is used to request NASA approval of all certification tests and analysis and their supporting documentation for purposes of completing certification activities for a component/subsystem/system
8. **OPR**: JP30 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: The identification of items to be certified will be based upon risk analysis assessment. The certification will take place in accordance with the certification program outlined in the USO-CLV-SE-25703, *Upper Stage Verification and Validation Plan.* Reference is made to USO-CLV-SE-25710, *Upper Stage ERD.*
14. **INTERRELATIONSHIP**: DRDs 1145VR-001, *Master Verification and Validation Plan (MVP)*, 1145VR-003, *Verification/Validation Reports*, 1145VR-005, *Verification/Validation Procedures*, 1145VR-006, *Verification/Validation Success Criteria*, 1145VR-007, *Test Plan* and 1145VR-008, *Test Procedures.* SOW paragraph 4.5
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Certification Approval Request shall provide the documented results of successful completion of the certification activity with respect to satisfying the applicable requirement(s) from component through subsystem level, as determined by risk analysis assessment. Delta CARs shall be submitted, as required, in accordance with the Re-Certification requirements contained in Upper Stage Verification and Validation Plan. The CAR shall provide evidence that the following activities have taken place:

1. Test procedure was in compliance.
2. Constraints noted are removed.
3. Any failures corrected or dispositioned.
4. Test/analysis data satisfies requirements.
5. Test witnessing was as required.
6. Traceability back to the requirement and/or certification success criteria.
7. Test/analysis report is acceptable and attached.

15.2 **APPLICABLE DOCUMENTS**:

DRD Continuation Sheet

TITLE: Certification Approval Request **DRD NO.: 1145QE-003**

DATA TYPE: 1 **PAGE**: 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

15.3 **CONTENTS**: The Certification Approval Request shall be prepared in accordance with Upper Stage Verification Plan and contain the following:

a. Certification requirement number.
b. Part number and name.
c. Supplier part number.
d. Subsystem.
f. Test agency and location.
g. Test start and completion dates.
h. Test plans and procedures with number and date.
i. Verification/Validation Reports. Test/analysis reports number and date. Each report shall contain:
    1. Conclusions and recommendations relative to success of the certification activity.
    2. Description of deviations from nominal results, failures, approved corrective actions and procedures, and retest.
    3. Identification of test configurations and any differences from the flight configuration.
    4. Specific results of each procedure including automated test segments, each analysis, or other certification activity.
    5. Performance data, plots, and pictures (as appropriate).
    6. Clear description of how many flights or cycles the component/subsystem/element/system that Certification Approval is being sought for.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145QE-004**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Certificate of Qualification (COQ)
7. **DESCRIPTION/USE**: To provide a uniform method for design qualification and certification of components and subsystems of a spacecraft system or payload or other experiments.
8. **OPR**: QD40 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: The identification of items to be certified shall be based upon risk analysis assessment using processes such as FMEA/CIL analysis, Hazards analysis and/or engineering analysis. An effective implementation of COQ processes and its documentation would help ensure that the design is qualified to meet the system and mission requirements.
14. **INTERRELATIONSHIP**: SOW paragraph 4.5.4
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The COQ document and the accompanying verification data is the information used by MSFC to accept a given design as qualified to meet end item and various subsystem requirements (environmental, performance, and design parameters) and its supporting documentation. Design Qualification and Certification documentation includes all documents detailing testing, engineering analysis, and/or similarity analysis or all of these together to qualify a complex system.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The COQ consists of the Certificate of Qualification which contains the Configuration Item (CI) nomenclature, part number, and specification number and an index of all the verification data and other data applicable to the certificate. The Certificate shall be signed by the developing contractor/organization's Program/Project Manager and the Chief Engineer or Head of Systems Engineering and the Quality Organization. MSFC corresponding organizations shall sign as accepting the certificate and supporting data as valid and in conformance with contract requirements. Supporting documentation referenced in the COQ shall provide objective evidence that the subject component/subsystem has met all specified certification requirements. The COQ shall meet design qualification requirements per NASA and program specific system and mission requirements.

15.4 **FORMAT:** The contractor shall use MSFC Form 511 for the format of COQs or equivalent.

15.5 **MAINTENANCE**: COQs and supporting documents shall be updated and maintained current as required by design and manufacturing changes for the life of the program.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145QE-005**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Software Quality Assurance (SQA) Audit Report

7. **DESCRIPTION/USE**: Document the findings and results of software process and product audits performed by the Software Assurance organization.

8. **OPR**: QD40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: DRDs 1145SW-001, Software Requirements Specification, 1145SW-005, Software Test Plan, 1145SW-004, Software Design Description. SOW paragraph 4.5.5

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: Product and process audits performed throughout the software development lifecycle shall be documented and submitted via audit report.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Software Quality Assurance (SQA) Audit Report shall include:

a. Date performed.
b. Description of audit.
c. Evaluation/audit criteria.
d. Findings, including detected problems, with reference to software problem report(s) as appropriate.
e. Recommended corrective action.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: As required to correct errors and to maintain findings closure status.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145QE-006**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Equipment Log Book
7. **DESCRIPTION/USE**: To document the activities and operations performed on selected deliverable hardware when specified by drawing or contract.
8. **OPR**: QD40 9. **DM**: JP30
10. **DISTRIBUTION**: The Equipment Log Books shall be delivered and remain with the equipment.
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**:
14. **INTERRELATIONSHIP**: SOW paragraph 4.5.4
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Equipment Log Books document the activities and operations performed on deliverable hardware.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The log book(s) shall contain the information identified in MSFC Form 3473.

15.4 **FORMAT**: Use MSFC Form 3473 or equivalent with MSFC approval.

15.5 **MAINTENANCE**: The log book shall be maintained as required to keep the information current during the contract.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145RM-001**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/4

6. **TITLE**: Reliability and Maintainability (R&M) Program Plan

7. **DESCRIPTION/USE**: Reliability and Maintainability Program Plan identifies all R&M tasks and activities (processes, tools and technologies) planned by the contractor throughout the project life cycle, identify processes for verification/demonstration of key R&M parameters through analysis, testing and/or similarity, and planned controls. The plan addresses maintenance and updates to R&M analyses during the sustaining engineering phase of the contract.

8. **OPR**: QD40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Initial submittal of the document shall be submitted as one package; however, the Government may approve the reliability and maintainability plans.

14. **INTERRELATIONSHIP**: DRDs 1145QE-001, *Quality Plan*, 1145RM-002, *Failure Modes and Effects Analysis and Critical Items List*; 1145RM-003, *Problem Reporting and Corrective Action*; 1145RM-004, *Limited Life Items List*; 1145RM-006, *MSFC ALERT System Documentation* and 1145SA-003, *Systems Safety Plan*. SOW paragraph 4.5.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Reliability and Maintainability Plan contain the information to provide the visibility of how the contractor shall ensure compliance with specified reliability and maintainability program requirements. Reliability and Maintainability Plans define and list the roadmap for all the related processes, tools, models, assumptions, groundrules, and targeted and actual goals achieved through a robust spiral development process.

15.2 **APPLICABLE DOCUMENTS**:

NASA-STD-8729.1	*Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program*
MIL-HDBK-2165	*Testability Handbook for Systems and Equipment*
MIL-HDBK-470	Designing and Developing *Maintainability Products and Systems*
CxP 70055	*Constellation Safety, Reliability and Quality Assurance Plan*
CxP 70059	*Constellation Program Safety, Reliability and Quality Assurance Requirements*
CxP 72020	*Exploration Launch Projects System Safety, Reliability and Quality Assurance Plan*

DRD Continuation Sheet

TITLE: Reliability and Maintainability (R&M) Program Plan **DRD NO.: 1145RM-001**
DATA TYPE: 1 **PAGE**: 2/4

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

15.3 CONTENTS: The Reliability and Maintainability Plan shall meet the requirements of the applicable documents in 15.2 and consists of separate volumes for R&M disciplines to meet applicable program requirements. NASA shall be provided with all the analysis and supporting information and documentation to verify and validate reliability and maintainability predictions with actual performance of system and system of systems, including the probability of mission success through objective means. All the planned key tasks, their processes and controls shall be summarized in this program plan. The plan shall describe the approach for the development and review of R&M products to be applied by the contractor and Tier II subcontractors.

a. Reliability Plan: Provide full details of reliability organization, processes, modeling and analysis to accomplish higher system reliability, maintainability, safety and availability goals by designing-in-reliability right from the conceptual design stage and its progressive improvement throughout the life cycle of the system.

1. Provide details of the organizational structure of reliability with reference to other organizations including maintainability, supportability, engineering etc., its interactions and interfaces.
2. Provide a list and details of reliability tasks within the scope of the contract Statement of Work (includes maintenance and update of Failure Modes Effects Analysis (FMEA) and Critical Items List (CIL) Analysis, Reliability Prediction including Probabilistic Risk Assessment (PRA) as applicable, Reliability Testing etc), processes and analyses for each key milestone of the program during the sustaining engineering phase of the contract with a roadmap to meet the operational reliability and safety requirements of development and flight system.
3. Provide details of how reliability is integrated into the design function for system design changes during sustaining engineering to improve system/subsystem reliability by influence the design as part of the systems engineering model.
4. Identify ground-rules and baseline design assumptions, and planned reliability tools, including those for probabilistic design analysis (PDA) and structural reliability. Identify data assumptions, attributes of the model (including level, assumed relationships, etc.), timelines modeled, capabilities modeled (i.e., crew escape). Identify the method to be utilized in verification of the models provided the Government has access to this material.
5. Define and document the contractor's plan to fully implement and perform a Reliability Prediction using appropriate industry/DOD Standards and/or Probabilistic Risk Assessment (PRA) (if applicable) in support of Level I requirements. A separately submitted PRA plan define the scope, content, basic approach, ground rules and assumptions that the contractor shall utilize in the development and performance of a Reliability Predictions/PRA for the System for loss-of-crew, loss-of-vehicle, and loss-of-mission (LOC, LOV and LOM) as applicable. The plan shall address the methods to be utilized along with any specific modifications to these methods. It shall also address data sources and model/data validation.
6. Provide roadmap of quantitative reliability assessment to support program reliability requirement risk evaluation and reduction efforts. Included in this roadmap shall be an identification of tests used to anchor reliability models, to anchor reliability growth predictions, and to evaluate the effectiveness of failure mode risk mitigation achieved from design, fault detection and isolation, health management systems, and system maintenance. The quantitative reliability assessment roadmap shall also identify reliability metrics to be assessed and the details of the reliability growth modeling approach. The roadmap can reference internal contractor/vendor procedures, processes and controls including EEE parts selection and control, data sources, studies, etc., provided the Government has access to this material.

DRD Continuation Sheet

TITLE: Reliability and Maintainability (R&M) Program Plan **DRD NO.: 1145RM-001**
DATA TYPE: 1 **PAGE**: 3/4

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

7. Provide process details and tools planned for effective integration of problem reporting, analyzing and corrective action system and Non-Conformance System. Provide details of planned Problem Trending System to assess risk and provide input to reliability and maintainability analyses.
8. Provide verification and validation process to ensure compliance of design to key reliability requirements to qualification and certification of flight hardware.
9. Include the planned process details and details of planned data submissions of the following key tasks:
   (a) Reliability prediction for the subsystem/system associated with system design changes.
   (b) NASA Alert System Documentation.
   (c) Equipment Log Books and Limited Life Items List.
   (d) Part Substitution Deviation Requests.
   (e) Where Used Parts List.
   (f) Problem and Resolution Report.
   (g) Failure and Unsatisfactory Condition Summary Report.
   (h) Materials and Qualification Test Procedures.
   (i) Certificate of Qualification.
   (j) Qualification Test Report.
   (k) Failure Mode and Effects Analysis (FMEA).
   (l) Critical Items List (CIL).
10. The Reliability Plan shall provide process details and tools planned for implementation of statistical process control and process capability activities to minimize process variances during manufacturing, testing and system integration of flight critical hardware to help understand, document, communicate and facilitate minimizing flight safety and mission risks.

b. Maintainability Plan: The Maintainability Plan shall provide full details of maintainability organization, processes, modeling and analysis to accomplish higher system reliability, maintainability, and higher safety and availability goals by designing-in-maintainability right from the conceptual design stage and its progressive improvement throughout the life cycle of the system.

1. Provide details of the organizational structure of maintainability with reference to other organization including reliability, supportability, operations and engineering etc, its interactions and interfaces.
2. Document all the relevant processes that are planned to ensure simplification and robustness of design, ease of access and details of reliability centered maintenance process (RCM) if applicable. Define the basis for decision logic for LRU and maintenance levels selection. Identity trade studies etc. planned to ensure an easily maintainable system to meet operational requirements at optimum life cycle cost.
3. Define testability requirement analyses and roadmap.
4. Identify the maintainability modeling and analysis performed by the contractor along with modeling relationships and assumptions, data sources and timelines. Identify the method for verification/validation of the models. The section can utilize references to internal contractor processes, data sources, studies, etc., and provide Government with access to this material.
5. Provide methodology and techniques for achieving the program maintainability requirements. Describe how the maintainability program plans to meet the requirements of the SOW and the design specifications.
6. Provide details of verification activities.

DRD Continuation Sheet

TITLE: Reliability and Maintainability (R&M) Program Plan **DRD NO.**: **1145RM-001**
DATA TYPE: 1 **PAGE**: 4/4

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

7. As a minimum, the Maintainability Program Plan shall include:
   (a) A description of how the maintainability program shall be conducted to ensure compliance with all applicable maintainability requirements (programmatic and technical).
   (b) Detailed description of each maintainability task. Also included shall be a roadmap of maintainability assessments to support program maintainability requirement risk evaluation and reduction efforts.
   (c) Description of the integration of maintainability activities with other related program activities (e.g., reliability, testability, and logistics). MIL-STD-470 shall be used for guidance in development of the Maintainability Program Plan.
   (d) Maintainability Program Plan shall be a standalone plan, combined with the program/project Reliability Plan, or included as part of the program/project Safety and Mission Assurance Plan. The Maintainability Program Plan shall be developed early in program/project formulation, and is a living document that shall be revised as necessary throughout the life of the program/project.
   (e) Establishing the maintainability engineers as an active participant in the design team is a key objective of the Maintainability Program Plan. This is the most effective way to ensure that the maintainability plan reflects the current design and also has an opportunity to influence the future design. All assumptions and groundrules used throughout the design process need to be fully documented and understood.
   (f) Maintainability prediction.
   (g) List of limited life items relevant to each LRU driving their planned maintenance.
   (h) Details of Reliability Centered Maintenance (RCM).
   (i) Maintainability Analysis shall provide time related information such as turn around time, time to repair, time between maintenance actions etc. along with the skill level of needed personal.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue of individual volumes.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP 2. **DRD NO**: **1145RM-002**
3. **DATA TYPE**: FMEA - Type 2 4. **DATE REVISED**:
CIL - Type 1 5. **PAGE**: 1/3

6. **TITLE**: Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL)

7. **DESCRIPTION/USE**: Failure Modes and Effects Analysis (FMEA) - to identify and document the possible failures modes and causes of each hardware item of a subsystem/system, the worst case effect of such failures for each mission phase and assigns criticality per the applicable FMEA/CIL guidelines document. This information is vital for design improvements, reliability and maintainability analysis.

Critical Items List (CIL) - to identify and document the list of critical failure modes of item(s) in each subsystem/system with potential worst case effect(s), such as Loss of Crew (LOC), Loss of Vehicle (LOV) and/or Loss of Mission (LOM) or detrimental failure effects as applicable to system under study per the applicable FMEA/CIL guideline document. The CIL provides details of relevant design features, testing and inspections processes and controls, as applicable to the failure mode, to mitigate/minimize the risk. CIL retention rationale bridges the gap in the design, test/verification requirements, inspection and process controls. CIL also facilitates in the identification of Government Mandatory Inspection Points. CIL also provides a flight waiver rationale for those critical failure modes, per applicable groundrules, which could not be eliminated by design.

8. **OPR**: QD40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to SAE ARP 4761, *Guidelines and Methods for Conducting the Safety Assessment on Civil Airborne Systems and Equipment.*

14. **INTERRELATIONSHIP**: DRDs 1145RM-001, *Reliability and Maintainability Program Plan;* 1145RM-003, *Problem Reporting and Corrective Action (PRACA) System and Trending;* 1145RM-006, *MSFC ALERT System Documentation* and 1145SA-001, *System Safety Hazards Analysis.* SOW paragraphs 4.5.3, 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 SCOPE: FMEA/CIL shall be performed for all flight hardware, Ground Support Equipment (GSE) and payload items to meet applicable program/project requirements. A detailed Reliability Block Diagram (RBD) is recommended to document all key line replaceable units and/or assemblies and their interrelationship in terms of redundant and series configuration and number of success paths to ensure mission success.

DRD Continuation Sheet

TITLE: Failure Modes and Effects Analysis and Critical Items List **DRD NO.**: **1145RM-002**

DATA TYPE: 1/2 **PAGE**: 2/3

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

FMEA provides for each hardware item in a subsystem/system as identified on the RBD. The FMEA identifies potential failure modes of each item and its associated failure causes, analyzes and documents the effect of the failure mode during each critical phase of the mission and assigns a criticality number to substantiate the appropriate crew, vehicle and mission risk.

Critical Items List (CIL) analysis provides for failure modes which lead to worst case failure conditions such as Loss of Crew (LOC), Loss of Vehicle (LOV), Loss of Mission (LOM) and/or other criticalities which are detrimental to the program per its applicable FMEA/CIL guideline document. The CIL provides lists of hardware identified in the FMEA categorized as being "Critical", i.e., those items whose failure could result in a loss of life or degradation of the mission The CIL documents the retention rationale and controls specific to each critical failure mode of the LRU/assembly under discussion for its design features, testing, and inspections along with the failure history. This CIL retention rationale, when effectively implemented, mitigates the risk with high degree of confidence, leading to mission success.

Common Cause Failures Analysis shall be performed as part of FMEA/CIL analysis to assess the crew, vehicle and mission risks.

15.2 **APPLICABLE DOCUMENTS**:

CxP 70043	*Hardware Failure Modes and Effects Analysis and Critical Items List (FMEA/CIL) Methodology*

15.3 **CONTENTS**:

a. FMEA documentation shall include all the data elements required by CxP 70043 including, but not limited to:
   1. Introduction: Concise statement on the objectives of the report.
   2. Subsystem description in term of its function (s) and list of hardware/LRU items.
   3. All assumptions and ground rules used in the analysis.
   4. Reliability Block Diagram, Schematics and/or other simple models of the system.
   5. List of all applicable and reference documents.
   6. Completed Analysis worksheets for every identified failure mode for its worst case effects for each hardware item. Worksheet shall include all relevant information such as: identification of the item to be analyzed, identification of the analyst and responsible managers, revision dates, hardware part number and its functional description, FMEA number, failure mode identification and description, failure causes, mission phase in which the failure occurs, the worst case failure effect on the subsystem, interfacing subsystems, mission, Space Transportation System, Payloads and other applicable systems, failure detection and isolation methods, corrective action, functional criticality, redundancy screens, success paths after first failure, Remarks/Hazards, effectivity, disposition and rationale.

NOTE: FMEA results shall be documented by listing each identified failure mode for each component in the system being analyzed on a separate table or worksheet. The worksheet contains all the data elements to be addressed in the analysis. The failure effects, causes, criticalities etc., are individually assessed for each component depending upon the function of that component performs.

DRD Continuation Sheet

TITLE: Failure Modes and Effects Analysis and Critical Items List **DRD NO.**: **1145RM-002**
DATA TYPE: 1/2 **PAGE**: 3/3

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

b. Critical Items List Analysis shall include:

1. Introduction: Concise statement on the objectives of the report.
2. Scope: Describe the major systems contained in the CIL and general information on what type of data is contained in the CIL.
3. List of all applicable and reference documents.
4. Critical LRU List: Provide a listing of LRU part numbers, reference designators (if appropriate), LRU nomenclature, LRU highest level criticality, lower level part numbers identified by the FMEA and respective nomenclature, failure mode number, quantity of items in the subsystem and FMEA/CIL criticality for each FMEA/CIL number, indicating redundancy screen (s) failed as applicable.
5. Analysis Results: Individual CIL shall be prepared for each failure mode identified as critical to the mission and shall document its associated design rationale (including its design qualification details and/or reference), testing and inspection details specific to the failure mode and failure causes to mitigate the mission risks for all failure causes with high degree of confidence. Each CIL shall contain all the data elements called out in the approved program specific FMEA/CIL requirements document, CxP 70043.
6. CIL shall also document critical manufacturing, assembly and inspection process as part of retention rationale under inspection section.

15.4 **FORMAT**: FMEA's worksheets shall use the format, content and tools utilized by NASA prior to transition. FMEA/CIL updates shall be prepared and submitted to NASA/MSFC electronically as well as hard copies per program specific directions. Contractor format is acceptable for FMEA and CIL after concurrence by MSFC S&MA.

15.5 **MAINTENANCE**: These FMEA/CIL shall be maintained current based on various design changes, flight and test experiences. Changes shall be incorporated by change page or complete reissue with routine updates at least once a year depending on complexity of the program.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145RM-003**
3. **DATA TYPE**: 1/2/3
4. **DATE REVISED**:
5. **PAGE**: 1/3

6. **TITLE**: Problem Reporting and Corrective Action (PRACA) System and Trending

7. **DESCRIPTION/USE**: To provide a closed loop system for reporting management visibility and accountability of reportable problems, significant anomalous conditions and recurrence control; provide processes and system to identify and track key critical issues using both qualitative and quantitative tools along with various trending processes for flight safety issues related to critical hardware/ software; and provide timely recommendations of effective recurrence control and its implementation plan/timeline.

8. **OPR**: QD40 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Processes shall be maintained current with the latest release of referenced documents. Reference is made to the following documents:

NPD 8700.1	*NASA Policy for Safety and Mission Success*
NPD 8720.1	*NASA Reliability and Maintainability Program Policy*
NASA-STD-8729.1	*Planning, Developing and Managing Effective Reliability and Maintainability Programs*
MIL-HDBK-470	*Designing and Developing Maintainable Products and Systems*
Maintainability Toolkit	*A Practical Guide for Designing and Developing Maintainable Products and Systems (Reliability Analysis Center)*
Reliability Toolkit	*Commercial Practices Edition – A Practical Guide for Commercial and Military Systems under Acquisition Reform (Reliability Analysis Center)*
NPR 8715.3	*NASA Safety Manual*
NPR 8705.2	*Human-Rating Requirements and Guidelines for Space Flight Systems*
CxP 70068	*Constellation Program Problem Reporting, Analysis and Corrective Action (PRACA) Methodology*
JSC 62809	*NASA Human Rated Spacecraft Pyrotechnic Specification*

14. **INTERRELATIONSHIP**: DRDs 1145RM-001, *Reliability and Maintainability Program Plan*, 1145RM-002, *Failure Modes and Effects Analysis & Critical Items List*, 1145SA-001, *Systems Safety Hazards Analysis* and 1145SA-002, *Fault Tree Analysis*. SOW paragraphs 4.5.3, 5.3, 6.3, 7.3, 8.3 and 9.3

DRD Continuation Sheet

TITLE: Problem Reporting and Corrective Action (PRACA) System and Trending **DRD NO.:** **1145RM-003**

DATA TYPE: 1/2/3 **PAGE:** 2/3

15. **DATA PREPARATION INFORMATION:**

15.1 **SCOPE:** The Problem Reporting and Corrective Action system shall include the information to provide visibility and accountability of reportable problems and recurrence control. The scope shall include all the hardware health conditions captured per PRACA guidelines and key problems captured through contractor's Nonconformance System which can be helpful to assess the health of the hardware and its key contributory factors. This shall include close integration of the contractor's nonconformance database and the PRACA database (definitely electronically) to capture anomalous hardware conditions observed during refurbishment operations (such as aging of the hardware due to environment temperature, humidity, induced damages, radiation, etc.) that cannot be positively screened through subsequent inspection and testing (such as exposed wires, insulation degradation, corrosion fatigue, induced damage, etc.). Suitable trending mechanisms/systems shall be developed and implemented to proactively identify and isolate the impending failures/failure conditions and to make recommendations for suitable corrective actions to mitigate critical failures or reduce risk. PRACA activities shall include supporting various program reviews and flight certification review, as needed.

The reportable problems and anomalous conditions are defined in the PRACA Document.

a. Problems of criticality categories 1, 1R, 2, 2R, 2P, 2PR, and functional failures of category 3 occurring on flight and flight-like hardware/software beginning with qualification or acceptance testing.
b. Unexplained hardware/software anomalies.
c. Overstress or potential overstress of hardware/software detected during acceptance or certification testing and subsequent operations involving flight hardware/software, flight support equipment, or ground support equipment reportable problems (e.g., equipment directly involved in mission operations).

15.2 **APPLICABLE DOCUMENTS:** None

15.3 **CONTENTS:** The problem report shall include the following information:

a. Initial notification:
   1. Unique identifiable report number.
   2. Date of occurrence.
   3. Complete description of problem including comparison of expected events with actual events (or results).
   4. Provide failure mode criticality.
   5. Test operation being performed at time of occurrence (certification, acceptance, final checkout, countdown), if applicable.
   6. Nonconforming article - part name, part number, serial number, manufacturer, and lot number.
   7. Next higher assembly - part name, part number, serial number, manufacturer (as applicable)
   8. Test article - part name, part number, serial number, and manufacturer.
   9. Indication of whether problem a failure or unsatisfactory condition.

DRD Continuation Sheet

TITLE: Problem Reporting and Corrective Action (PRACA) System and Trending **DRD NO.:** **1145RM-003**

DATA TYPE: 1/2/3 **PAGE:** 3/3

15. **DATA PREPARATION INFORMATION (CONTINUED):**

10. Indication of whether problem is due to design deficiency or manufacturing inconsistency, if known.
11. List test documents (if applicable).
12. Preliminary cause of problem (if possible).
13. Remedial action taken.

b. Problem closure shall include updates to 1 thru 13 above as necessary and the following:
1. Date of resolution.
2. Actual cause of problem based on failure analysis.
3. Corrective action implemented to prevent recurrence.
4. Disposition of failed hardware.
5. Copy of test reports, studies and presentations.
6. Failure analysis reports.
7. Implementation change paper.

c. If no corrective action is taken or the cause of the problem cannot be determined, the problem shall have an "explained" disposition. The final report shall contain problem clarification, problem history, planned used of hardware or like units, analysis results and probable cause, last test able to detect the anomaly, methods of detecting in flight, the effect of recurrence, operational work-arounds, rationale for acceptability, and corrective action for subsequent hardware.

d. All problems shall be dispositioned prior to flight. If a closure or explanation cannot be provided, the problem shall be "interim closed" for resolution at a later date if:
1. Problem is not applicable to hardware scheduled for that flight.
2. Condition does not exist on the flight hardware.
3. Condition is screened by acceptance test procedures, preflight checkout, or special test.
4. Problem is applicable to the flight, but sufficient evidence exists that the hardware/software in question can be flown safely as an accepted risk.

e. In addition to the normal distribution, a copy of the reports shall be submitted to the MSFC Problem Assessment Center (PAC).

f. Support shall be provided to the Problem Review Board (PRB) if requested by NASA.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145RM-004**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Limited Life Items List
7. **DESCRIPTION/USE**: To provide a list of items possessing limited life characteristics, and their designed or allowed usage.
8. **OPR**: QD40 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**:
14. **INTERRELATIONSHIP**: DRDs 1145RM-001, *Reliability and Maintainability Program (R&M) Plan,* 1145RM-002, *Failure Modes and Effects Analysis and Critical Items List;* 1145RM-004, *Certificate of Qualifications* and 1145SA-003, *System Safety Plan.* SOW paragraphs 4.5 and 4.5.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Limited Life Items List provides a list depicting items of hardware categorized as having "limited life", i.e., items having characteristics of quality degradation or drift with age or use.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Limited Life Items List shall contain the following for those items identified as time, cycle, or age sensitive:

a. Name of item.
b. Lot number and Part number.
c. Allowable time and/or cycles and age permitted.
d. Accumulated time and/or cycles at time of shipment.
e. Required time and/or cycles and age that must be remaining prior to conducting each major milestone test and launch.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145RM-005**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/2
6. **TITLE**: MSFC ALERT System Documentation
7. **DESCRIPTION/USE**: To provide a controlled method for MSFC and contractor ALERT initiation, investigation, resolution, and response.
8. **OPR**: QD40 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: The identification of items to be ALERT'ed shall be based on requirements of government requirements. Reference is made to MPD 8720.1, *MSFC Reliability and Maintainability Program to Space Systems* and CxP 72020, Exploration Launch Projects System Safety, Reliability and Quality Assurance Plan.
14. **INTERRELATIONSHIP**: DRD 1145RM-001, *Reliability and Maintainability Program Plan.* SOW paragraphs 4.5.3, 5.3, 6.3, 7.3, 8.3 and 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The MSFC ALERT System Documentation provides information relative to unexpected failures or discrepant conditions of parts and materials used in equipment which may be of significant application in other equipment and to safety problems of general concern. This applies to failures or discrepant conditions encountered when such parts or materials are applied within the limits of the applicable specification.

15.2 **APPLICABLE DOCUMENTS:**

SO300-BT-PRO-010	*Government-Industry Data Exchange Program (GIDEP) Policies and Procedures Manual*
NPR 8735.1	*Procedures for Exchanging Parts, Materials, and Safety Problem Data Utilizing the Government-Industry Data Exchange Program and NASA Advisories.*

15.3 **CONTENTS**: ALERTs shall be prepared and responded to in accordance with SO300-BT-PRO-010 and NPR 8735.1 and shall include:

a. Contractor initiated ALERTs - The proposed ALERT shall include, but not be limited to:
   1. Essential details required to identify problem by types and/or manufacturer's name, special requirements and environments, the problem situation (condition) and cause, actions taken and recommendations. Such data shall be restricted to objective, factual information.
   2. Names of responsible individuals and organizations contacted for further technical details.
   3. Upon MSFC approval, contractor initiated ALERTs which are of general concern shall be submitted to the Government-Industry Data Exchange Program (GIDEP) for dissemination to all participants. Proposed ALERTs which only concern NASA shall be disseminated to the NASA community by the MSFC coordinator.

DRD Continuation Sheet

TITLE: MSFC ALERT System Documentation **DRD NO.:** **1145RM-006**
DATA TYPE: 3 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

b. Response reports for ALERT disseminated by MSFC shall include:

1. Initial * - As a minimum, the results of the contractor's review for applicability and impact to the hardware. (May close ALERT if information regarding usage, impact, corrective action [or rationale for "flying-as-is"] is justifiable to the project's Safety and Mission Assurance [S&MA] representative).
2. Extension Request - One-time per report explanation as to why response cannot be provided within the 21 working-day time frame and requesting a 30 calendar day extension in response. (Extension shall not be allowed if the ALERT relates to a mission to be performed within the extension time frame).
3. Follow-on - reports results of investigations, analyses, etc. extended beyond the 21 working days allowed for the initial report (may closeout ALERT if no corrective action required).
4. Final - required to report implementation of corrective action.

Notes:

* This report shall include a negative response if part or material is not used.

No response required on ALERTs marked "Information Only" unless an impact is identified. If an impact is identified, the ALERT shall be OPENed against the project and contractor involved once an initial response is provided that identifies the component use.

15.4 **FORMAT**:

a. Contractor Initiated ALERT - The proposed ALERT shall be submitted to the project's S&MA representative with a copy to the MSFC ALERT coordinator under non-safety-critical circumstances. Preliminary ALERTs shall be issued by letter, or a partially complete GIDEP ALERT Form (GIDEP Form 97-1), when immediate notification of the NASA community is considered urgent, and time or insufficient technical detail does not allow completion of the ALERT. Upon approval, the initiator shall follow GIDEP procedure for dissemination of the completed ALERT to all GIDEP participants.

b. MSFC ALERT Response Report - The ALERT response shall be prepared in the contractor's format including information specified in 15.3 of this DRD.

15.5 **MAINTENANCE**: Pertinent comments clarifying, correcting, or expanding data in a previous ALERT shall be issued as ALERT addenda on GIDEP Form 97-1 referring to the previous ALERT identification number. The letters "A," "B," "C," etc., shall be added as a suffix to the original ALERT identification number to denote successive addenda.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SA-001**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: System Safety Hazard Analysis

7. **DESCRIPTION/USE**: The intent of the hazard analysis is to document the identifying, controlling, and verification activities associated with potential safety hazards and to support the risk management process which eliminates the identified hazard or reduces the risk of its occurrence to an acceptable level based on agency and program requirements. The analysis provides status of the resolution the potential safety risks and the supporting risk acceptance rationale for any hazards that are not eliminated. The analysis will support program and/or independent safety review panels and their evaluation of program compliance with the associated safety requirements.

8. **OPR**: QD01 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: The hazard analyses shall be updated as the program progresses, providing continuity and covering the interrelated areas of design, operations, and integration.

14. **INTERRELATIONSHIP**: DRDs 1145SA-002, *Fault Tree Analysis;* 1145RM-002, *Failure Modes Effects Analysis and Critical Items List;* DRD's 1145SA-003, *System Safety Plan;* 1145QA-001, *Quality Plan.* SOW paragraphs 4.5.1, 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: System Safety Hazard Analyses identify hazards, determine the methods used for controlling the hazards, support the program risk management process, and establish verification methods and assure closure for the identified hazard. The System Safety Hazard Analysis will provide a total assessment of the subject systems (hardware and software) and their operational environment. The analyses shall cover the complete program life cycle from concept definition until program completion and hardware disposal.

15.2 **APPLICABLE DOCUMENTS**:

a. All Programs:

NPD 8700.1A	*NASA Policy for Safety and Mission Success*
NPR 8000.4	*Risk Management Procedures and Guidelines*
NPR 8715.3	*NASA Safety Manual*
NASA-STD-8719.13	*NASA Software Safety Standard*

b. Upper Stage:

CxP 70038	*Hazard Analysis Methodology*
CxP 70055	*Constellation Safety, Reliability and Quality Plan*
CxP 72034	*Ares I System Requirements Document*
CxP 72032	*Ares I Crew Launch Vehicle Operational Concepts Document*

DRD Continuation Sheet

TITLE: System Safety Hazard Analysis **DRD NO.**: **1145SA-001**
DATA TYPE: 1 **PAGE**: 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

c. Special Programs:

FAA Requirements — For programs that must also comply with FAA requirements, *AC 431.35-2, Reusable Launch and Re-entry Vehicle System Safety Process,* identifies the elements of the System Safety Process (SSP) to required to identify hazards and assess risks to public safety

DoD Requirements — For programs that must also comply with Department of Defense requirements, *MIL-STD-882, Standard Practice for System Safety,* identifies the required hazard analyses and processes

Human Rating — For programs that are developing human crewed space flight systems, *NPR 8705.2, NASA Human Rating Requirements and Guidelines for Space Flight Systems* provides the guidelines for the hazard analysis which is an integral part the total effort

15.3 **CONTENTS**: The analyses shall identify hazards, determine the methods used for controlling the hazards, support the program risk management process, and establish verification methods applicable to design, development, manufacturing and assembly, testing, inspection, integration, and flight (of subject systems) including any interfacing ground support equipment (GSE), facilities, and ground operations in accordance with Applicable Documents in 15.2 and be an integrated effort. This analysis shall be a part of integrated system design effort for assessing all systems risks with processes such as Fault Tree Analysis, FMEA/CIL and quantitative reliability assessments, mitigating hazards and documenting the assessment with proper rationale to ensure safety of flight operations.

a. The reports shall be structured to be in compliance with the agency level guidelines and shall be consistent with any specific program requirements. Any special analyses efforts established by internal program agreements shall also be documented.
b. The analysis shall address the total system including hardware and related software.
c. The System Safety Hazard Analysis shall contain, as a minimum, the data required to support program milestone reviews and the associated safety panel reviews.

15.4 **FORMAT**: The analysis shall be provided in both hard copy and in an electronic format compatible with standard data as specified by program requirements. The format will be consistent with the format at transition to minimize integration effort.

15.4 **MAINTENANCE**: The hazard analyses shall be updated as the program progresses, providing continuity and covering the interrelated areas of design, operations, and vehicle subsystem integration.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SA-002**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Fault Tree Analysis

7. **DESCRIPTION/USE**: The fault tree is a symbolic logic diagram showing the cause-effect relationship between a top undesired event (failure) and one or more contributing causes. It is a type of logic tree that is developed by deductive logic from a top undesired event to all related sub-events.

8. **OPR**: QD10 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: The Fault Tree Analyses shall be updated as the program progresses, providing continuity and covering the interrelated areas of design, operations, and system integration and processing throughout the program life-cycle. Submissions shall support safety risk assessments including Hazard Analysis and program risk assessments focused on specific issues.

14. **INTERRELATIONSHIP**: DRD's 1145RM-002, *Failure Modes and Effects Analysis and Critical Items List;* 1145SA-001, *System Safety Hazard Analysis* and 1145SA-003, *System Safety Plan.* SOW paragraphs 4.5.1, 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Fault Tree Analysis shall identify single and/or combinations of failures that can result in hazards. The assessment shall address internal (program) events and external events including those originating in hardware and operational interfaces and environments. The effort shall be developed in parallel and in support of the design, development, and operational phases of the program.

The scope of the FTAs will be defined by program requirements and agency guidelines. While individual Fault Tree Analyses may be developed to support special case assessments; individual FTAs shall be structured to support the related integrated program FTA assessment.

15.2 **APPLICABLE DOCUMENTS**:

a. All programs:

NPD 8700.1A	*NASA Policy for Safety and Mission Success*
NPR 8715.3	*NASA Safety Manual*

b. Upper Stage

CxP 70038	*Hazard Analysis Methodology*
CxP 70055	*Constellation Safety, Reliability and Quality Plan*
CxP 72034	*Ares I System Requirements Document*
CxP 72032	*Ares I Crew Launch Vehicle Operational Concepts Document*
NASA-FTA-PG	*Fault Tree Handbook with Aerospace Applications*
NUREG-0492	*Fault Tree Handbook, Nuclear Regulatory Commission*

DRD Continuation Sheet

TITLE: Fault Tree Analysis **DRD NO.:** **1145SA-002**

DATA TYPE: 1 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION:**

15.3 **CONTENTS**: The Fault Tree Analysis shall identify the top-level undesired event or hazardous condition, and lower level relationships to the degree necessary to provide the level of detail to identify potential failure modes and event causes. The FTA shall include Loss of Crew (LOC) and/or loss of vehicle as the highest undesirable event (failure) and should flow down to sufficient level of details using fault tree standard tools/symbols/logic to identify potential failure modes and hazard causes. It shall identify single and/or combinations of failures that can result in hazards. The assessment shall address internal (program) events and external events including those originating in hardware and operational interfaces and environments. The Fault Tree Analysis shall support and be compatible with the Hazard Analysis and associated risk analyses tools including the Failure Modes and Effects Analysis (FMEA) and the Probabilistic Risk Assessment Analysis (PRA). It shall support both internal and external risk management processes including any required formal safety review processes. In addition the Fault Tree Analysis shall provide the following information:

a. Definition of the top undesired event.
b. Ground rules and assumptions.
c. Scope of analysis.
d. Fault tree symbols legend.
e. Fault tree logic symbols legend.
f. Diagram representation of the system being analyzed with associated logic and event/functions (tree diagram).
g. Summary of analysis results.

15.4 **FORMAT**: Contractor shall maintain the format and analysis tool used by NASA prior to transitioning to the sustaining engineering phase to assure continued compatibility with program analyses. The analysis shall be provided in both hard copy and in an electronic format compatible with standard data processing tools.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SA-003**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/3
6. **TITLE**: System Safety Plan (SSP)
7. **DESCRIPTION/USE**: The System Safety Plan (SSP) defines the contractor's objectives, responsibilities, and methods to be used for overall system safety program conduct and control. It describes the integration of system safety provisions into the total program based on early implementation, planned safety certification review/process, and total program life cycle support.
8. **OPR**: QD01 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: This plan may be incorporated in more comprehensive safety and mission assurance plans or other general program plans provided the system safety data elements remain identifiable and completely reflect the requirements of this DRD.
14. **INTERRELATIONSHIP**: DRDs 1145QE-001, *Quality Plan;* 1145RM-002, *Failure Modes and Effects Analysis and Critical Items List;* 1145SA-001, *System Safety Hazard Analysis* and 1145SA-002, *Fault Tree Analysis.* SOW paragraph 4.5.1
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The System Safety Plan (SSP) will be consistent with the status of the program's technical development providing a description of the system safety program necessary to support the total program life cycle. The plan will include detailed task requirements for the system safety task as tailored for this program. It will address requirements for safety organization participation in design, safety, and readiness reviews.

15.2 **APPLICABLE DOCUMENTS:**

a. All programs:

NPD 8700.1A	*NASA Policy for Safety and Mission Success*
NPR 8715.3	*NASA Safety Manual*

b. Upper Stage

CxP 70038	*Hazard Analysis Methodology*
CxP 70055	*Constellation Safety, Reliability and Quality Plan*
CxP 70059	*Constellation Program Safety, Reliability and Quality Assurance Requirements*
CxP 72020	*Exploration Launch Projects System Safety, Reliability and Quality Assurance Plan*
CxP 72034	*Ares I System Requirements Document*
USO-CLV-SE-25710	*Upper Stage Element Requirements Document*

DRD Continuation Sheet

TITLE: System Safety Plan (SSP) **DRD NO.: 1145SA-003**
DATA TYPE: 1 **PAGE**: 2/3

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

15.3 **CONTENTS**: The System Safety Plan shall meet the requirements of the applicable documents in 15.2. The level of detail in the plan directly correlates with the nature and complexity of the system safety effort required to meet program requirements and objectives. It shall provide a general description of the appropriate safety tasks that shall become the foundation for safety efforts during the system definition, design, manufacture, test, and operations. The SSP program shall be the vehicle for safety task planning. The elements of the SSP shall identify the interfaces with other program activities including design, development, test, operation, continuous risk management and program control (waivers, deviations, corrective actions). While individual program characteristics may vary the emphasis for a particular effort, the plan shall focus on the basic elements:

a. Planning.
   1. Identify special safety studies that may be required during system definition or design.
   2. Personnel requirements both in terms of skills and level of effort required for the safety program during the complete system life cycle.
   3. Establish safety goals and objectives to determine the type of safety input for the overall program. The goals and objectives should be identified in the initial submittal and evaluated at the major milestone reviews.
      (a) Goals should be measurable and state what would be accomplished by performing the various safety tasks.
      (b) Goals should be structured so that safety tasks can be selected to accomplish them.
      (c) Task results should clearly demonstrate that the goals have been met.

b. Organization. The program organization and system safety relationships and responsibilities shall be described along with reporting channels for this task. The description will include any provisions for independent reporting of issues in addition to the program processes.

c. Contracting. The identification of the relationships to other program elements, subcontractor, and supplier system safety efforts will be done.

d. Interface/Coordination. Relationships to other program planning documentation shall be identified to assure proper coordination of activities.

e. Requirements. Applicable requirements and their sources (programmatic, agency or other) shall be listed.

f. Analysis. The plan shall stipulate hazard analysis methodologies and their intended application. The related DRDs for Hazard Reports (HRs) shall be identified along with the approval process for the reports. (Specific format, data and delivery milestones may be deferred to the System Safety Hazard Analysis DRD.) System Safety analysis strategies shall define that support:
   1. Concept trade studies (Initial hazard identification and recommended design alternatives).
   2. Utilization of HR results in the design development and the process to assure the analysis maintains currency with the evolving system and program requirements.
   3. Inputs to test and system verification activities.
   4. Definition of operational system safety requirements.
      (a) Redundancy.
      (b) Probabilistic Risk Level for loss of vehicle and/or loss of crew.
      (c) Technical and engineering.
   5. Evaluation of end of life and/or disposal safety issues.
      (a) Orbital Debris Generation Issues.
      (b) Flight Termination System Implementation.
      (c) Environmental hazards.

DRD Continuation Sheet

TITLE: System Safety Plan (SSP) **DRD NO.:** **1145SA-003**

DATA TYPE: 1 **PAGE:** 3/3

15. **DATA PREPARATION INFORMATION (CONTINUED):**

g. Safety review and certification process. The plan shall address safety review and certification processes that apply to the program.

h. Risk assessment. The description of the role of system safety in the program risk management process shall address:

1. The review of pertinent historical safety data from similar systems.
2. The utilization of Hazard Analysis and related safety assessments. This shall include the process for recommending corrective action or alternatives to the appropriate management level for a decision to either eliminate the hazard or accept the risk.
3. The program definition for acceptable or residual risk. If the risk management process allows for risk acceptance at varied levels, the plan shall address the role of system safety at each level and in the notification of risk acceptance to the program manager.

i. Reporting. The implementation of the requirements for reporting System Safety activities and products shall be provided at program milestone review.

j. Mishap investigation. The role of System Safety in the investigation, development of corrective actions and the application of lesson's learned. Provisions for supporting related NASA activities in the investigation process.

k. Data retention. Planning for the maintenance of the system safety documentation shall be identified. Data documentation shall include safety risk acceptance rationale and the associated supporting information.

15.4 **FORMAT**: Contractor format is acceptable unless another format is specified in the general contract provisions. The plan shall be provided in both hard copy and in an electronic format as specified by the program.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SA-004**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/5
6. **TITLE**: Safety, Health, and Environmental (SHE) Plan

7. **DESCRIPTION/USE**: To provide the contractor and the Government a baseline document to (1) prevent employee fatalities, (2) reduce the number of incidents, (3) reduce the severity of employee injuries and illnesses, and (4) protect the environment through the ongoing planning, implementation, integration and management control of the contractor's industrial safety, occupational health, and environmental program by compliance with the Marshall Space Flight Center (MSFC) SHE core program requirements in accordance with NFS 1852.223-73.

8. **OPR**: AS10/QD50 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: NFS 1852.223-70, *Safety and Health;* NFS 1852.223-73, *Safety and Health Plan;* FAR 52.223-3, *Hazardous Material Identification and Material Safety Data;* FAR 52.223-4, *Recovered Material Certification;* FAR 52.223-5, *Pollution Prevention and Right-to-Know Information;* FAR 52.223-7, *Notice of Radioactive Materials;* FAR 52.223-9, *Estimate of Percentage of Recovered Material Content for EPA-Designated Products;* FAR 52.223-10, *Waste Reduction Program;* FAR 52.223-11, *Ozone Depleting Substances;* FAR 52.223-12, *Refrigeration Equipment and Air Conditioners;* FAR 52.223-13, *Certification of Toxic Chemical Release Reporting;* and FAR 52.223-14, *Toxic Chemical Release Reporting.* DRD 1145SA-005, *Mishap and Safety Statistics Report.* SOW paragraph 4.5.2

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Safety, Health, and Environmental Plan shall describe the contractor's methods of planning, implementing and controlling their industrial safety, occupational health, and environmental requirements over the duration of the contract.

15.2 **APPLICABLE DOCUMENTS**: Compliance with the following Occupational Safety and Health Standards and applicable requirements shall be specified in the plan (if applicable to the scope of this contract).

29 CFR 1910	*Department of Labor; Occupational Safety and Health Administration Standards for General Industry*
29 CFR 1926	*Department of Labor; Occupational Safety and Health Administration Standards for Construction Industry*
40 CFR	*Protection of the Environment*

ANSI Standards applicable to the scope of this contract
ASME Boiler and Pressure Vessel Code applicable to the scope of this contract
NFPA Standards *National Fire Codes*

DRD Continuation Sheet

TITLE: Safety, Health, and Environmental (SHE) Plan **DRD NO.: 1145SA-004**

DATA TYPE: 2 **PAGE**: 2/5

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

NASA-STD-8719.11	*Safety Standard for Fire Protection*
NPR 8715.3	*NASA General Safety Program Requirements*
MPR 1040.3	*MSFC Emergency Plan*
MPD 1800.1	*MSFC Smoking Policy*
MPR 1800.1	*Bloodborne Pathogens*
MPR 1810.1	*MSFC Occupational Medicine*
MPD 1840.1	*MSFC Environmental Health Program*
MPR 1840.1	*MSFC Confined Space Entries*
MPD 1840.2	*MSFC Hearing Conservation Program*
MPR 1840.2	*MSFC Hazard Communication Program*
MPD 1840.3	*MSFC Respiratory Protection Program*
MPR 1840.3	*MSFC Hazardous Chemicals in Laboratories Protection Program*
MPD 1860.1	*Laser Safety*
MPD 1860.2	*MSFC Radiation Safety Program*
MPR 3410.1	*Training*
MWI 3410.1	*Personnel Certification Program*
MPD 8500.1	*MSFC Environmental Management Policy*
MPR 8500.1	*MSFC Environmental Management Program*
MPR 8500.2	*MSFC Environmental Management System Manual*
MWI 8540.2	*Affirmative Procurement Program for Environmentally Preferable Products*
MWI 8550.1	*Waste Management*
MWI 8550.2	*Storm Water Management*
MWI 8550.3	*Wastewater Compliance*
MWI 8550.4	*Air Emissions Compliance*
MWI 8550.5	*Chemical Management*
MWI 8621.1	*Close Call and Mishap Reporting and Investigation Program*
MPR 8715.1	*Marshall Safety, Health and Environmental (SHE) Program*
MWI 8715.1	*Electrical Safety*
MWI 8715.2	*Lockout/Tagout Program*
MWI 8715.3	*Hazard Identification & Warning System*
MWI 8715.4	*Personal Protective Equipment (PPE)*
MWI 8715.5	*Building Manager Program*
MWI 8715.9	*Occupational Safety Guidelines for Contractors*
MWI 8715.10	*Explosives, Propellants, & Pyrotechnics Program*
MWI 8715.11	*Fire Safety Program*
MWI 8715.12	*Safety, Health, and Environmental Finding Tracking System (SHEtrak)*
MWI 8715.13	*Safety Concerns Reporting System (SCRS)*
MWI 8715.15	*Ground Operations Safety Assessment & Risk Mitigation Program*
MPD 8900.1	*Medical Operations Responsibilities for Human Space Flight Programs* (NOTE: This document only applies to Space Station contracts)

DRD Continuation Sheet

TITLE: Safety, Health, and Environmental (SHE) Plan **DRD NO.: 1145SA-004**
DATA TYPE: 2 **PAGE**: 3/5

15. **DATA PREPARATION INFORMATION (CONTINUED):**

15.3 CONTENTS: The Safety, Health, and Environmental (SHE) Plan shall clearly describe how the contractor shall comply with the MSFC SHE core program requirements listed below to accomplish the following: (1) the methods to ensure compliance with the MSFC SHE core program requirements listed below, (2) the methods to ensure potentially hazardous conditions are identified and corrected, (3) the methods to ensure employees are trained to perform their tasks in a safe and healthful manner, and (4) the methods to ensure compliance with the applicable documents that pertain to the specific work tasks .

a. Management leadership and employee involvement:
   1. A statement of the management policy and their commitment to (1) provide a safe and healthful workplace for personnel (i.e., employees, customers, and public), (2) protect the property and the environment, and (3) ensure compliance with EPA, OSHA and NASA requirements applicable to the contracted effort.
   2. A description of how management and employees are held accountable for implementing their tasks in a safe and healthful manner while protecting the environment through the use of motivational or innovative techniques and when necessary through the use of a disciplinary program.
   3. A description of safety, health, environmental awareness and motivation programs that, include documented safety meetings and safety awareness training for employees. (Onsite contractors shall document their safety meeting statistics in the MSFC Supervisors Safety Web page (SSWP).
   4. A method of performing and documenting self evaluations of the contractor's safety, health and environmental program including the frequency of these evaluations.
   5. A method of ensuring the flowdown of MSFC safety, health, and environmental responsibilities and requirements applicable to the contracted effort are passed between all company levels and to all subcontractors, when applicable.
   6. The identification by title the individual who is assigned the responsibility for implementing the contractor's SHE program elements and serve as the SHE Point of Contact (POC) for the contracted effort.
   7. A method to ensure compliance with MPR 8715.1 and all other SHE documents that are applicable to the contracted effort.
   8. A method to ensure that each employee has read the SHE plan and fully understands their roles and responsibilities in supporting the MSFC SHE program.
   9. A method to ensure the SHE plan is reviewed annually and updated as necessary.

b. System and worksite analysis:
   1. The methods of identifying potentially hazardous conditions in the work area and operations, e.g., hazard analysis, safety assessment, change analysis, risk assessment and employee identified concerns.
   2. A description of the OSHA programs that require documented programs that are applicable to the contracted effort (e.g., Respiratory Protection, Hazard Communication, Confined Space, and Lockout/Tagout, etc. Address their interrelationships with the applicable MSFC SHE programs.)
   3. The methods of conducting and documenting formal worksite safety inspections as required by OSHA. [Applicable **ONLY** to offsite contracts]
   4. The methods of conducting and documenting supervisors' monthly safety visits. Onsite safety visits shall be performed once per month per supervisor and documented in the Supervisors Safety Web page.

DRD Continuation Sheet

TITLE: Safety, Health, and Environmental (SHE) Plan **DRD NO.:** **1145SA-004**
DATA TYPE: 2 **PAGE:** 4/5

15. **DATA PREPARATION INFORMATION (CONTINUED):**

c. Hazard prevention and control:

1. The methods of controlling potentially hazardous conditions in the work area or in operations. This includes the generation of plans, procedures, and other working documents which clearly identify the hazardous situations in the work are or operation and the necessary cautions taken to mitigate the hazards. NOTE: MSFC requires an annual review of these plans and procedures. MSFC Safety Department concurrence is required for onsite hazardous procedures.
2. The methods of ensuring controls over the procurement, storage, issuance, and use of hazardous chemical and materials are in accordance with MPR 8500.1 and the recycling and disposal of any hazardous waste is in accordance with MWI 8550.1.
3. The methods of ensuring a documented emergency management program. Include a list of contractor emergency points that are located onsite. (Note: Onsite contractors may use MPR 1040.3.)
4. The methods of ensuring the investigation of all mishaps and close calls to determine root cause and the reporting requirements are in accordance with MWI 8621.1. (Reference DRD 1145SA-005, *Mishap and Safety Statistics Report*).
5. The method for providing safety, health, and environmental services applicable to the contracted effort such as hazardous waste disposal, industrial hygiene monitoring, emergency medical support, hearing conservation program, respiratory protection, and hazard communication. (Note in the SHE plan which, if any of these services are to be provided by MSFC for onsite work.)
6. The methods employees have to suspend work where safety, health or environmental conditions warrant such action.

d. Safety, health and environmental training:

1. The methods for ensuring each employee is trained to recognize hazards, avoid accidents, know the hazards specific to their job, and fully understands the contractor's disciplinary program.
2. The methods for assessing employee training needs specific to their job. (Onsite employee assessments shall be performed using the SHE Training Assessment located on the MSFC Supervisor Safety Web Page.) [Documentation in the Supervisor Safety Web Page is applicable **ONLY** to onsite contracts.]
3. The methods for training and documenting this training when designating employees to be competent, qualified, authorized or certified to perform operations that require specific training in accordance with 29 CFR 1910 or 29 CFR 1926.
4. A list of identified job categories under the contracted effort that require MSFC safety certification in accordance with MWI 3410.1, "Personnel Certification Program". Example job categories that require MSFC safety certification include, but not limited to, operating MSFC lifting equipment (forklifts, cranes, etc.), working with chemicals, hazardous waste, pressure systems, etc. Personnel Certification for onsite job categories identified in MWI 3410.1 shall be tracked in the MSFC Certification Database (CERTRAK). (NOTE: offsite contracts shall list the job categories under the contracted effort that require OSHA documented training and certification.)

DRD Continuation Sheet

TITLE: Safety, Health, and Environmental (SHE) Plan **DRD NO.**: **1145SA-004**
DATA TYPE: 2 **PAGE**: 5/5

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

e. Environmental compliance - The methods to ensure compliance with environmental laws and regulations 40 CFR, Alabama Department of Environmental Management (ADEM), and MPR 8500.1 by:

1. Reporting hazardous and toxic substance use.
2. Implementing and reporting green procurements in accordance with MWI 8540.2.
3. Reducing, reusing, and recycling of hazardous and toxic substances prior to disposal in accordance with MWI 8550.1.
4. Minimizing stormwater pollution in accordance with MWI 8550.2.
5. Ensuring equipment and processes permitted by applicable laws.
6. Disposing of solid and liquid materials as permitted by applicable laws.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SA-005**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Mishap and Safety Statistics Reports
7. **DESCRIPTION/USE**: To provide reporting of metrics, mishaps, close calls, and serious non-occupational injuries or illnesses.
8. **OPR**: QD50 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**:
14. **INTERRELATIONSHIP**: DRD 1145SA-004, *Safety, Health, and Environmental (SHE) Plan.* SOW paragraphs 4.5.2, 5.3, 6.3, 7.3, 8.3 and 9.3
15. **DATA PREPARATION INFORMATION:**

15.1 **SCOPE**: The Mishap and Safety Statistics Reports document all mishaps and close calls as required in NPR 8621.1.

15.2 **APPLICABLE DOCUMENTS**:

NPR 8621.1	*NASA Procedural Requirements for Mishap Reporting, Investigating, and Recordkeeping*
MWI 8621.1	*Close Call and Mishap Reporting and Investigation Program*

15.3 **CONTENTS**: The Mishap and Safety Statistics Reports shall contain the information required by NPR 8621.1 and MWI 8621.1. The contractor shall use the forms listed in 15.4 to report mishaps and related information required to produce the safety metrics.

15.4 **FORMAT**: The following formats or electronic equivalent shall be submitted:

a. MSFC Form 4370, "MSFC Flash Mishap Report."
b. NASA Form 1627, "NASA Mishap Report."
c. MSFC Form 4371, "MSFC Contractor Accident and Safety Statistics."
d. Mishap Board Report using the format provided in NPR 8621.1.

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SE-001**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/1

6. **TITLE**: Systems Engineering Management Plan

7. **DESCRIPTION/USE**: To describe the overall systems engineering approach for the contractor integration effort.

8. **OPR**: EV61 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to USO-CLV-SE-25707, *Upper Stage Systems Engineering Management Plan* and NPR 7123.1, *NASA System Engineering Processes and Requirements*

14. **INTERRELATIONSHIP**: SOW paragraph 4.2

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Systems Engineering Management Plan defines the Systems Engineering and Integration (SE&I) process and products throughout the project life cycle and its' interface(s) with other engineering disciplines across the project.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Systems Engineering Management Plan shall provide a description of the planned systems engineering and integration (SE&I) activities including, but not limited to, requirements development, system analyses, interface control, and verification. The plan shall include key milestones, a schedule of SE&I tasks and products, an overview of planned technical reviews, the methods, tools, and techniques for performing and controlling the systems engineering and integration functions, and the organizational structure utilized to accomplish these activities.

15.4 **FORMAT**: Contractor format is acceptable.

15.6 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SE-002**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/1

6. **TITLE**: Specifications

7. **DESCRIPTION/USE**: A technical document used to describe the functional and physical characteristics of a Source Control Item (SCI) and how these characteristics are met.

8. **OPR**: QD02/EV62/JP309. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: Specifications provide the performance, design detail, and verification requirements for a SCI.

15.2 **APPLICABLE DOCUMENTS**:

MIL-STD-961	*Department of Defense Standard Practices for, Defense Specifications*
MSFC-STD-3394	*Standard for Contractor Configuration Management, MSFC Programs/Projects*

15.3 **CONTENTS**: The specifications shall be prepared in accordance with MIL-STD-961.

15.4 **FORMAT**: The format shall be in accordance with the instructions in MIL-STD-961.

15.5 **MAINTENANCE**: Changes shall be incorporated by complete reissue. When a specification is placed under Government configuration control, proposed changes shall be submitted by Engineering Change Proposal (ECP) in accordance with MSFC-STD-3394.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: RFP **ISSUE**: RFP
2. **DRD NO.**: **1145SE-003**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/4
6. **TITLE**: Interface Control Documents
7. **DESCRIPTION/USE**: To provide documentation in the form of drawings and/or written records to identify for each side of an interface those necessary design definitions between contractors and/or Government agencies to provide control of and assure an agreeable and compatible interface for SCIs.
8. **OPR**: EV62 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Attachment A to this DRD contains a sample Interface Control Document outline.
14. **INTERRELATIONSHIP**: ICD content is traceable to the requirements found in the system specifications (DRD 1145CM-002). SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Interface Control Documents (ICD's) identify design definitions for each side of an interface that shall assure design control and compatibility.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: ICD's shall address all physical, functional, and procedural requirements necessary to describe the interfaces that must be met to ensure project, hardware, and software compatibility. These interfaces shall include the following:

a. Physical - Interfaces involving physical mating and spatial relationships between interconnecting parts of interfacing end items, including clearance envelopes established to avoid interferences and to permit access.
b. Functional - Interfaces involving the interaction or influence of conditions imposed by one subsystem or component upon another or by external sources such as fluids, thermal, electrical, environmental, data, and loads.
c. Procedural - Interfaces involving critical sequence of events occurring in assembly, disassembly, alignment, service operations, and computer programs.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated as approved by Engineering Change Proposal (ECP).

Attachment A
Sample Outline for Interface Control Document

1.0 SCOPE

1.1 Introduction - *This section identifies the extent and the systems/subsystems to which the ICD is applicable.*

1.2 Program Description - *This section presents a brief description of the overall program and identifies each applicable interface. It will provide a general description of each interface and any other related systems.*

1.3 Roles and Responsibilities - *This section will define the technical responsibilities for each organization involved in controlling the interface. It will specify who has prime and who has support responsibilities and will appropriately present a programmatic schedule. The members and responsibilities of the Interface Control Working Group (ICWG) will also be identified.*

1.4 Interface Configuration Management - *This section will specify how configuration control of the interface will be managed.*

1.5 Contractor and Government/Customer Deliverables - *This section will summarize any agreements that involve the interchange or delivery of hardware, software, or data between or among organizations. A clearly defined schedule will be provided and agreed to by all affected organizations.*

2.0 APPLICABLE DOCUMENTS - *This section must contain a list of every document referenced in the text. Every document listed here must be referenced in the ICD text. A standard paragraph is usually included as follows: "The following documents, latest revision unless otherwise specified, form a part of this specification to the extent specified herein. In the event of conflict between documents referenced herein and the contents of this specification, this specification shall apply, except for safety-related items and issues."*

2.1 Government Documents - *Government documents shall be listed by the document number and title in the following order:*

1. *Specifications: federal, military, and other government agency.*
2. *Standards: federal, military, and other government agency.*
3. *Drawings: where detailed drawings referenced in a specification are listed on an assembly drawing, it is only necessary to list the assembly drawing.*
4. *Other publications: manuals, regulations, handbooks, bulletins, etc.*

2.2 Contractor Documents - *Non-government documents shall be listed by the document number and title in the same order (i.e., specifications, standards, drawings, other).*

3.0 INTERFACE DEFINITION AND DESCRIPTION

3.1 A-to-B Interface Characteristics and Functions - *More detailed information on interface functional descriptions and unique interface properties will be provided here. The remaining paragraphs in this document will contain the interface design details. The sections specified in 3.2 through 3.10 below are provided as a checklist. Each of these topics listed, when applicable, will be accompanied by detailed interface drawings, schematics, wiring data, quantitative tables listing specific requirements (i.e. loads, environments), interface characteristics, etc., in order to specify exact parameters of the interface. The document will only contain those sections applicable to the interface.*

Attachment A
Sample Outline for Interface Control Document

3.2 Mechanical Interfaces
- 3.2.1 Envelopes
- 3.2.2 Coordinate Systems
- 3.2.3 Mounting/Installation
- 3.2.4 Stowage Provisions
- 3.2.5 Handling
- 3.2.6 Purge, Vent, Drain
- 3.2.7 Umbilicals and Appendages
- 3.2.8 Flight Crew
- 3.2.9 Personnel

3.3 Structural Interfaces
- 3.3.1 Loads
  - 3.3.1.1 Acoustic
  - 3.3.1.2 Transportation
  - 3.3.1.3 Flight
  - 3.3.1.4 Vibration
  - 3.3.1.5 Ground Handling
  - 3.3.1.6 Flight Crew
  - 3.3.1.7 Personnel
- 3.3.2 Structural Characteristics
  - 3.3.2.1 Flexibility
- 3.3.3 Mass Properties
  - 3.3.3.1 Weight/Mass
  - 3.3.3.2 Center of Gravity
  - 3.3.3.3 Moments of Inertia

3.4 Environmental Issues

3.5 Electrical Interfaces
- 3.5.1 Power
- 3.5.2 Switching
- 3.5.3 Fusing
- 3.5.4 Grounding
- 3.5.5 Electro-Explosive Devices
- 3.5.6 EMI/EMC

3.6 Communications and Data Handling Interfaces
- 3.6.1 Communications
- 3.6.2 Telemetry
- 3.6.3 Tracking
- 3.6.4 Command

3.7 Performance Interfaces
- 3.7.1 Orbits
- 3.7.2 Delta V

Attachment A
Sample Outline for Interface Control Document

3.8 Operations Interfaces
- 3.8.1 Flight Operations
  - 3.8.1.1 Docking/Alignment
  - 3.8.1.2 Rendezvous
  - 3.8.1.3 Deployment/Retrieval
  - 3.8.1.4 Flight Crew
- 3.8.2 Ground Operations
  - 3.8.2.1 Checkout
  - 3.8.2.2 Prelaunch
  - 3.8.2.3 Post Landing
  - 3.8.2.4 Personnel
- 3.8.3 Command/Control Center
  - 3.8.3.1 Man-Machine Operations
  - 3.8.3.2 Personnel

3.9 Safety
- 3.9.1 Design Safety
- 3.9.2 Flight Operations
- 3.9.3 Ground Operations
- 3.9.4 Range Safety

3.10 Reliability
- 3.10.1 Reliability Design

3.11 Maintainability

4.0 APPENDICES
4.1 Interface Control Drawings
4.2 Supporting Data

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SE-004**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Launch Commit Criteria
7. **DESCRIPTION/USE**: To provide Constellation Vehicle specific LCC input to the Launch Commit Criteria and Background document.
8. **OPR**: JP30
9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**:
14. **INTERRELATIONSHIP**: SOW paragraph 4.2
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Launch Commit Criteria establishes the requirements for the content, format and maintenance of the Launch Commit Criteria Inputs for the Upper Stage and related GSE.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Launch Commit Criteria shall identify each constraint to launch and the associated acceptable limits, applicable time, and preplanned contingencies. Rational, measurement numbers, and other applicable information shall be included as defined by the Constellation Program Office.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Contractor shall ensure that all Upper Stage sections are current. Contractor shall review all changes proposed by other elements for possible affect on Upper Stage hardware.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SE-005**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2
6. **TITLE**: Electromagnetic Effects System Control Plan
7. **DESCRIPTION/USE**: To define the electromagnetic compatibility (EMC), lightning protection, and electrostatic discharge (ESD) control program.
8. **OPR**: EI24 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: The control plan shall be updated during the contract to reflect the evolution of the design.
14. **INTERRELATIONSHIP**: SOW paragraph 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Electromagnetic Effects Control Plan defines the approach for implementation of an electromagnetic effects (EME) control program. It describes the contractor EME control program organization and responsibilities. It also includes interpretation of EME requirements and a description of additional EME requirements levied by the contractor on subsystems and equipment to meet system EME requirements. Additionally, this document addresses specific design measures to meet EME requirements as well as addressing EME design, test, and analysis requirements.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: This plan shall document an approach for implementation of an EMC control program for the element. The detailed plan shall consider the following areas:

a. Internal organization and responsibility.
b. System compatibility.
c. Subsystem compatibility.
d. Subsystem and equipment requirements.
e. Electromagnetic interference safety margins for critical equipment.
f. Interference and susceptibility control.
g. Degradation criteria.
h. Wiring and cable.
i. Electrical power and electrical interface.
j. Power frequency leakage current.
k. Bonding and grounding.
l. Lightning protection.
m. Lightning critical items list.

DRD Continuation Sheet

TITLE: Electromagnetic Effects Control Plan **DRD NO.:** 1145SE-005

DATA TYPE: 2 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

n. Static electricity.
o. Personnel hazards.
p. Pyrotechnics and bridge wire actuated devices (BWAD's).
q. Spacecraft charging controls.
r. EMC analysis requirements.
s. EMC verification planning and methodology.
t. EMC, lightning protection, and ESD documentation and reports.

The plan shall include design and test requirements which will assure compatibility within the element as well as with all external interfaces. This includes modification of equipment level requirements to be compatible with special element requirements and the EMC sections of applicable Interface Control Documents (ICD's).

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SE-006**
3. **DATA TYPE**: 2/3
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Sustaining Engineering Plan and Reports
7. **DESCRIPTION/USE**: To provide a detailed approach for the sustaining engineering of the Upper Stage system and periodic project reports.
8. **OPR**: JP30 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Plan shall be a Type 2 and Reports shall be a Type 3.
14. **INTERRELATIONSHIP**: SOW paragraph 4.7
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Sustaining Engineering Plan and Report describes the sustaining engineering approach for the Upper Stage system and the report provides status of sustaining engineering activities.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Sustaining Engineering Plan and Report shall define the approach to perform sustaining engineering of the hardware and software for the Upper Stage Element and associated engineering development units and flight test units; Ground Processing Systems, and Support Equipment; Mission Operations Systems and Support Equipment; Training Systems and Support Equipment; Flight Test Facilities, Systems, and Support Systems. The plan shall describe the Program Management, Program Integration, Systems Engineering and Integration, Safety & Mission Assurance, and Integrated Logistics Support functions. This plan shall detail the approach to perform sustaining engineering of contractor-responsible facilities. The plan shall address the sustaining engineering approach for cost, schedule, and technical change initiation, definition, and implementation. The plan shall contain a list of Data Requirements Descriptions (DRDs) that the contractor proposes to maintain in the sustaining engineering phase and any proposed changes to those Data Requirements Descriptions (DRD's). The plan shall propose changes to procedures/processes implemented for DDT&E. Finally, the plan shall provide the approach for disposal of Upper Stage assets at the end of the program. A detailed list of items and recommended methods of disposal shall be provided.

Monthly project progress reports track the estimated vs. actual worker resources and costs (workers and materials) to implement each sustaining engineering change to Upper Stage systems.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SE-007**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: System Connectivity Diagrams and End-to-End Functional Schematics

7. **DESCRIPTION/USE**: To provide connectivity and end-to-end functional definition of systems for analysis and troubleshooting during design and operation.

8. **OPR**: EV12 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: These diagrams and schematics include end-to-end paths and signal identification for command and control, power distribution and monitoring, temperature control, environmental control, etc., in sufficient detail to define functions and architecture of the integrated system.

15.2 **APPLICABLE DOCUMENTS**:
MIL-STD-100 *Engineering Drawings Practices*

15.3 **CONTENTS**:

a. System Connectivity Diagrams - Diagrams shall be prepared to graphically depict the integrated connectivity of services such as electrical power, command and data flow, thermal and environmental, and fluids structured in a logical manner to show relationships of functional assemblies/enclosures/equipment.

b. End-to-End Functional Schematics - Schematics shall be prepared to depict integrated end-to-end functional configuration of all signals (control and monitor), and power and energy paths within a system. Schematics shall be structured in a logical manner that will show the complete functional performance and relationship of the system and subsystems and the primary element interfaces to the plug/pin or connector level. End-to-End Schematics shall reference internal component/box design drawing for distribution or configuration details and shall identify various power sources, switch elements, controls, indicators, valves, motors, relays, sensors, effectors, wires pipes, etc. by symbol and reference designator number. Sensor and effector input/output channels and components shall be identified by the name and identification number as defined in the Instrumentation Program and Command List Specification. Logic functions performed by data management system shall also be depicted.

15.4 **FORMAT**: Format of product drawings shall be in accordance with MIL-STD-100.

DRD Continuation Sheet

TITLE: System Connectivity Diagrams and End-to-End Functional Schematics **DRD NO.:** **1145SE-007**

DATA TYPE: 3 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

15.5 **MAINTENANCE**: All drawings produced under this DRD shall be maintained current. Changes to and/or updating of drawings shall be in accordance with the Contractor's approved drawing system. Any changes to engineering drawings under Government Class I change control shall be submitted by engineering change proposal (ECP) and must include the changes to the system functional schematics and interconnect diagrams, if applicable.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SE-008**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Mass Properties Report

7. **DESCRIPTION/USE**: To report on the status of the contractor's mass properties, which includes Basic and Predicted estimates. The report also provides the mass properties required for other technical analyses and/or trade studies.

8. **OPR**: EV12 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to AIAA S-120-2006, *Mass Properties Control for Space Systems* and CxP 72050, *Mass Properties Control Plan for CLV Integrated Stack.*

14. **INTERRELATIONSHIP**: SOW paragraphs 4.2, 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: Periodic Mass Properties Reports provide insight to the status of the mass properties of the program throughout all of its phases. The mass maturity (estimated, calculated, or actual) of each component mass shall be included as part of the recorded component data. Totals of each of these categories shall be recorded to provide an indication of the system maturity.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: For the purposes of mass properties, coordinate systems for all flight elements shall be separate but parallel to the system coordinate system with defined offsets. The Mass Properties Report shall include the following:

a. Scope.
b. Introduction.
c. Mass summaries.
    1. Mass summary by function.
    2. Mass properties summary by location.
    3. Mass Technical Performance Measurement (TPMs) single sheet, including:
        (a) Basic and predicted mass relative to the requirement, reserves if applicable.
        (b) Top potential changes (threats and opportunities).
        (c) Mass maturity by maturity code as specified in the Mass Properties Control Plan.
d. Mass change analysis.
    1. Mass change summary.
    2. Pending changes.
    3. Potential changes.
e. Coordinate system(s).
f. Sequenced mass properties.
    1. Staging events.
    2. Propellant depletion.

DRD Continuation Sheet

TITLE: Mass Properties Report **DRD NO.:** 1145SE-008
DATA TYPE: 3 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**
    g. Movable parts.
    h. Critical mass properties.
    i. Mass Growth Allowance (MGA) depletion schedule as specified in the MPCP.
    j. Uncertainties.
    k. System design features.
    l. Detailed mass properties.
    m. Acronyms.
    n. References.

15.4 **FORMAT**: The contractor and the government shall agree to a functional breakdown of the mass properties data. Microsoft Excel or compatible or other electronic transmission must be acceptable to MSFC.

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SE-009**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/2
6. **TITLE**: Requirement Flowdown Matrix
7. **DESCRIPTION/USE**: To provide the traceability and visibility that program requirements have been properly and completely flowed down to lower level documents.
8. **OPR**: EV62 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Trace to the testable function of DRD 1145VR-002, *Verification Requirements Information/Document*. Compliance for each requirement is documented in DRD 1145VR-006, *Verification Compliance Information/Document.*
14. **INTERRELATIONSHIP**: SOW paragraph 4.2
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Requirement Flowdown Matrix covers the flowdown of requirements starting with the top level requirements (Level I) down through subsequent levels, including identification of all end item requirements.

15.2 **APPLICABLE DOCUMENTS**:
Level V Subsystem Specifications
Source Control Item Specifications

15.3 **CONTENTS**: The Requirement Flowdown Matrix shall identify and trace all project and program requirements from Level V Subsystem Specifications to Source Control Item Specifications. The matrix shall state the paragraph numbers and requirements to be met at each level. Higher level requirements that are not flowed down and lower level requirements that do not trace to a higher level requirement shall be identified.

15.4 **FORMAT**: The format shall include the data which identifies and relates each requirement with the applicable next level requirement and shall be Cradle compatible.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SE-010**
3. **DATA TYPE**: 3
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Electromagnetic Effects Design Analysis Report
7. **DESCRIPTION/USE**: To provide data thatensure the electromagnetic compatibility of equipment and the overall system.
8. **OPR**: EI24
9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Informal technical memoranda using the contractor's internal format shall be provided periodically to report significant analytical findings and inform MSFC of analytical developments.
14. **INTERRELATIONSHIP**: SOW paragraph 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Electromagnetic Effects (EME) Design Analysis Report describes the design, analyses, tests and results of efforts to assure individual equipment meets the EME requirements and the entire system is compatible.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Electromagnetic Effects Design Analysis Report shall describe the approach taken to assure EME requirements are met and the results of that effort. The report shall include the following items (where applicable) for a system, subsystem, or individual equipment:

a. Electrical bonding.
b. Circuit grounding and isolation.
c. Cable design and routing.
d. Connector separation and shield termination.
e. Frequency management.
f. Emission and susceptibility control.
g. Critical circuit identification.
h. Lightning protection.
i. Electrostatic discharge protection.
j. Analyses results.
k. Test results.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SW-001**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Software Requirements Specification

7. **DESCRIPTION/USE**: To define and record the software requirements to be met by a computer software configuration item (CSCI). To specify the requirements for a CSCI and the methods to be used to ensure that each requirement has been met; the basis for design and qualification testing of a CSCI.

8. **OPR**: EV22 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Requirements pertaining to the CSCI's external interfaces are presented in the Software Requirements Specification (SRS). Software requirements specifications need not be textual, and may include representations in rigorous specification languages, graphical representations, or specifications suitable for requirements or design analysis tools or methodologies.

14. **INTERRELATIONSHIP**: SOW paragraph 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Software Requirements Specification details the software performance, interface, operational, verification, and quality assurance requirements.

15.2 **APPLICABLE DOCUMENTS:** None

15.3 **CONTENTS**: The Software Requirements Specification shall contain:

a. System overview.
b. CSCI requirements.
   1. Functional requirements.
   2. Required states and modes.
   3. External interface requirements.
   4. Internal interface requirements.
   5. Internal data requirements.
   6. Adaptation requirements.
   7. Safety requirements.
   8. Performance and timing requirements.
   9. Security and privacy requirements.
   10. Environment requirements.
   11. Computer resource requirements.
      (a) Computer hardware resource utilization requirements.
      (b) Computer software requirements.
      (c) Computer communications requirements.

DRD Continuation Sheet

TITLE: Software Requirements Specification **DRD NO.:** **1145SW-001**
DATA TYPE: 1 **PAGE:** 2/2

15.3 **CONTENTS (CONTINUED):**

12. Software quality characteristics.
13. Design and implementation constraints.
14. Personnel-related requirements.
15. Training-related requirements.
16. Logistics-related requirements.
17. Packaging requirements.
18. Precedence and criticality of requirements.

c. Qualification provisions.
d. Requirements traceability and verification data.
e. Requirements partitioning for phased delivery.
f. Testing requirements that drive software design decisions; e.g., special system level timing requirements/checkpoint restart.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SW-002**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Software Configuration Management Plan
7. **DESCRIPTION/USE**: To describe a plan for performing software configuration management (SCM). To develop and record plans for software configuration management activities.
8. **OPR**: EV22 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**.
14. **INTERRELATIONSHIP**: SOW paragraph 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**.: The Software Configuration Management Plan describes the functions, responsibilities, and authority for the accomplishment and implementation of software configuration management to be performed during the software life cycle. This plan identifies the required coordination of software configuration management activities with other activities of the project. This plan also identifies the tools and the physical and human resources required for the execution of the plan.

15.2 **APPLICABLE DOCUMENTS:** None

15.3 **CONTENTS**: The Software Configuration Management Plan shall contain:

a. The project organization(s) within which Software Configuration Management is to apply.
b. Responsibilities of the software configuration management organization.
c. References to the software configuration management policies and directives that apply to the project.
d. All functions and tasks required to manage the configuration of the software, including configuration identification, configuration control, status accounting, and configuration audits and reviews.
e. Schedule information, which establishes the sequence and coordination for the identified activities and for all events affecting the Plan's implementation.
f. Resource information, which identifies the software tools, techniques, and equipment necessary for the implementation of the activities.
g. Plan maintenance information, which identifies the activities and responsibilities necessary to ensure continued planning during the life cycle of the project.
h. Release management and delivery.

15.4 **FORMAT**: Contractor format is acceptable.

15.4 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SW-003**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Software Maintenance Plan

7. **DESCRIPTION/USE:** To define the objectives, standards, and procedures to be used in the software maintenance process.

8. **OPR**: EV22 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraph 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Software Maintenance Plan provides insight into the method, approach, responsibility, and processes to be followed for maintenance of software and its associated documentation

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Software Maintenance Plan shall provide separate volumes for each system element, e.g., ground operations, flight operations, mission operations, and spacecraft. The Software Maintenance Plan shall include:

a. Plan information for the following activities:
   1. Maintenance process implementation.
   2. Problem and modification analysis.
   3. Modification implementation.
   4. Maintenance review/acceptance.
   5 Migration.
   6. Software Retirement.
   7. Software Assurance.

b. Specific standards, methods, tools, actions, procedures, and responsibilities associated with the maintenance process. In addition, the following elements are included:
   1. Development and tracking of required upgrade intervals, including implementation plan.
   2. Approach for the scheduling, implementation, and tracking of software upgrades.
   3. Equipment and labs required for software verification and implementation.
   4. Updates to documentation for modified Commercial-Off-The-Shelf (COTS) or non-COTS software.
   5. Licensing agreements for COTS.
   6. Plan for and tracking of operational backup software.
   7. Approach for the implementation of modifications to operational software (e.g., testing of software in development lab prior to operational use).

DRD Continuation Sheet

TITLE: Software Maintenance Plan **DRD NO.:** **1145SW-003**

DATA TYPE: 2 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

8. Approach for software delivery process including distribution to facilities and users of the software products and installation of the software in the target environment (including, but not limited to, spacecraft, simulators, Mission Control Center, and ground operations facilities).
9. Approach for providing NASA access to the software version description data; e.g., revision number, licensing agreement.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SW-004**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2
6. **TITLE**: Software Design Description
7. **DESCRIPTION/USE**: To define and record the design of a computer software configuration item (CSCI). To be used as the basis for implementing the software, and to provide visibility into the design and the information needed for software support.
8. **OPR**: EV22
9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Software design specifications need not be textual, and may include representations in rigorous specification languages, graphical representations, or specifications suitable for requirements or design analysis tools or methodologies.
14. **INTERRELATIONSHIP**: SOW paragraph 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Software Design Description describes the design of a CSCI. It describes the CSCI-wide design decisions, the CSCI architectural design, and the detailed design needed to implement the software.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Software Design Description shall include:

a. CSCI-wide design decisions/trade decisions.
b. CSCI architectural design.
c. CSCI decomposition and interrelationship between components.
   1. CSCI components:
      (a) Description of how the software item satisfies the software requirements, including algorithms, data structures, and functional decomposition.
      (b) Software item input/output description.
      (c) Static/architectural relationship of the software units.
      (d) Concept of execution including data flow, control flow, and timing.
      (e) Requirements traceability.
      (f) CSCI's planned utilization of computer hardware resources.
   2. Rationale for software item design decisions/trade decisions including assumptions, limitations, safety and reliability related items/concerns or constraints in design documentation.
   3. Interface design.
d. CSCI Implementation Plan.

DRD Continuation Sheet

TITLE: Software Design Description **DRD NO.: 1145SW-004**

DATA TYPE: 2 **PAGE**: 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED)**:

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SW-005**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Software Test Plan
7. **DESCRIPTION/USE**: To develop and record plans for conducting computer software configuration item (CSCI) qualification testing and/or system qualification testing of a software system. To assess the adequacy of planning for CSCI and, if applicable, software system qualification testing.
8. **OPR**: EV22
9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Requirements pertaining to CSCI interfaces are presented in the *Software Requirements Specification* (DRD 1145SW-001).
14. **INTERRELATIONSHIP**: SOW paragraph 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Software Test Plan describes the plans for software component level testing, software integration testing, software qualification testing, and system qualification testing of software systems. The plan describes the software test environment to be used for testing, identifies the tests to be performed, and provides schedules for environment, development, and test activities. The plan provides an overview of software testing, test schedules, test management procedures, required resources, relevant stakeholder roles/responsibilities, and training requirements.

15.2 **APPLICABLE DOCUMENTS:** None

15.3 **CONTENTS**: The Software Test Plan shall include:

a. Test levels.
b. Test types (e.g., unit testing, software integration testing, systems integration testing, end-to-end testing, acceptance testing, regression testing).
c. Test classes.
d. General test conditions.
e. Test progression.
f. Data recording, reduction, and analysis.
g. Test coverage (breadth and depth) or other methods for ensuring sufficiency of testing.
h. Planned tests, including items and their identifiers.
i. Test schedules.
j. Requirements traceability (or verification matrix).
k. Qualification testing environment, site, personnel, and participating organizations.
l. Training requirements.
m. Resources.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145SW-006**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/1

6. **TITLE**: Software Test Procedures

7. **DESCRIPTION/USE**: To define and record the test preparation, test cases, and test procedures to be used for computer software configuration item (CSCI) qualification testing or for system qualification testing of a software system. To assess the adequacy of the qualification testing to be performed.

8. **OPR**: EV22 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraph 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Software Test Procedures describe the test preparations, test cases, and test procedures to be used to perform qualification testing of a CSCI or a software system or subsystem.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Software Test Procedures shall contain:

a. Test preparations, including hardware and software.
b. Test descriptions, including:
   1. Test identifier.
   2. System or CSCI requirements addressed by the test case.
   3. Prerequisite conditions.
   4. Test input.
   5. Instructions for conducting procedure.
   6. Expected test results, including criteria for evaluating results, and assumptions and constraints.
   7. Criteria for evaluating results.
c. Requirements traceability.
d. Identification of test configuration

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO:** 1145 **ISSUE:** RFP
2. **DRD NO.:** **1145SW-007**
3. **DATA TYPE:** 3
4. **DATE REVISED:**
5. **PAGE:** 1/1
6. **TITLE:** Software Test Report
7. **DESCRIPTION/USE:** To assess, analyze and record the results of the computer software configuration item (CSCI) qualification testing, system qualification testing of a software system, or other testing identified in the contract.
8. **OPR:** EV22
9. **DM:** JP30
10. **DISTRIBUTION:** Per Contracting Officer's letter
11. **INITIAL SUBMISSION:** Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY:** Per Data Requirements Matrix
13. **REMARKS:**
14. **INTERRELATIONSHIP:** SOW paragraph 9.3
15. **DATA PREPARATION INFORMATION:**

15.1 **SCOPE:** The Software Test Report is a record of the qualification testing performed on a CSCI, a software system or subsystem, or other software-related item. This report covers the qualification of individual contract end items of software.

15.2 **APPLICABLE DOCUMENTS:** None

15.3 **CONTENTS:** The Software Test Report shall include:

a. Overview of the test results.
   1. Overall assessment of the software as demonstrated by the test results.
   2. Remaining deficiencies, limitations, or constraints detected by testing. (e.g., including description of the impact on software and system performance, the impact a correction would have on software and system design, and recommendations for correcting the deficiency, limitation, or constraint).
   3. Impact of test environment.
b. Detailed test results.
   1. Project-unique identifier of a test and test procedure(s).
   2. Summary of test results (e.g., including requirements verified).
   3. Problems encountered.
   4. Deviations from test cases/procedures.
c. Test log.
   1. Date(s), time(s), and location(s) of tests performed.
   2. Test environment, hardware, and software configurations used for each test.
   3. Date and time of each test-related activity, the identity of the individual(s) who performed the activity, and the identities of witnesses, as applicable.
d. Rationale for decisions.

15.4 **FORMAT:** Contractor format is acceptable.

15.6 **MAINTENANCE:** Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145VR-001**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/2
6. **TITLE**: Master Verification and Validation Plan
7. **DESCRIPTION/USE**: To document the verification/validation approach, verification/validation activities, and organizations necessary to define and execute the project's verification/validation program. To identify the verification/validation required to be performed to satisfy each of the requirements.
8. **OPR**: EV62 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Reference is made to MSFC-HDBK-2221, *Verification Handbook, Volume I: Verification Process,* and *Volume II: Verification Documentation Examples.* Volume II provides examples of verification documentation as specified in Volume I that can be used as a guide in the development of or in the assessment of similar documentation. Verification/Validation planning documents developed to address specific verification activities (e.g., Test Plans, Analyses Plans, Inspection Plans, etc.) shall be acceptable as long as the respective content of the data meets that identified in CONTENTS (Item 15.3) and the submission of the collective data meets that identified in INITIAL SUBMISSION/SUBMISSION FREQUENCY (Items 11 & 12). Reference is made to USO-CLV-SE-25703, *Upper Stage V&V Plan* and USO-CLV-SE-TBD, *Upper Stage Subsystem Requirements Document.*
14. **INTERRELATIONSHIP**: SOW paragraph 4.2
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Master Verification Plan information provides a detail description of the project's verification/validation approach and structure for implementing the verification/validation program, as well as detail descriptions for the planned verification/validation requirements. The Plan also defines the method(s) (e.g., test, analysis, inspection), level(s) (e.g., component, subsystem, system), and phase(s) (e.g., qualification, acceptance) of the verification /validation to be performed to satisfy each of the requirements.

15.2 **APPLICABLE DOCUMENTS**:

15.3 **CONTENTS**: The Master Verification Plan shall include the following:

a. Identification of the method(s) (e.g., test, analysis, inspection) in which the verification/validation is performed to satisfy each of the requirements documented in the Subsystem Specifications (as applicable) and Source Control Item specifications.
b. Identification of the level(s) (e.g., component, subsystem, system) at which the verification/validation is performed to satisfy each of the requirements documented in the Subsystem Specifications (as applicable) and Source Control Item specifications.

DRD Continuation Sheet

TITLE: Master Verification and Validation Plan (MVP) **DRD NO.:** **1145VR-001**
DATA TYPE: 1 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

c. Identification of the phase(s) (e.g., qualification, acceptance) during which the verification/ validation is performed to satisfy each of the requirements documented in the SS SPec, CEI, or EIS.

d. Overview of the project's verification/validation program (i.e., qualification/acceptance vs. protoflight, verification/validation of spares, refurbishment/reverification/revalidation plans).

e. Description of the project's organizational structure for implementing the verification/ validation program (i.e., organization's involved in component vs. system tests, review and signoff authority for compliance data).

f. Detail descriptions of all verification/validation activities (i.e., tests, analyses, inspections) to be performed based on the identified verification/validation requirements. Identify any prerequisites, constraints, and objectives for all the verification/validation activities.

g. Detail time correlated sequence of verification/validation activities.

h. Description and planned usage of the support equipment, software, facilities, and tooling necessary to execute the verification/validation activities.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145VR-002**
3. **DATA TYPE**: 1
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Verification/Validation Requirements
7. **DESCRIPTION/USE**: To identify the verification/validation required to be performed to satisfy each of the requirements.
8. **OPR**: EV62 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Reference is made to MSFC-HDBK-2221, *Verification Handbook, Volume I: Verification Process,* and *Volume II: Verification Documentation Examples.* Volume II provides examples of verification documentation as specified in Volume I that can be used as a guide in the development of or in the assessment of similar documentation.
14. **INTERRELATIONSHIP**: SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Verification/Validation Requirements information identifies the method(s) (e.g., test, analysis, inspection), level(s) (e.g., component, subsystem, system), and phase(s) (e.g., qualification, acceptance) of the verification /validation to be performed to satisfy each of the requirements.

15.2 **APPLICABLE DOCUMENTS**:
Upper Stage Subsystem Requirements Document
USPC Configuration End Item (CEI) Specification
USPC End Item Specification (EIS)

15.3 **CONTENTS**: The Verification/Validation Requirements information shall include the following:

a. Identification of the method(s) (e.g., test, analysis, inspection) in which the verification/validation is performed to satisfy each of the requirements documented in the SRD, CEI, or EIS.
b. Identification of the level(s) (e.g., component, subsystem, system) at which the verification/validation is performed to satisfy each of the requirements documented in the SRD, CEI, or EIS.
c. Identification of the phase(s) (e.g., qualification, acceptance) during which the verification/validation is performed to satisfy each of the requirements documented in the SRD, CEI, or EIS.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.:** 1145 **ISSUE:** RFP
2. **DRD NO.:** **1145VR-003**
3. **DATA TYPE:** 2
4. **DATE REVISED:**
5. **PAGE:** 1/1

6. **TITLE:** Verification/Validation Reports

7. **DESCRIPTION/USE:** To report the results of the verification/validation activities.

8. **OPR:** EV62 9. **DM:** JP30

10. **DISTRIBUTION:** Per Contracting Officer's letter

11. **INITIAL SUBMISSION:** Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY:** Per Data Requirements Matrix

13. **REMARKS:** Reference is made to MSFC-HDBK-2221, *Verification Handbook, Volume I: Verification Process,* and *Volume II: Verification Documentation Examples.* Volume II provides examples of verification documentation as specified in Volume I that can be used as a guide in the development of or in the assessment of similar documentation. Verification/Validation reports developed to address specific verification activities (e.g., Test Report, Inspection Report, etc.) shall be acceptable as long as the respective content of the data meets that identified in CONTENTS (15.3) and the submission of the collective data meets that identified in INITIAL SUBMISSION/SUBMISSION FREQUENCY (11 & 12).

14. **INTERRELATIONSHIP:** DRD 1145VR-004, *Verification/Validation Success Criteria.* SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION:**

15.1 **SCOPE:** The Verification/Validation Reports (i.e., procedure, memo, assessment, test reports, inspection reports) document the results of each verification/validation activity with respect to satisfying the applicable requirement(s).

15.2 **APPLICABLE DOCUMENTS:** None

15.3 **CONTENTS:** The Verification/Validation Reports shall contain the following:

a. Conclusions and recommendations relative to success of the verification/validation activity.
b. Description of deviations from nominal results, failures, approved corrective actions and procedures, and retest.
c. Traceability back to the requirement and/or verification/validation success criteria.
d. Copy of as-run procedure (as appropriate).
e. Identification of test configuration and any differences from the flight configuration.
f. Specific results of each procedure including automated test segments, each analysis, or other verification/validation activity.
g. Performance data, plots, and pictures (as appropriate).

15.4 **FORMAT:** Contractor format is acceptable.

15.5 **MAINTENANCE:** None required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145VR-004**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Verification/Validation Success Criteria

7. **DESCRIPTION/USE**: To establish and document the detail success criteria for each of the verification/validation planning activities.

8. **OPR**: EV62 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to MSFC-HDBK-2221, *Verification Handbook, Volume I: Verification Process*, and *Volume II: Verification Documentation Examples*. Volume II provides examples of verification documentation as specified in Volume I that can be used as a guide in the development of or in the assessment of similar documentation.

14. **INTERRELATIONSHIP**: DRD 1145VR-001, *Verification/Validation Planning*. SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Verification/Validation Success Criteria information establishes the detail success criteria for each of the activities identified in the verification/validation planning.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Verification/Validation Success Criteria information shall establish:

a. Detail success criteria (i.e. test limits, tolerances, specifications, margins) used in determining acceptability of the results of each verification/validation activity.
b. Detail constraint criteria associated with performing the verification/validation activity or on the results of each verification/validation activity.

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145VR-005**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Verification/Validation Procedures

7. **DESCRIPTION/USE**: To document and provide procedures for performing test, inspection, or demonstration verification/validation activities.

8. **OPR**: EV62 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**: Reference is made to MSFC-HDBK-2221, *Verification Handbook, Volume I: Verification Process,* and *Volume II: Verification Documentation Examples.* Volume II provides examples of verification documentation as specified in Volume I that can be used as a guide in the development of or in the assessment of similar documentation.

14. **INTERRELATIONSHIP**: DRDs 1145VR-001, *Verification/Validation Planning,* and 1145VR-004, *Verification/Validation Success Criteria.* SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Verification/Validation Procedures define the detail instructions to be followed in conducting the identified verification/validation activities (test, inspection, or demonstration).

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: Each Verification/Validation Procedure shall contain the following:

a. Identification of item/article being subjected to test, inspection, or demonstration.
b. Identification of objectives established for the particular test, inspection, or demonstration.
c. Characteristics and criteria to be verified, including values, with tolerances, for acceptance or rejection and traceability back to the applicable verification success criteria.
d. Description of steps and operations, in sequence, to be taken.
e. Identification of measuring and recording equipment to be used, specifying range, accuracy, and type and any special instructions for operating such equipment.
f. Confirmation that required support equipment has been calibrated and certification of the calibration is still valid.
g. Identification that any support equipment has been verified prior to use with flight hardware.
h. Layouts, schematics, or diagrams showing identification, location, and interconnection of item/article, support equipment, and measuring equipment.
i. Identification of hazardous situations or operations.
j. Precautions and safety instructions to ensure safety of personnel and prevent degradation of verification article and supporting equipment.
k. Environmental and/or other conditions to be maintained with tolerances.
l. Constraints on test, inspection, or demonstration.
m. Instructions for handling non-conformances and anomalous occurrences during activity.

DRD Continuation Sheet

TITLE: Verification/Validation Procedures **DRD NO.:** 1145VR-005

DATA TYPE: 2 **PAGE:** 2/2

15. **DATA PREPARATION INFORMATION (CONTINUED):**

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Changes shall be incorporated by change.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145VR-006**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/1
6. **TITLE**: Verification/Validation Compliance
7. **DESCRIPTION/USE**: To identify and correlate the submitted verification/validation reports against the requirements.
8. **OPR**: EV62 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**: Reference is made to MSFC-HDBK-2221, *Verification Handbook, Volume I: Verification Process,* and *Volume II: Verification Documentation Examples.* Volume II provides examples of verification documentation as specified in Volume I that can be used as a guide in the development of or in the assessment of similar documentation.
14. **INTERRELATIONSHIP**: DRDs 1145VR-002, *Verification/Validation Requirements,* and 1145VR-003, *Verification/Validation Reports.* SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: The Verification/Validation Compliance information identifies the compliance data associated with each requirement.

15.2 **APPLICABLE DOCUMENTS**: None

15.3 **CONTENTS**: The Verification/Validation Compliance information shall include the following:

a. Identification of the agreed-upon verification/validation requirements associated with each requirement.
b. Identification of the verification/validation reports (i.e., test report, analysis, procedure) that identify compliance to the requirement(s).
c. Identification of traceability of the compliance data to the requirement(s).
d. Identification of any nonconformances (e.g. waivers, deviations, discrepancy report) against the requirement(s).

15.4 **FORMAT**: Contractor format is acceptable.

15.5 **MAINTENANCE**: Update and maintain as required

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145VR-007**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2

6. **TITLE**: Test Plans

7. **DESCRIPTION/USE**: The Test Plan (TPL) provides all details, objectives, and requirements necessary to define and implement a test or test series at the subsystem and component level. A series is defined as a set of tests with a unique objective that take place at a specific facility with unique requirements.

8. **OPR**: JP30 9. **DM**: JP30

10. **DISTRIBUTION**: Per Contracting Officer's letter

11. **INITIAL SUBMISSION**: Per Data Requirements Matrix

12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix

13. **REMARKS**:

14. **INTERRELATIONSHIP**: SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3

15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: Each Subsystem and Component Test Plan will serve as the test requirements document and describe US component, and subsystem test activities required for verification of functional, performance, and operational requirements.

15.2 **APPLICABLE DOCUMENTS**:

EI52-OWI-001	*Test Document Control*
EI52-OWI-002	*Flight Systems Testing Organizational Work Instruction*

15.3 **CONTENTS**: This Test Plan shall be provided for each test or test series that is delegated by the NASA team to the contractor. Each Test Plan shall include the following:

a. Complete description of article under evaluation, including the description of the interface requirements between the article and the test facility (or apparatus) and differences between the article under evaluation and the fully configured flight article.
b. Differences between flight conditions and evaluation conditions and how those differences are accounted for in the evaluation.
c. The overall philosophy, approach, and objective for each item, including any special tailoring or interpretation of design and testing requirements.
d. The allocation of requirements to appropriate verification levels of assembly. Usually this is a reference to a requirements traceability matrix listing all design requirements and indicating a cross-reference to a verification method and to the applicable assembly level.
e. The identification of separate environmental test zones (such as the engine, fairing, or cargo).
f. The identification of separate states or modes where the configuration or environmental levels may be different (such as during testing, launch, upper-stage transfer, on-orbit, eclipse, or reentry).
g. The environmental specifications or life cycle environmental profiles for each of the environmental test zones.

DRD Continuation Sheet

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15. **DATA PREPARATION INFORMATION (CONTINUED)**:

h. Required special test equipment (including instrumentation), facilities, interfaces, commodities, test support services and downtime requirements.

i. Required verification tools and test beds including the qualification testing planned for the test tools and test beds to demonstrate that they represent an operational system environment and verify that simulated interfaces are correct.

j. Hardware and data format standards to be used for the recording of test data on computer compatible electronic media, such as compact disks, to facilitate automated accumulation and sorting of data.

k. The review and approval process to be followed for test plans and procedures and for making changes to approved test plans and procedures.

l. Overall schedule of verification activities showing conformance with the Program schedules including the scheduled availability of test articles, test facilities, special test equipment and procedures.

15.4 **FORMAT**: Contractor plan(s) shall be in compliance with MSFC's EI52-OWI-001, *Test Document Control* EI52-OWI-002, *Flight Systems Testing Organizational Work Instruction*

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.

DATA REQUIREMENTS DESCRIPTION (DRD)

1. **DPD NO.**: 1145 **ISSUE**: RFP
2. **DRD NO.**: **1145VR-008**
3. **DATA TYPE**: 2
4. **DATE REVISED**:
5. **PAGE**: 1/2
6. **TITLE**: Test Procedures
7. **DESCRIPTION/USE**: The Test Procedure (TPR) provides documentation and procedures for performing component and subsystem tests and test series. A series is defined as a set of tests with a unique objective that take place at a specific facility with unique requirements.
8. **OPR**: ET01 9. **DM**: JP30
10. **DISTRIBUTION**: Per Contracting Officer's letter
11. **INITIAL SUBMISSION**: Per Data Requirements Matrix
12. **SUBMISSION FREQUENCY**: Per Data Requirements Matrix
13. **REMARKS**:
14. **INTERRELATIONSHIP**: SOW paragraphs 5.3, 6.3, 7.3, 8.3 and 9.3
15. **DATA PREPARATION INFORMATION**:

15.1 **SCOPE**: Each Subsystem and Component Test Procedure will define the detail instructions to be followed in conducting the identified Test activities. Test Procedures will be established before start of testing to ensure Test Objectives can be obtained per the Test Plan.

15.2 **APPLICABLE DOCUMENTS**:

EI52-OWI-001	*Test Document Control*
EI52-OWI-002	*Flight Systems Testing Organizational Work Instruction*

15.3 **CONTENTS**: This Test Procedure shall be provided for each test or test series that is delegated by the NASA team to the contractor. Each Test Procedure shall include the following:

a. Criteria, objectives, assumptions, and constraints.
b. Test setup, including drawings and schematics.
c. Initialization requirements (Loads, Pressure, etc.).
d. Input data.
e. Test instrumentation and instrumentation location.
f. Expected intermediate results.
g. Requirements for output data.
h. Minimum requirements for valid data to consider the test successful.
i. Pass-fail criteria for evaluating results.
j. Safety considerations and hazardous conditions.
k. Customer(s) for the test results.
l. Identification of item/article being subjected to test, inspection, or demonstration.
m. Characteristics and criteria to be verified, including values, with tolerances, for acceptance or rejection and traceability back to the applicable test success criteria.
n. Description of steps and operations, in sequence, to be taken.
o. Identification of measuring and recording equipment to be used, specifying range, accuracy, rate of data collection, and type and any special instructions for operating such equipment.

DRD Continuation Sheet

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15. **DATA PREPARATION INFORMATION (CONTINUED)**:

p. Confirmation that required support equipment has been calibrated and certification of the calibration is still valid.

q. Identification that any support equipment has been verified prior to use with flight hardware.

r. Layouts, schematics, or diagrams showing identification, location, and interconnection of item/article, support equipment, and measuring equipment.

s. Identification of hazardous situations or operations.

t. Precautions and safety instructions to ensure safety of personnel, and prevent degradation of verification article and supporting equipment.

u. Environmental and/or other conditions to be maintained with tolerances.

v. Constraints on test, inspection, or demonstration.

w. Instructions for handling non-conformances and anomalous occurrences during activity.

15.4 **FORMAT**: Contractor plans shall be in compliance with MSFC's EI52-OWI-001, *Test Document Control* EI52-OWI-002, *Flight Systems Testing Organizational Work Instruction*

15.5 **MAINTENANCE**: Changes shall be incorporated by change page or complete reissue.