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Revision A

SMall EXplorers (SMEX)

Mission Assurance Requirements (MAR)

Mission Risk Classification – NPR 7120.5 Class D

Goddard Space Flight Center
Greenbelt, Maryland

National Aeronautics and
Space Administration

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Preface

This SMall EXplorers (SMEX) Program signature-controlled document was developed in support of the NASA Science Mission Directorate released an Announcement of Opportunity (AO) that solicited proposals for Small Explorer (SMEX) missions NNH14ZDA013O to accomplish Astrophysics Explorer Program science objectives. NASA also released simultaneously a solicitation for Astrophysics Explorer Mission of Opportunity (MO) through the NASA AO NNH12ZDA006O, Second Stand Alone MO Notice (SALMON-2).

All of the requirements in this document assume the use of the word "shall" unless otherwise stated.

Questions or comments concerning this document should be addressed to:

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Change History Log

Revision	Effective Date	CCR #	CCB/ERB Approval Date	Description of Changes
-	9/28/2015	EXP-CCR-0004	9/28/2015	Initial Release
A	8/3/2016	EXP-CCR-0006	8/3/2016	**Section 1.1.** From: "The developer shall prepare, document, and implement a Mission Assurance Implementation Plan (MAIP). Developer MAIP and Compliance Matrix drafts are due with AO response." To: "The developer shall prepare, document, and implement a Mission Assurance Implementation Plan (MAIP). Developer MAIP and Compliance Matrix drafts are due with the Concept Study Report." **Appendix A, DID No.: 1-1** Delete: ▪ Deliver draft plan and compliance matrix with procuring activity (included as part of response) for information Add: ▪ Deliver draft plan and compliance matrix with Concept Study Report for information.

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1 GENERAL

This Mission Assurance Requirements (MAR) document is a Class D MAR for Small Explorers (SMEX) missions in accordance with the requirements of NPR 7120.5 as a Class D mission. Each proposal will be evaluated against its individual total cost, risk, and merit values.

1.1 Systems Safety and Mission Assurance Program

The developer shall prepare, document, and implement a Mission Assurance Implementation Plan (MAIP). Developer MAIP and Compliance Matrix drafts are due with the Concept Study Report.

The MAIP shall cover:

a. Flight hardware and software that is designed, built, or provided by the developer and its subcontractors or furnished by the government, from project initiation through launch and mission operations
b. The ground support equipment that interfaces with flight items to the extent necessary to assure the integrity and safety of flight items
c. The ground data system to the extent necessary to assure performance as required by the Statement of Work

The mission assurance requirements compliance matrix shall accompany the MAIP submittal (DID 1-1) – identify variances along with supporting rationale for processes, procedures, and standards that are proposed as alternatives to those specified. A sufficiently documented alternative process in the MAIP can take the place of a waiver/deviation. While the MAIP represents how the contractor will meet the MAR Requirements, it does not supersede those requirements.

1.2 Management

The developer shall designate a manager for assurance activities. The assurance manager shall not be responsible for project costs and schedules other than those pertaining to assurance activities. The manager shall have direct access to management that is independent of project management and the functional freedom and authority to interact with all elements of the project.

1.3 Requirements Flowdown

The developer shall apply the applicable system safety and mission assurance requirements to subcontractors and suppliers to the extent necessary to ensure that the delivered product meets requirements and this MAR.

1.4 Suspension of Work Activities

The developer shall direct the suspension of any work activity that presents a hazard, imminent danger, or future hazard to personnel, property, or mission operations resulting from unsafe acts or conditions that are identified by inspection, test, or analysis.

1.5 Contract Data Requirements List (CDRL)

The CDRL identifies Data Item Descriptions (DID) for deliverables. The developer shall deliver data items per the requirements of the applicable CDRL/DID. DIDs listed in Appendix A

The developer shall perform work in accordance with the following definitions:

a. Deliver for approval: The GSFC Project approves the deliverable within the specified period of time before the developer proceeds with the associated work.
b. Deliver for review: The GSFC Project reviews the deliverable and provides comments with the specified period of time before the developer proceeds with the associated work. The developer can continue with the associated work while preparing a response to the GSFC comments unless directed to stop work.
c. Deliver for information: For GSFC Project information only. The developer continues with the associated work.

Note: The developer may combine deliverables if the requirements for the individual deliverables are addressed

1.6 Surveillance

The developer shall grant access for National Aeronautics and Space Administration (NASA) and NASA assurance representatives to conduct an audit, assessment, inspections, or survey upon notice. The developer shall supply documents, records, equipment, and a suitable work area within the developer's facilities.
Note: See Federal Acquisition Regulations (FAR) Parts 46.103, 46.104, 46.202-2, 46.4, and 46.5 for government quality assurance requirements at contractor facilities. See FAR Part 52.246 for inspection clauses by contract type.

1.7 Government Mandatory Inspection Points (GMIPS)

The developer shall plan for the following GMIPS listed below (activities shall be accompanied by work instructions, drawings, etc.):

a. Circuit Card/Hardware Assemblies - Final Solder / Pre Conformal Coating and Staking
b. Circuit Card/Hardware Assemblies - Post Conformal Coating
c. Harness – pre integration (pre staking or potting)
d. Unit/component, subsystem, and top level assembly – witness final assembly
e. Mechanical – final assembly and acceptance test
f. Rework and repairs to flight hardware
g. **Test – TBD** (addressed at time of contract)

These GMIPS are for generic planning purposes. Additional GMIPS may be required based on the specifics of the development effort.

2 QUALITY MANAGEMENT SYSTEM

2.1 General

The developer shall have a quality management system that meets the intent of SAE AS9100 Quality Systems - Aerospace - Model for Quality Assurance in Design, Development, Production, Installation and Servicing or ISO 9001 Quality Management System.

2.2 Supplemental Quality Management System Requirements

2.2.1 Control of Nonconforming Product

The developer shall have a documented closed loop system for identifying, reporting, and correcting product nonconformances. The system shall ensure that the adequacy of corrective action is determined by audit or test, that objective evidence is collected, and that preventive action is implemented to preclude recurrence.

2.2.2 Material Review Board (MRB)

The developer shall have a documented process for the establishment and operation of a MRB to process nonconformances, including the definitions of major and minor nonconformances. The developer shall appoint an SMA MRB chairperson who is responsible for implementing the MRB process and functional and project representatives as MRB members. The MRB shall include the CSO or their designee, who shall be a voting member with approval authority on all major (repair and use as is disposition) MRBs involving procured hardware. The project government representative shall have access to the applicable documentation in advance of the scheduled MRB. The developer shall inform the government of MRB actions (DID 2-1).

The MRB shall use the following disposition actions:

a. Scrap — the product is not usable
b. Re-work — the product will be re-worked to conform to requirements
c. Return to supplier — the product will be returned to the supplier
d. Repair — the product will be repaired using a repair process approved by the MRB
e. Use as is — the product will be used as is

2.3 Anomaly Reporting and Disposition

The developer shall have a documented process for anomaly reporting and disposition. The process will establish an anomaly review board (ARB) whose membership shall include the CSO or their designee, as a voting member with approval authority for proposed actions on all major anomalies. Major anomalies are those that have resulted in hardware or software test failures and damage or potential damage to hardware. Examples of major anomalies are overvoltage or over current conditions, exceedance of test limits resulting in overstress, blown fuses, and unexpected system responses.

The process shall require major anomalies to be submitted to the ARB and the government (DID 2-2). The developer shall report major hardware anomalies beginning with the first

application of power at the component level, major software anomalies beginning with flight software acceptance testing and when interfacing with flight hardware, and major mechanical system anomalies beginning with the first operation. The developer shall assess the failure risk ratings and failure effect risk ratings for major anomalies (see DID 2-2 for criteria) and identify those that have a failure effect risk rating of 2 or 3 and a failure corrective action risk rating of 3 or 4 as a significant residual risk in the risk list.

The process shall allow the developer to disposition minor anomalies with an appropriate subset of the ARB. Minor anomalies are those that have not resulted in hardware failure or have caused no damage or stress to hardware or required no change in flight software. Examples of minor anomalies are those that can be resolved immediately, procedural errors, database problems, operator errors, and exceedance of test limits that do not affect the end item.

Note: A component is defined as a functional subdivision of a subsystem and generally as a self-contained combination of items performing a function necessary for the subsystem's operation.

3 SYSTEM SAFETY

3.1 General

The developer shall document and implement a system safety program, support the ELV Safety Review Process as defined in paragraph 2.4 of NPR 8715.7 Expendable Launch Vehicle Payload Safety Program, meet launch service provider requirements, and launch range safety requirements.

Specific safety requirements include the following:

a. The developer shall incorporate three independent inhibits in the design (dual failure tolerant) if a system failure may lead to a catastrophic hazard. A catastrophic hazard prelaunch is defined as a payload-related hazard, condition, or event occurring prior to launch (on ground) that could result in a mishap causing fatal injury to personnel or loss of ground facility. A catastrophic hazard post-launch is defined as a payload-related hazard, condition or event occurring post-launch (airborne) through payload separation that could result in a mishap causing fatal injury (including fatal injuries to the public) or loss of flight termination system.
b. The developer shall incorporate two independent inhibits in the design (single failure tolerant) if a system failure may lead to a critical hazard. A critical hazard is defined as a condition that may cause a severe injury or occupational illness to personnel or major property damage to facilities.
c. The developer shall adhere to specific detailed safety requirements, including compliance verification that must be met for design elements with hazards that cannot be controlled by failure tolerance. The process by which safety is incorporated into these design elements (e.g., structures and pressure vessels) is called "Design for Minimum Risk".

3.2 Mission Related Safety Requirements Documentation

Tailoring Note: Delete subsections that do not apply to the mission. Verify applicability and existence of specific foreign safety requirement documents before including them in the contract.

The developer shall implement launch range safety requirements as applicable for the specific launch site. The most stringent applicable safety requirement shall take precedence in the event of conflicting requirements.

ELV Eastern Test Range (ETR) or Western Test Range (WTR) Missions

a. NASA-STD 8719.24 (with Annex) NASA Expendable Launch Vehicle Payload Safety Requirements
b. KNPR 8715.3, “KSC Safety Practices Procedural Requirements” (applicable at KSC property, KSC-controlled property, and offsite facility areas where KSC has operational responsibility)
c. NPR 8715.7, “Expendable Launch Vehicle Payload Safety Program”
d. Launch Site Facility-specific Safety Requirements, as applicable (e.g., Astrotech)

Japanese Missions

a. NASA-STD 8719.24 (with Annex) NASA Expendable Launch Vehicle Payload Safety Requirements, as negotiated with JAXA and GSFC SMA Directorate
b. JMR 002, "Launch Vehicle Payload Safety Requirements"
c. JERG-1-007, "Safety Regulations for Launch Site Operations/Flight Control Operations"
d. KDP-99105, "Safety Guide for H-II/H-IIA Payload Launch Campaign"

3.3 System Safety Deliverables

3.3.1 System Safety Plan

The developer shall prepare a System Safety Program Plan (SSPP) that describes the tasks and activities of system safety management and engineering required to identify, evaluate, and eliminate or control hazards to the hardware, software, and system design by reducing the associated risk to an acceptable level throughout the system life cycle, including launch range safety requirements (DID 3-1).

The SSPP shall:

a. Define the roles and responsibilities of personnel
b. Define the required documentation, applicable requirements documents, and completion schedules for analyses, reviews, and safety packages
c. Address support for Safety Reviews (as defined in NPR 8715.7), Safety Working Group Meetings and TIMs
d. Provide for early identification and control of hazards to personnel, facilities, support equipment, and the flight system during product development, including design, fabrication, test, transportation, and ground activities.
e. Address compliance with the launch range safety requirements
f. Address compliance with industrial safety requirements imposed by NASA and OSHA design and operational needs and contractually imposed mission unique obligations

3.3.2 Safety Requirements Compliance Checklist

The developer shall document and implement a Safety Requirements Compliance Checklist to demonstrate that the payload is in compliance with NASA and range safety requirements (DID 3-2). Noncompliances to safety requirements will be documented in waivers using the NASA ELV Payload Safety Waiver Request NF1827 and submitted for approval.

3.3.3 Hazard Analyses

3.3.3.1 Preliminary Hazard Analysis

The developer shall perform a Preliminary Hazard Analysis (PHA) to obtain an initial risk assessment and identify safety critical areas of a concept or system. The PHA shall be submitted as a part of the Preliminary ISAR (DID 3-4) or the Preliminary SDP (DID 3-4). It is based on the best available data, including mishap data from similar systems and other lessons learned. The developer shall evaluate hazards associated with the proposed design or

function for severity, control approach (fault tolerance or design for minimum risk), and operational constraints. The developer shall identify safety provisions and alternatives that are needed to eliminate hazards or reduce their associated risk to an acceptable level.

The PHA shall consider the following for identification and evaluation of hazards as a minimum:

a. Hazardous components (e.g., fuels, propellants, lasers, explosives, toxic substances, hazardous construction materials, pressure systems, and other energy sources).
b. Safety related interface considerations among various elements of the system (e.g., material compatibilities, electromagnetic interference, inadvertent activation, fire/explosive initiation and propagation, and hardware and software controls). This shall include consideration of the potential contribution by software (including software developed by other contractors/sources) to subsystem/system mishaps that occur prior to separation from launch vehicle on-orbit. Safety design criteria to control safety-critical software commands and responses (e.g., inadvertent command, failure to command, untimely command or responses, inappropriate magnitude, or other undesired events) shall be identified and appropriate action taken to incorporate them in the software (and related hardware) specifications.
c. Environmental constraints including the operating environments (e.g., drop, shock, vibration, extreme temperatures, noise, exposure to toxic substances, health hazards, fire, electrostatic discharge, lightning, electromagnetic environmental effects, ionizing and non-ionizing radiation including laser radiation).
d. Operating, test, maintenance, built-in-tests, diagnostics, and emergency procedures (e.g., human factors engineering, human error analysis of operator functions, tasks, and requirements); effect of factors such as equipment layout, lighting requirements, potential exposures to toxic materials, effects of noise or radiation on human performance; explosive ordnance render safe and emergency disposal procedures. Those test unique hazards that will be a direct result of the test and evaluation of the article or vehicle.
e. Facilities, real property installed equipment, support equipment (e.g., provisions for storage, assembly, checkout, proof testing of hazardous systems/assemblies that may involve toxic, flammable, explosive, corrosive or cryogenic materials/wastes; radiation or noise emitters; electrical power sources) and training (e.g. training and certification pertaining to safety operations and maintenance).
f. Safety related equipment, safeguards, and possible alternate approaches (e.g., interlocks; system redundancy; fail safe design considerations using hardware or software controls; subsystem protection; fire detection and suppression systems; personal protective equipment; heating, ventilation, and air-conditioning; and noise or radiation barriers).
g. Malfunctions to the system, subsystems, or software. Each malfunction shall be specified, the causing and resulting sequence of events determined, the degree of hazard determined, and appropriate specification and/or design changes developed.

3.3.3.2 Operations Hazard Analysis (OHA) and Hazard Verification Tracking Log (VTL)

The developer shall perform and document an Operations Hazard Analysis (OHA) and a Hazard Verification Tracking Log (VTL) to demonstrate that hardware operations, test equipment operations, and integration and test (I&T) activities comply with facility safety

requirements and that hazards associated with those activities are mitigated to an acceptable level of risk (DID 3-3). The developer shall update and maintain the Hazard Verification Tracking Log during I&T activities to track open issues.

3.3.3.3 Lifting Device Safety Requirements

The developer shall implement the following safety requirements for lifting devices and equipment when performing NASA work at non-NASA facilities beginning with integration of the instruments:

a. Ensure that for critical lifts overhead cranes, winches, and hoists have dual holding brakes and dual upper limit switches installed as defined in NASA Standard 8719.9 paragraph 4.2. A single holding brake in combination with a motor drive that automatically tests the holding ability of the brake prior to every release of the brake is acceptable as a second brake as long as the crane has a notification device to alert operator of failure of the braking system.
b. Perform periodic load testing in accordance with paragraph 4.4 of NASA-STD-8719.9 for the following lifting devices and equipment: overhead cranes; mobile cranes and derricks; hooks hydra-sets and load measuring devices; and slings and riggings.
c. After the initial proof test of the lifting device or equipment (LDE), a load test of the rated safe working load (SWL) LDE shall be performed every four years. Proof tests will be 125% of the SWL for Lifting Devices, such as overhead and mobile cranes and include aerial platforms used near critical hardware. Proof tests will be at 200% of the SWL for Lifting Equipment, such as shackles, turnbuckles and so forth. A load test will be at 100% of the labeled SWL for all LDE. If the LDE is de-rated to a lower SWL because of a lower proof or load test, the LDE shall be labeled as this new SWL and only be used to the maximum capacity as such.
d. Perform NDT inspections using an American Society of Nondestructive Testing (ASNT) or equivalently trained inspector on critical lifting hardware/equipment on critical welds (weld failure would result in failure of hardware) after initial proof test and load testing.
e. Label and tag lifting devices and equipment per NASA-STD-8719.9 paragraph 4.8.or other acceptable means.

3.3.3.4 Operating and Support Hazard Analysis

The developer shall perform and document an Operating and Support Hazard Analysis (O&SHA) to evaluate activities for hazards introduced during testing, transportation, storage, integration, and prelaunch operations at the launch site. Its primary purpose is to evaluate the adequacy of procedures used to eliminate, control or mitigate identified hazards in order to ensure implementation of safety requirements for personnel, procedures, and equipment used during activities at the launch site. The results of the O&SHA shall be submitted as a part of the Intermediate & Final ISARs (DID 3-4) or SDP II and SDP III (DID 3-4).

3.3.4 Tailor Note: Delete the non-applicable title and paragraph and the related DID

Instrument Safety Assessment Report (ISAR)

The developer shall generate an ISAR to document the comprehensive evaluation of the risk being assumed prior to the testing or operation of an instrument. The spacecraft developer will use the ISAR as an input to the Safety Data Package (SDP) (DID 3-4).

Safety Data Package (SDP)

The developer shall prepare an integrated SDP to document the results of hazard analyses identifying the prelaunch, launch and ascent hazards associated with the flight system, ground support equipment, and their interfaces in hazard reports (DID 3-4).

3.3.5 Verification Tracking Log (VTL)

The developer shall prepare a VTL that provides documentation of a Hazard Control and Verification Tracking process as a closed-loop system to ensure that safety compliance has been satisfied in accordance to applicable launch range safety requirements. The VTL shall demonstrate the process of verifying the control of all hazards by test, analysis, inspection, similarity to previously qualified hardware, or any combination of these activities. All verifications that are listed on the hazard reports shall reference the specific test/analysis/inspection reports with a summary of the pertinent results. Results of these tests/analyses/inspections shall be available for review.

The VTL shall identify hazard controls that are not verified as closed and shall be delivered to the Project Office with the final ISAR (DID 3-4) or SDP III (DID 3-4). Regular updates to this log shall be provided to the Project Office electronically for review until all hazard controls are verified as closed.

3.3.6 Hazardous Procedures for Payload I&T and Pre-launch Processing

The developer shall document and implement hazardous procedures that comply with applicable facility safety requirements when performing integration and test activities and pre-launch activities at the launch site (DID 3-5). The developer shall provide safety support for hazardous operations at the launch site.

3.3.7 Orbital Debris Assessment Report (ODAR) and End of Mission Plan (EOMP)

The developer shall provide the inputs necessary for the development of the ODAR and the EOMP deliveries per the content defined in NASA-STD 8719.14, (DID 3-6).

3.3.8 Mishap Reporting and Investigation

The developer shall prepare a Pre-Mishap Plan that describes appropriate mishap and close call notification, reporting, recording, and investigation procedures (DID 3-7). The developer shall report accidents, test failures, or other mishaps and close calls promptly to NASA. The developer shall promptly investigate so as to determine the root cause.

4 RELIABILITY

4.1 Reliability Program

The developer shall plan, document (in MAIP) and implement a Reliability Program that interacts effectively with other project disciplines, including engineering, hardware design, software reliability, systems safety, and mission assurance. This plan shall include how the developer will be performing the analyses specified in the remainder of this section to evaluate mission risks and when additional reliability analysis techniques (e.g., RBD/prediction, FMEA (Functional, Design, or Process), PSA, and/or WCA) will be used to supplement these when needed.

4.2 Fault Tree Analysis (FTA)

The developer shall perform qualitative fault tree analyses to address mission failure and degraded modes of operation (DID 4-1). The fault tree analyses shall address both hardware and software contributions to loss of mission scenarios.

The FTA is meant to be a living document that is updated throughout the development life cycle to address the latest design and any changes to corresponding faults, fault consequences, fault logic, and/or fault propagation scenarios.

The FTA shall analyze critical items needed to achieve level 1 requirements to assess risk and where there is an opportunity to influence design or process (i.e., manufacturing, measurement, inspection, and/or test), recommend corresponding mitigation strategies.

The FTA shall analyze where there is a potential to damage other items/elements across an interface (e.g., power surges, excessive thermal dissipation, inadvertent grounding, erroneous control commands) having safety or significant mission success implications.

4.3 Limited Life Items

The developer shall document and implement a plan to identify and manage limited life items (in MAIP). Records shall be maintained for limited-life and presented at PDR, CDR, and PSR.

Limited Life items are generally defined as items subject to wear-out that have a limited shelf life, operational life, or cycle life whose life expectancy is less than 2x the required life to assess the risk and /or the mitigation plans for continued use of the item; factoring in the wear caused by atomic oxygen, solar and trapped radiation, shelf-life, extreme temperatures, thermal cycling, and mechanical wear / fatigue, and/or refurbishment/ maintenance plans. Potential limited-life items shall include, but not necessarily be limited to: selected consumables; structures; mechanisms; batteries; seals; thermal control surfaces; solar arrays; and, electromechanical mechanisms.

5 SOFTWARE ASSURANCE

5.1 Applicable Software Definitions

When identifying, developing, verifying, and maintaining software, the developer shall apply the following definitions:

a. Software is defined as computer programs, procedures, scripts, rules, and associated documentation pertaining to the development and operation of a computer system. Software includes commercial–off-the-shelf (COTS) software, government-off-the-shelf (GOTS) software, modified-off-the-shelf (MOTS) software, custom software, reused software, heritage software, auto-generated code, and code executed on microprocessors.
b. Mission-Critical Software - Software that can cause, contribute to, or mitigate the loss of capabilities that are essential to the primary mission objectives. The software reliability assessment and analysis is focused on failure modes specific to post-separation mission phases.
c. Safety-Critical Software - Software that can cause, contribute to, or mitigate human safety hazards or damage to facilities. The software safety assessment and analysis is focused on hazards specific to Integration and Test, launch, and up through spacecraft separation from the launch vehicle (except for International Space Station (ISS) payloads that have constant human presence) and re-entry/recovery (where applicable).

5.2 Software Assurance Program

The developer shall plan and document the software assurance program in a Software Assurance Plan (DID 5-1). The plan will address the disciplines of Software Quality, Software Safety, Software Reliability, and Software Verification and Validation (V&V) commensurate the project's risk posture. If desired, the Software Assurance Plan can be included as a separate chapter of the MAIP (DID 1-1).

The developer shall identify the person responsible for directing and managing the software assurance program and interfacing with government assurance personnel.

5.2.1 Software Quality

The developer shall evaluate software processes and work products per their documented plans and procedures, with an emphasis on configuration management, requirements management, and verification & validation. The developer shall identify, document, and communicate noncompliance issues to the project.

5.2.2 Software Safety Analysis

The developer shall identify safety critical software per NASA-STD-8719.13, Software Safety Standard.

For software that is safety critical, the developer shall:

a. Identify whether software can contribute to a hazard
b. Identify specific software modules or functions associated with the hazard cause

c. Identify hazard elimination and hazard control methodologies and associated software safety requirements
d. Verify that the inhibits and controls incorporated to eliminate or mitigate hazards are effective

The developer shall incorporate the results from the Software Safety Analyses, including references to the associated software requirements, into hazard reports and deliver as part of the SDP (DID 3-4).

5.2.3 Software Reliability Analysis

The developer shall ensure traceability and consistency between the reliability analysis and the software design.

5.2.4 Verification and Validation

The developer shall plan and implement Verification and Validation (V&V) Plans and support reviews/walkthroughs of test procedures. The developer shall witness or review results of software testing, review software discrepancy reports, and review software delivery documentation.

5.3 Reviews

The developer shall plan for software peer reviews and milestone reviews to ensure that they are conducted according to documented procedures.

5.4 Surveillance of Software Development, Maintenance, and Assurance Activities

The developer shall provide access to the following:

a. Schedule of software assurance reviews, audits, and assessments of the developer's processes and products
b. Corrective actions from software process and product audits

6 WORKMANSHIP

6.1 General

The developer shall implement a workmanship program to assure that electronic packaging technologies, processes, and workmanship meet mission objectives for quality and reliability per the requirements of the following standards:

a. NASA-STD-8739.1 Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies
b. NASA-STD-8739.4 Crimping, Interconnecting Cables, Harnesses, and Wiring
c. NASA-STD-8739.5 Fiber Optic Terminations, Cable Assemblies, and Installation
d. NASA-STD-8739.6, Implementation Requirements for NASA Workmanship Standards
e. GSFC-STD-6001, Ceramic Column Grid Array Design and Manufacturing Rules for Flight Hardware
f. IPC-J-STD-001FS, Joint Industry Standard, Space Applications Electronic Hardware Addendum (except Chapter 10 of IPC-J-STD-001F)
g. IPC-2221 Generic Standard on Printed Board Design
h. IPC-2222 Sectional Design Standard for Rigid Organic Printed Boards
i. IPC-2223 Sectional Design Standard for Flexible Printed Boards
j. IPC-2225 Sectional Design Standard for Organic Multichip Modules (MCM-L) and MCM-L Assemblies
k. IPC-A-600 Acceptability of Printed Boards (Class 3 requirements)
l. IPC-6011 Generic Performance Specification for Printed Boards (Class 3 requirements)
m. IPC-6012 Qualification and Performance Specification for Rigid Printed Boards (Class 3/A requirements). If design constraints preclude full implementation of 3/A requirements, then a waiver shall be submitted for those requirements that cannot be met due to the design constraints.
n. MIL-PRF-55110H, Performance Specification: Printed Wiring Board, Rigid, General Specification For
o. IPC-6013 Qualification and Performance Specification for Flexible Printed Boards (Class 3 requirements)
p. MIL-PRF-50884F, Performance Specification: Printed Wiring Board, Flexible or Rigid-Flex, General Specification For
q. IPC-6015 Qualification and Performance Specification for Organic Multichip Module (MCM-L) Mounting and Interconnecting Structures
r. IPC-6018 Qualification and Performance Specification for High Frequency (Microwave) Printed Boards (Class 3 requirements)

6.2 Design and Process Qualification

The developer shall perform and document qualification of designs and processes that are not covered by or do not conform to the above standards and submit a waiver request for government approval.

6.3 Electrostatic Discharge Control (ESD)

The developer shall prepare and implement an ESD control program that conforms to the requirements of ANSI/ESD S20.20, Protection of Electrical and Electronic Parts, Assemblies

and Equipment [Excluding Electrically Initiated Explosive Devices] (made available upon request).

6.4 Splices, Circuit Board Trace Cuts, and Jumper Wires

The developer shall not incorporate splices, board trace cuts, or jumper wires that result from repairs or design changes into flight hardware, including previously developed hardware, unless approved by the MRB.

6.5 Printed Wiring Board (PWB) Test Coupons

The developer shall provide printed wiring board test coupons to the GSFC or to a GSFC-approved facility for analysis (DID 6-1). The developer shall not use printed wiring boards until coupon analysis results are approved or waived by MRB.

7 EEE PARTS

7.1 General

The developer shall document and implement a Parts Control Plan (PCP) utilizing Level 1, Level 2 or Level 3 parts per the requirements of GSFC EEE-INST-002 Instruction for EEE Parts Selection, Screening, Qualification, and De-rating (DID 7-1). Level 3 is the minimum quality level for the Project to be considered a standard part. Additionally, Military specification parts with prior flight history may be used without any additional screening or qualification.

Level 1 and 2 Parts are recommended for use when schedule or overall project costs are not adversely impacted.

Plastic-encapsulated Microcircuits (PEMs) may be used per the process prescribed in EEE-INST-002, section M4.

The PCP shall address all EEE component radiation effects in accordance with project requirements.

The developer shall identify the person responsible for directing and managing the EEE parts program and interfacing with government assurance personnel.

7.2 Nonstandard Parts

Non-standard parts are parts that do not have a military specification part number or Source Control Drawing (SCD) that reflects the required reliability level for a Level 1, Level 2, or Level 3 mission per the EEE-INST-002. Non-standard parts shall be documented, evaluated and approved by the PCB.

7.3 Parts Control Board

The developer shall establish a process for the planning, management, and coordination of the selection, application, and procurement requirements of EEE parts. This process shall be implemented through a Parts Control Board (PCB) and shall be described in the Parts Control Plan (PCP).

The Project Parts Engineer (GSFC) shall be an active/voting member of the PCB.

7.4 Re-use of EEE Parts

The developer shall require approval of the MRB to re-use EEE parts that have been installed and removed.

7.5 Master EEE Parts List

The developer shall develop and maintain a Master EEE Parts List (DID 7-2).

8 MATERIALS AND PROCESSES

8.1 General

The developer shall prepare and implement a Materials and Processes (M&P) Selection, Control, and Implementation Plan (DID 8-1). As part of the plan, the developer shall implement an M&P Control Board process or equivalent developer process, which defines the planning, management, and coordination of the selection, application, procurement, control, and standardization of M&P for the contract and for directing the disposition of M&P nonconformance and problem resolutions.

NASA-STD-6016 (or equivalent developer's standard) shall form the basis for the requirements of the project's M&P Requirements. Tailoring of NASA-STD-6016 or the direct use of the developer's standard is allowed, and shall address application, launch site, and platform (e.g., ISS) specific M&P requirements. The developer shall document the tailoring in the M&P Selection, Control, and Implementation Plan to provide the degree of conformance with and the method of implementation of the requirements (NASA-STD-6016).

The Project Materials and Processes Engineer (GSFC) shall be an active/voting member of the Materials and Processes Control Board or equivalent developer process.

8.2 Materials Identification and Usage List (MIUL)

The developer shall prepare a materials identification and usage list (DID 8-2).

9 CONTAMINATION CONTROL

9.1 Contamination Control Plan

The developer shall prepare and implement a contamination control program (DID 9-1).

10 METROLOGY AND CALIBRATION

10.1 Metrology and Calibration Program

The developer shall comply with one of the following standards for the calibration of measuring and test equipment:

a. ANSI/NCSL Z540.1-1994 (R2002) Calibration Laboratories & Measuring & Test Equipment - General Requirements
b. ANSI/NCSL Z540.3-2006 Requirements for the Calibration of Measuring and Test Equipment
c. ISO 17025-2002 General requirements for the competence of testing and calibration laboratories

10.2 Use of Calibrated and Non-calibrated Instruments

The developer shall maintain the calibration of test and measuring equipment and safety instruments used for: acceptance testing; inspection; maintenance; flight hardware qualification; measurement where accuracy is essential for the safety of personnel or the public; telecommunication, transmission, and test equipment where exact signal interfaces and circuit confirmations are essential to mission success; development, testing, and special applications where the specifications, end products, or data are accuracy sensitive, including instruments used in hazardous and critical applications, in cases where pertinent measurements and signals with accuracy requirements are not verified against calibrated sources before use.

Calibration of equipment is not required if all measurements and signals associated with the particular piece of equipment that have accuracy requirements are verified against calibrated instruments (per 10.1) prior to use.

11 GIDEP ALERTS AND PROBLEM ADVISORIES

11.1 Government-Industry Data Exchange Program (GIDEP)

The developer shall participate in GIDEP per the GIDEP Operations Manual S0300-BT-PRO-010 and GIDEP Requirements Guide S0300-BU-GYD-010 (Note: these documents are available through (http://www.gidep.org).

11.2 Alert Disposition

The developer shall review the following, hereafter referred to collectively as Alerts, for affects on EEE parts, materials, equipment and software used in NASA products: GIDEP Alerts; GIDEP SAFE-ALERTS; GIDEP Problem Advisories; GIDEP Agency Action Notices; NASA Advisories.

When the developer has identified an applicable item in their design, inventory, or assembly that is documented in a GIDEP or NASA advisory, the developer shall document this through their standard nonconformance reporting system as an MRB item. The developer shall eliminate or mitigate the effects of Alerts on NASA products. The disposition of the MRB will include NASA representation.

11.3 GIDEP Reporting

The developer shall prepare and submit failure experience data and safety issue reports per the requirements of S0300-BT-PRO-010 and S0300-BU-GYD-010 whenever failed or nonconforming items that are available to other buyers are discovered.

11.4 Review Reporting

The developer shall report the status of NASA products that are affected by Alerts or by significant EEE parts, materials, and safety problems at monthly status reviews, parts control board meetings, program milestone reviews and readiness reviews. The developer shall include a summary of the review status for EEE parts and materials lists and of actions taken to eliminate or mitigate negative effects.

12 END ITEM ACCEPTANCE DATA PACKAGE

The developer shall submit an end item acceptance data package (DID 12-1).

Appendix A: Data Item Descriptions

Important Note: All DIDs become CDRLs at the time of contract award

Title: Mission Assurance Implementation Plan / Compliance Matrix	**DID No.: 1-1**
MAR Paragraph: 1.1	**CDRL No.:**
Use: ▪ Documents the developer's compliance with the contractual system safety and mission assurance requirements.	
Reference Documents:	
Place/Time/Purpose of Delivery: ▪ Deliver draft plan and compliance matrix with Concept Study Report for information. ▪ Deliver final plan and compliance matrix to the Project Office sixty (60) days after contract award for approval ▪ Deliver updates to the plan to the Project Office thirty (30) days prior to implementation for approval	
Preparation Information: 1. The Mission Assurance Implementation Plan / Compliance Matrix shall cover: a. All flight hardware and software that is designed, built, or provided by the developer and its subcontractors, or furnished by the government, from project initiation through launch and mission operations b. The ground system that interfaces with flight equipment to the extent necessary to assure the integrity and safety of flight items c. The ground data system d. The Mission Assurance Compliance Matrix (below) shall identify variances and acceptance rationale for processes, procedures, and standards that are proposed as alternatives.	

Mission Assurance Compliance Matrix

Note: Delete one of the two entries in paragraph 3.3.3 and DID 3-4 of this table to correspond with the tailoring selection made for Paragraph 3.3.3 of the MAR.

- Enter *Yes* or *No* regarding compliance with the requirements.
- A response of ***Yes*** indicates full compliance with the requirements. The Comment column shall be used to indicate how compliance will be achieved, e.g., through a specified requirements document or equivalent procedure.
- A response of ***No*** indicates less than full compliance with the requirements and requires an entry in the Comment column to explain the deviation from full compliance.

Paragraph or DID	Title	Comply Y / N	Comment (Required for *No*)
1 General			
1.1	MAIP & Mission Assurance Requirements Compliance Matrix		
1.2	Management		
1.3	Requirements Flowdown		
1.4	Suspension of Work Activities		
1.5	Contract Data Requirements List		
1.6	Surveillance		
1.7	Government Mandatory Inspection Points		
DID 1-1	Mission Assurance Implementation Plan / Compliance Matrix		
2 Quality Management System			
2.1	General		
2.2	Supplemental Quality Management System Requirements		
2.2.1	Control of Nonconforming Product		
2.2.2	Material Review Board		
2.3	Anomaly Reporting and Disposition		
DID 2-1	Reporting of MRB Actions		
DID 2-2	Anomaly Report		
3 System Safety			
3.1	General		
3.2	Mission Related Safety Requirements Documentation		
3.3	System Safety Deliverables		
3.3.1	System Safety Program Plan		
3.3.2	Safety Requirements Compliance Checklist		
3.3.3	Hazard Analyses		

3.3.3.1	Preliminary Hazard Analysis		
3.3.3.2	Operations Hazard Analysis (OHA) and Hazard Verification Tracking Log (VTL)		
3.3.3.3	Lifting Devices Safety Requirements		
3.3.3.4	Operating and Support Hazard Analysis		
3.3.4	Instrument Safety Assessment Report ***or*** Safety Data Package		
3.3.5	Verification Tracking Log		
3.3.6	Hazardous Procedures for Payload I&T and Pre-Launch Processing		
3.3.7	Orbital Debris Assessment Report (ODAR) and End of Mission Plan (EOMP)		
3.3.8	Mishap Reporting and Investigation		
DID 3-1	System Safety Program Plan		
DID 3-2	Safety Requirements Compliance Checklist		
DID 3-3	Operations Hazard Analysis and Hazard Verification Tracking Log		
DID 3-4	Instrument Safety Assessment Report ***or*** Safety Data Package		
DID 3-5	Hazardous Procedures for Payload I&T and Pre-Launch Processing		
DID 3-6	Input to Orbital Debris Assessment Report and End of Mission Plan		
DID 3-7	Pre-Mishap Plan		
4 Reliability			
4.1	Reliability Program Plan		
4.2	Fault Tree Analysis		
4.3	Limited Life Items		
DID 4-1	Fault Tree Analysis		
5 Software Assurance (Flight and Ground Segments)			

5.1	Applicable Software Definition		
5.2	Software Assurance Program		
5.2.1	Software Quality		
5.2.2	Software Safety Analysis		
5.2.3	Software Reliability Analysis		
5.2.4	Verification and Validation		
5.3	Reviews		
5.4	Surveillance of Software Development, Maintenance, and Assurance Activities		
DID 5-1	Software Assurance Plan		
6 Workmanship			
6.1	General		
6.2	Design and Process Qualification		
6.3	Electrostatic Discharge Control (ESD)		
6.4	Splices, Circuit Board Trace Cuts, and Jumper Wires		
6.5	Printed Wiring Board (PWB) Test Coupons		
DID 6-1	Printed Wiring Board Test Coupons		
7 EEE Parts			
7.1	General		
7.2	Nonstandard Parts		
7.3	Parts Control Board		
7.4	Re-use of EEE Parts		
7.5	Master EEE Parts List		
DID 7-1	Parts Control Plan		
DID 7-2	Master EEE Parts List		
8 Materials and Processes			
8.1	General		
8.2	Materials Identification and Usage List (MIUL)		
DID 8-1	Materials & Processes Selection, Control, and Implementation Plan		
DID 8-2	Materials Identification and Usage List		
9 Contamination Control			

9.1	Contamination Control Plan		
DID 9-1	Contamination Control Plan and Data		
10 Metrology and Calibration			
10.1	Metrology and Calibration Program		
10.2	Use of Non-calibrated Instruments		
11 GIDEP Alerts and Problem Advisories			
11.1	Government-Industry Data Exchange Program (GIDEP)		
11.2	Alert Disposition		
11.3	GIDEP Reporting		
11.4	Review Reporting		
12 End Item Acceptance Data Package			
12	End Item Acceptance Data Package		
DID 12-1	End Item Acceptance Data Package		

Title: Reporting of MRB Actions	**DID No.: 2-1**
MAR Paragraph: 2.2.2	**CDRL No.:**

Use:
- Report MRB actions to the project office.

Reference Documents:
- SAE AS9100 Quality Systems - Aerospace - Model for Quality Assurance in Design, Development, Production, Installation and Servicing

Place/Time/Purpose of Delivery:
- Major MRB actions: Notify project CSO when generated, for meetings, status change, and approval
- Minor MRB actions: Available via electronic reporting system

Preparation Information:
1. Developer's MRB System shall be made available electronically to GSFCs project team.
2. The developer shall document the MRB action per the developer's MRB system form, which shall contain at a minimum:
   a. MRB Classification (major/minor)
   b. Dates (opened, closed, etc.)
   c. Condition Observed
   d. Cause
   e. Corrective Action Taken
   f. Preventive Action

Title: Anomaly Report	**DID No.: 2-2**
MAR Paragraph: 2.3	**CDRL No.:**

Use:

- Document anomalies, investigative activities, rationale for closure, and corrective and preventive actions.

Reference Documents:

- SAE AS9100 Quality Systems - Aerospace - Model for Quality Assurance in Design, Development, Production, Installation and Servicing

Place/Time/Purpose of Delivery:

- Major Anomaly: Notify project CSO within 24 hours of the initial event, and 24 hours prior to meetings.
- Minor Anomaly: Available via electronic reporting system.

Preparation Information:

1. Developer's Anomaly Reporting System shall be made available electronically to GSFC's project team.
2. Document anomalies, changes in status, or proposed closures shall identify the following information:
   a. Identification of project, system, or sub-system
   b. Identification of failed item (e.g., assembly, sub-assembly, or part)
   c. Description of item
   d. Identification of next higher assembly
   e. Description of anomaly, including activities leading up to anomaly, if known
   f. Names and contact information of individuals involved in anomaly
   g. Date and time of anomaly
   h. Status of item
   i. Contact information for personnel who originated the report
   j. Date of original submission
   k. Anomaly cause
   l. Corrective and Preventive actions implemented
   m. Retesting performed and results
   n. Other items affected
   o. Risk ratings – the numerical ratings for failure effect risk and corrective action risk per the following criteria:

   Failure Effect Risk Rating – indicates the potential impact of the anomaly on hardware or software performance if it occurred during the mission. Redundancy shall be ignored in establishing this rating. The project shall assign a failure effect risk rating per the following criteria: and corresponding numerical values:

   1 Negligible or no effect on mission, system or instrument performance, reliability or safety.

   2 Moderate or significant effect on the mission, system or instrument performance, reliability or safety, defined as: an appreciable change in functional capability, an appreciable degradation of engineering or science telemetry, causing significant operational difficulties or constraints, or causing a reduction in mission lifetime.

   3 Catastrophic or major degradation to mission, system or instrument performance, reliability or safety.

   Corrective Action Rating – indicates the confidence in the root cause and the corrective action. The project shall assign a failure corrective action risk rating per the following criteria:

   1 Recurrence very unlikely – the root cause of the anomaly has been determined with confidence by analysis or test. Corrective action has been determined, implemented, and verified with certainty. There is a very low probability of recurrence.

   2 Recurrence unlikely – the root cause of the anomaly has not been determined with confidence. However, some corrective action has been determined, implemented, and verified to the extent that there is a very low probability of recurrence.

   3 Recurrence possible – the root cause is considered known and understood with confidence. Corrective action has not been determined, implemented, or verified with certainty. There exists a possibility that the anomaly may recur.

   4 Recurrence credible – the root cause has not been determined with confidence. Corrective action has not been determined, implemented, or verified with certainty. There exists a possibility that the anomaly may recur.

Title: System Safety Program Plan	**DID No.: 3-1**
MAR Paragraph: 3.3.1	**CDRL No.:**

Use:

- The System Safety Program Plan (SSPP) describes the tasks and activities of system safety management and engineering required to identify, evaluate, and eliminate or control hazards to the hardware, software, and system design by reducing the associated risk to an acceptable level throughout the system life cycle.

Reference Documents:

- NPR 8715.7 Expendable Launch Vehicle Payload Safety Program
- NASA-STD 8719.24 (with Annex), NASA Expendable Launch Vehicle Payload Safety Requirements

Place/Time/Purpose of Delivery:

- Deliver preliminary plan to the Project Office at SRR for information.
- Deliver final plan to the Project Office forty-five (45) days prior to PDR for information.
- Deliver updates to the final plan to the Project Office thirty (30) days prior to implementation for information

Preparation Information:

If desired, the SSPP can be included as a separate chapter of the MAIP.

1. The developer shall prepare a SSPP that describes the development and implementation of a system safety program that complies with the requirements of NPR 8715.7, the launch service provider, and launch range safety. The developer shall:
   a. Define the roles and responsibilities of personnel
   b. Define the required documentation, applicable requirements documents, and completion schedules for analyses, reviews, and safety packages
   c. Address support for Safety Reviews, Safety Working Group Meetings and TIMs
   d. Provide for early identification and control of hazards to personnel, facilities, support equipment, and the flight system during product development, including design, fabrication, test, transportation, and ground activities.
   e. Address compliance with the launch range safety requirements
   f. Include a safety review process that meets the requirements of NASA-STD-8715.7 Expendable Launch Vehicle Payloads Safety Program
   g. Address compliance with industrial safety requirements imposed by NASA and OSHA design and operational needs (e.g., NASA-STD-8719.9 Lifting Devices and Equipment as applicable) and contractually imposed mission unique obligations

Title: Safety Requirements Compliance Checklist	**DID No.: 3-2**
MAR Paragraph: 3.3.2	**CDRL No.:**

Use:

- The checklist indicates for each requirement whether the proposed design is compliant, non-compliant but meets intent, non-compliant, or if the requirement is not applicable. An indication other than compliant will include rationale.

  Note: the developer shall submit safety waivers for non-compliant design elements using the NASA ELV Payload Safety Waiver Request NF1827 (found on the NASA ELV Payload Safety Web site at http//:kscsma.ksc.nasa.gov/ELVPayloadSafety/Default.html under the "ELV Payload Safety Forms" button),

Reference Documents:

- NASA-STD 8719.24 (with Annex), NASA Expendable Launch Vehicle Payload Safety Requirements

Place/Time/Purpose of Delivery:

- Deliver Preliminary version to the Project Office forty-five (45) days prior to PDR for approval.
- Deliver Final version to the Project Office forty-five (45) days prior to CDR for approval.

Preparation Information:

1. The developer shall prepare a compliance checklist of all design, test, analysis, and data submittal requirements. The following shall be included:
   a. Criteria and requirement.
   b. System
   c. Indication of compliance, noncompliance, or not applicable
   d. Rationale for indications other than compliant
   e. Resolution
   f. Reference
   g. Copies of Range Safety and NASA approved non-compliances, including waivers and equivalent levels of safety certifications

Title: Operations Hazard Analysis and Hazard Verification Tracking Log	**DID No.: 3-3**
MAR Paragraph: 3.3.3.2	**CDRL No.:**

Use:

- The Operations Hazard Analysis (OHA) and Hazard Verification Tracking Log (VTL) shall demonstrate that hazards related to the operation of hardware and test equipment during integration and test activities have been addressed with respect to facility safety requirements.

Reference Documents:

Place/Time/Purpose of Delivery:

- Deliver the OHA and Hazard VTL for flight hardware to the Project Office forty-five (45) days prior to Systems Integration Review or Pre-Environmental Review for approval (Note: OHA controls for engineering test units undergoing environmental tests shall be presented in accordance with local safety authorities 45 days prior to test performance)

Preparation Information:

1. The OHA shall include the following information:
   a. Introduction – a summary of the major findings of the analysis and the proposed corrective actions and definitions of special terms, acronyms, and abbreviations.
   b. System Description – a description of system hardware and configuration, with a list of subsystem components and schedules for integration and testing
   c. Analysis of Hazards
   d. List of real or potential hazards to personnel, equipment, and property during I&T processing
   e. The following information shall be included for each hazard:
      - System Component/Phase – the phase and component with which the analysis is concerned; e.g., system, subsystem, component, operating/maintenance procedure, or environmental condition.
      - System Description and Hazard Identification, Indication:
        - A description of expected results from operating the component/subsystem or performing the operating/maintenance action
        - A complete description of the actual or potential hazard resulting from normal actions or equipment failures; indicate whether the hazard will cause personnel injury and equipment damage.
        - A description of crew indications which include means of identifying the hazard to operating or maintenance personnel.
        - A description of the safety hazards of software controlling hardware systems where the hardware effects are safety critical.
      - Effect on System – the detrimental effects of an uncontrolled hazard on the system
      - Risk Assessment.
      - Caution and Warning Notes – a list of warnings, cautions, procedures required in operating and maintenance manuals, training courses, and test plans
      - Status/Remarks – the status of actions to implement hazard controls.
   f. References (e.g., test reports, preliminary operating and maintenance manuals, and other hazard analyses)

Tailoring note: Delete either this or the following DID per the tailoring of Paragraph 3.3.4

Title: Instrument Safety Assessment Report (ISAR)	**DID No.: 3-4**
MAR Paragraph: 3.3.3.1, 3.3.3.4, 3.3.4, 3.3.5	**CDRL No.:**

Use:

- The Instrument Safety Assessment Report (ISAR) documents the comprehensive evaluation of the risk being assumed prior to the testing or operation of an instrument. The spacecraft developer will append the ISAR as an input to the Safety Data Package (SDP) and will verify inhibit controls ultimately used in whole or part to control instrument hazards at the observatory level.

Reference Documents: ***Tailoring note: delete non-applicable documents***

- NASA-STD 8719.24 (with Annex), NASA Expendable Launch Vehicle Payload Safety Requirements
- JSC 26943 Guidelines for the Preparation of Payload Flight Safety Data Packages and Hazard Reports

Place/Time/Purpose of Delivery:

- Deliver the Preliminary ISAR to the Project Office thirty (30) days prior to instrument PDR for approval.
- Deliver the Intermediate ISAR to the Project Office thirty (30) days prior to instrument CDR for approval.
- Deliver the Final ISAR to the Project Office thirty (30) days prior to instrument PSR for approval.

Preparation Information:

1. The ISAR will identify safety features of the hardware, software, and system design as well as procedural, hardware, and software related hazards that may be present in the instrument. This includes specific procedural controls and precautions that should be followed. The ISAR will include the following information:
2. The safety criteria and methodology used to classify and rank hazards, including assumptions upon which the criteria or methodologies were based or derived
3. The results of hazard analyses and tests used to identify hazards in the system including:
    - Those hazards that still have a residual risk and the actions that have been taken to reduce the associated risk to a level contractually specified as acceptable
    - Results of tests conducted to validate safety criteria, requirements, and analyses
    - Hazard reports documenting the results of the hazard analyses to include a list of all significant hazards along with specific safety recommendations or precautions required to ensure safety of personnel, property, or the environment. NOTE: Identify whether or not the risks may be expected under normal or abnormal operating conditions.
    - Any hazardous materials generated by or used in the system
    - The conclusion that all identified hazards have been eliminated or their associated risks controlled to levels contractually specified as acceptable and that the instrument is ready to test, operate, or proceed to the next phase
4. In order to aid the spacecraft developer in completing an orbital debris assessment of the instrument it is necessary to identify any stored energy sources in instruments (pressure vessel, Dewar, etc.) as well as any energy sources that can be passivated at end of life.

Tailoring note: Delete either this or the preceding DID per the tailoring of Paragraph 3.3.4

Title: Safety Data Package (SDP)	**DID No.: 3-4**
MAR Paragraph: 3.3.3.1, 3.3.3.4, 3.3.4, 3.3.5	**CDRL No.:**

Use:

- The SDP provides a description of the payload design to support hazard analysis results, hazard analysis method, and other applicable safety related information. The developer shall include hazard analyses identifying the prelaunch, launch and flight hazards associated with the flight system, ground support equipment, and their interfaces. The developer shall take measures to control or minimize hazards.
- In addition to identifying hazards, the SDP documents controls and verification methods for each hazard in Hazard Reports, which are included in a separate appendix. The analysis shall be updated as the hardware progresses through design, fabrication, and test. A list of hazardous/toxic materials with material safety data sheets and a description of the hazardous and safety critical operations associated with the payload shall be included in the final SDP.
- The safety assessment shall begin early in the program formulation process and continue throughout all phases of the mission lifecycle through safe separation from the launch vehicle. The spacecraft or instrument Project Manager shall demonstrate compliance with these requirements and shall certify to GSFC and the launch range, through the SDP, that all safety requirements have been met.

Reference Documents: ***Tailoring note: delete non-applicable documents***

- NASA-STD 8719.24 (with Annex), NASA Expendable Launch Vehicle Payload Safety Requirements
- JSC 26943, Guidelines for the Preparation of Payload Flight Safety Data Packages and Hazard Reports (Ad hoc reference)

Place/Time/Purpose of Delivery:

- Deliver the SDP I to the Project Office forty-five (45) days prior to Mission PDR for approval.
- Deliver the SDP II to the Project Office forty-five (45) days prior to Mission CDR for approval.
- Deliver the SDP III to the Project Office ninety (90) days prior to shipment for approval.

Preparation Information:

1. NASA-STD-8719.24, Volume 3,Attachment 1, Paragraph A1.2 provides a detailed description of the information required in the SDP.
2. The Final SDP shall also include appropriate KSC forms as defined by PSWG.
   a. Material Selection Forms are available for download from ELV Payload Safety Program website at URL: http://kscsma.ksc.nasa.gov/ELVPayloadSafety/NASAReferenceDocs_2.html
   b. Ionizing and Non-Ionizing Radiation Forms are available for download from ELV Payload Safety Program website at URL: http://kscsma.ksc.nasa.gov/ELVPayloadSafety/Forms.html

Title: Hazardous Procedures for Payload I&T and Pre-launch Processing	**DID No.: 3-5**
MAR Paragraph: 3.3.6	**CDRL No.:**
Use: ▪ Documents hazardous procedures and associated safeguards that the developer will use for integration and test activities and pre-launch activities that comply with the applicable safety requirements of the installation where the activities are performed.	
Reference Documents: ▪ NASA-STD 8719.24 (with Annex), NASA Expendable Launch Vehicle Payload Safety Requirements ▪ KNPR 8715.3, KSC Safety Practices Procedural Requirements (as applicable)	
Place/Time/Purpose of Delivery: ▪ Submit Payload I&T Hazardous Procedures to the Project Office seven (7) days before first use for approval. ▪ Submit Launch Range Hazardous Procedures to the Project Office sixty (60) days prior to first use for approval. ▪ After Project Office approval, submit Launch Range Hazardous Procedures to Range Safety forty-five (45) days prior to first use for approval.	

Title: Input to Orbital Debris Assessment Report (ODAR) and End of Mission Plan (EOMP)	**DID No.: 3-6**
MAR Paragraph: 3.3.7	**CDRL No.:**

Use:
- Ensure NASA requirements for post mission orbital debris control and end of mission planning are met.

Reference Documents:
- NASA-STD-8719.14 Process for Limiting Orbital Debris (Appendix A for ODAR, & Appendix B for EOMP

Place/Time/Purpose of Delivery:

ODAR
- Deliver preliminary ODAR inputs to the Project Office fifteen (15) days prior to mission PDR for information.
- Deliver ODAR interim inputs to the Project Office sixty (60) days prior to mission CDR for information.
- Deliver the final/updated ODAR and EOMP inputs to the Project Office 90 days prior to PSR for information.

EOMP
- Deliver initial draft EOMP inputs to the Project Office sixty (60) days prior to mission CDR for information.
- Deliver inputs to Prelaunch EOMP to the Project Office ninety (90) days prior to PSR for information.

Preparation Information:

1. NASA-STD-8719.14 Process for Limiting Orbital Debris Appendix A (ODAR) and Appendix B (EOMP) provide details on what information is required for the Project Office to complete these analyses

   NOTE: Orbital Debris Assessment Software is available for download from Johnson Space Center at URL: http://sn-callisto.jsc.nasa.gov/mitigate/das/das.html

Title: Pre-Mishap Plan	**DID No.: 3-7**
MAR Paragraph: 3.3.8	**CDRL No.:**

Use:

- Provides a plan for procedures to be followed to respond to and control a mishap or a close call that may have personnel or hardware safety implications, or may cause flight or GSE hardware damage.
- Provide the Project Office and NASA with information on any mishaps, incidents, and close calls related to the developer's efforts.

Reference Documents:

- Sample Pre-Mishap Plan – available from the Project Office upon request

Place/Time/Purpose of Delivery:

- Deliver to the Project Office forty-five (45) days prior to mission PDR for approval.

Preparation Information:

1. The plan shall identify the processes and procedures to be followed to respond to the occurrence of a mishap or a close call and identify the chain of individuals, including government personnel, to be contacted. The Mishap Plan should include the following information:
   a. The developer's policies and plan regarding response to a mishap or close call, to include:
      - Actions to be taken from the occurrence through implementation of corrective actions.
      - Plans for emergency response, notification, evidence preservation, mishap investigation, the mishap investigation report, lessons learned, and corrective actions.
      - Information regarding responsible for duties and tasks involved in the process.
   b. The following definitions:
      - Close Call -- An occurrence or a condition of employee concern in which there is no injury or minor injury requiring first aid and no or minor equipment or property damage (less than $20,000) but which possesses a potential to cause a mishap.
      - Incident -- An occurrence of a close call or a mishap.
      - Mishap -- An unplanned occurrence that results in damage to property or personnel injury or illness: damage to developer, government, or customer-owned hardware property or critical products; fatalities, injuries, or illnesses occurring during program operations; environmental releases or spills occurring in the course of program operations.
   c. The following definitions regarding the type of mishaps:
      - Type A Mishap -- A mishap resulting in one or more of the following: (1) an occupational injury or illness resulting in a fatality, a permanent total disability, or the hospitalization for inpatient care of 3 or more people within 30 workdays of the mishap; (2) a total direct cost of mission failure and property damage of $2 million or more.
      - Type B Mishap -- A mishap that caused an occupational injury or illness that resulted in a permanent partial disability, the hospitalization for inpatient care of 1-2 people within 30 workdays of the mishap, or a total direct cost of mission failure and property damage of at least $500,000 but less than $2,000,000.
      - Type C Mishap -- A mishap resulting in a nonfatal occupational injury or illness that caused any days away from work, restricted duty, or transfer to another job beyond the day or shift on which it occurred, or a total direct cost of mission failure and property damage of at least $50,000 but less than $500,000.
      - Type D Mishap -- A mishap that caused any nonfatal OSHA recordable occupational injury and/or illness that does not meet the definition of a Type C mishap, or a total direct cost of mission failure and property damage of at least $20,000 but less than $50,000.
   d. Contact information for Project Office personnel.
   e. Notification schedule and mishap response process timeline (notification in no more than 24 hours).
   f. Note: The following are not reportable as mishaps but may be reportable as failures or anomalies:
      - Property Damage:
        - Items normally covered under Failure Reporting
        - Malfunction or failure of component parts or equipment due to normal wear and tear where the malfunction is the only damage and the only action is to replace or repair the equipment.
        - Anticipated damage to equipment or property was incurred during testing or manufacturing.
        - Property damage from vandalism, arson, sabotage or acts of God.

- Injury:
  - Injuries and illnesses from non-occupational diseases.
  - Injuries that occur during work arrival or departure.
  - Injuries or illness sustained before working at the developer unless specifically aggravated by a work assignment.
  - Injuries from non-work-related, pre-existing disorders or by minimum stress and strain.
  - Injuries from activities unrelated to work (e.g., recreational activities, workouts, etc.).

Title: Fault Tree Analysis (FTA)	**DID No.: 4-1**
MAR Paragraph: 4.2	**CDRL No.:**

Use:

- Used to assess mission failure from the top-level perspective. Undesired top-level states are identified and combinations of lower-level events are considered to derive credible failure scenarios. The technique provides a methodical approach to identify events or environments that can adversely affect mission success and provides an informed basis for assessing system risks.

Reference Documents

- NASA Fault Tree Handbook with Aerospace Applications (http://www.hq.nasa.gov/office/codeq/doctree/fthb.pdf)
- NPR 8705.4 Risk Classification for NASA Payloads
- NPR 8715.3 NASA General Safety Program Requirements

Place/Time/Purpose of Delivery:

- Deliver preliminary qualitative mission FTA report to Project Office thirty (30) days prior to PDR for review.
- Deliver final qualitative mission FTA report to Project Office thirty (30) days prior to CDR for approval.
- Deliver qualitative mission FTA report to Project Office within thirty (30) days of updates/changes for approval.

Preparation Information:

1. The mission FTA Report shall contain:
   a. Analysis ground rules including definitions of undesirable end states
   b. References to documents and data used
   c. Fault tree diagrams
   d. Results and conclusions

Title: Software Assurance Plan	**DID No.: 5-1**
MAR Paragraph: 5.2	**CDRL No.:**

Use:

- Documents the developers' Software Assurance roles and responsibilities and surveillance activities to be performed as outlined in the NASA Software Assurance Standard.

Reference Documents:

- NASA-STD-8739.8, NASA Standard for Software Assurance
- SSP-50038 Computer –Based Control System Safety Requirements
- NASA-STD-8719.13, NASA Software Safety Standard
- IEEE Standard 730-2002, Software Quality Assurance Plans

Place/Time/Purpose of Delivery:

- Deliver preliminary plan to the Project Office thirty (30) days prior to SRR for information.
- Deliver final plan to the Project Office forty-five (45) days prior to PDR for information.
- Deliver updates to the Project Office thirty (30) days prior to implementation for information.

Preparation Information:

1. The Software Assurance Plan (SAP) shall address the following:
   a. Purpose
   b. Scope
   c. Reference documents and definitions
   d. Assurance Organization and Management – including roles and responsibilities
   e. Assurance Activities by discipline
      - Software Quality (process and product)
      - Software Safety
      - Software Reliability
      - Software Verification and Validation
   f. Reviews: Peer reviews and milestone reviews
   g. Assurance tools, techniques, and methodologies
   h. Assurance Problem Reporting and Corrective Action
   i. Assurance records, collection, maintenance, and retention
   j. SAP Change procedure and history

Title: Printed Wiring Board (PWB) Test Coupons	**DID No.: 6-1**
MAR Paragraph: 6.5	**CDRL No.:**

Use:

- PWB test coupons are evaluated to validate that PWBs are suitable for use in space flight and mission critical ground applications.

Reference Documents:

- IPC-6011 Generic Performance Specifications for Printed Boards (Class 3 Requirements)
- IPC-6012 Qualification and Performance Specification for Rigid Printed Boards (Class 3A Requirements)
- IPC-6013 Qualification and Performance Specification for Flexible Printed Boards (Class 3 Requirements)
- IPC-6018 Qualification and Performance Specification for High Frequency (Microwave) Printed Boards (Class 3 Requirements)
- MIL-PRF-50884F, Performance Specification: Printed Wiring Board, Flexible Rigid-Flex, General Specification For
- MIL-PRF-55110H, Performance Specification: Printed Wiring Board, Rigid, General Specification For
- IPC-A-600 Guidelines for Acceptability of Printed Boards (Class 3 Requirements)
- IPC-2221 Generic Stand on Printed Board Design

Place/Time/Purpose of Delivery:

- The developer shall notify and deliver test coupons and supporting manufacturing information traceable to the flight boards to GSFC or a GSFC approved laboratory as soon as practicable for analysis of the printed wiring boards for approval.
- Note: Coupon specimens do not need to be submitted for single-sided PWBs or double-sided PWBs that don't contain any plated through holes or vias.
- Note: If a GSFC-approved laboratory is used for coupon evaluation, the developer shall make available the laboratory results to GSFC Project CSO upon receipt for information (electronically).

Preparation Information:

1. Notify GSFC regarding shipment of PWB test coupons.
2. The developer shall provide:
   a. Coupon specimens with sufficient A, B, A/B coupons, or their equivalent per IPC-2221 for thermally stressed micro-sectioned coupon evaluation per section 3.6 of the applicable IPC-60XX specification.
   b. If the represented PWB design contains a blind, buried, or micro via, the developer shall provide additional B or A/B coupons for each contained feature for thermally stressed evaluation.
   c. M coupon or equivalent if a specialty plating is used (e.g., ENIG, ENIPIG).
   d. Supporting manufacturing documentation that is traceable to the flight boards and that includes: the specification to which the board was produced; board drawing or drawing notes; class of printed board; type of printed board; indication if there are blind, buried, or micro vias present; laminate information; part number; serial number and Vendor ID (CAGE Code for a US manufacturer).

Title: Parts Control Plan	**DID No.: 7-1**
MAR Paragraph: 7.1	**CDRL No.:**

Use:

- Development and implementation of an EEE parts control plan that addresses the system requirements for mission lifetime and reliability.

Reference Documents

- GSFC EEE-INST-002 Instructions for EEE Parts Selection, Screening, Qualification, and Derating
- S-311-M-70 Specification for Destructive Physical Analysis
- SAE AS5553 Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition

Place/Time/Purpose of Delivery:

- The developer shall submit the PCP to the project office thirty (30) days after contract award for approval

Preparation Information:

1. The PCP shall address the following:
   a. Parts control program organization and management
   b. Shelf life control plan
   c. Parts application derating
   d. Supplier and manufacturer surveillance
   e. Qualification
   f. Procedures regarding application specific integrated circuits, gate arrays, system-on-chip, and custom integrated circuits
   g. Incoming inspection and test
   h. Sparing policies
   i. Destructive physical analysis
   j. Defective parts controls program.
   k. Handling, preservation, and packing
   l. Contamination control
   m. Alternate quality conformance inspection and small lot sampling
   n. Traceability and lot control
   o. Failure analysis
   p. Counterfeit parts control plan per AS5553
   q. Radiation hardness assurance program, which shall address: total ionizing dose; displacement damage (total non-ionizing dose); destructive and non-destructive single-event effects; single-event effect rates; proton hardness/tolerance
   r. Parts Control Board Operations
      - Organization and membership
      - Meeting schedule and notices
      - Distribution of meeting agenda, notes, and minutes
      - Review and approval responsibilities and processes
      - Documentation and records

Title: Master EEE Parts List	**DID No.: 7-2**
MAR Paragraph: 7.5	**CDRL No.:**

Use:

- Tracking EEE parts from preliminary design through final flight hardware fabrication

Reference Documents:

Place/Time/Purpose of Delivery:

- The developer shall obtain Parts Control Board approval for each of the phases listed below
- The developer shall submit EEE parts additions/changes to the to the Parts Control Board for approval (prior to use)

Preparation Information:

1. Information shall be maintained in a searchable electronic format – with access granted to GSFC Project Parts Engineer.
2. The Developer shall generate and maintain a Master Parts List with the minimum information listed below for the various stages throughout the projects lifecycle:

   Phase A/B: Initial Parts Identification List shall contain the following
   - Flight component identity to the circuit board level
   - Complete part number (i.e. Defense Supply Center Columbus part number, Specification Control Drawing part number, with all suffixes)
   - Manufacturer's Generic Part number
   - Manufacturer (not distributor)
   - Part Description (please include meaningful detail)
   - Federal Supply Class
   - Procurement Specification
   - Comments and clarifications, as appropriate
   - Estimated quantity required (for procurement forecasting)

   Phase B: Parts that are approved for flight use shall be updated to include the following information
   - Procurement Part Number
   - Flight Part Number (if different from the procurement part number)
   - Package Style/Designation
   - Single Event Latch-up (SEL) Hardness/Tolerance and Data Source
   - Single Event Upset (SEU) Hardness/Tolerance and Data Source
   - Total Ionizing Dose (TID) Hardness/Tolerance and Data Source
   - Displacement Damage Hardness/Tolerance (total non-ionizing dose) and Data Source
   - Proton Hardness/Tolerance and Data Source
   - PCB Status
   - PCB Approval Date
   - PCB Required Testing/Evaluations

   Phase C: Once a design is approved for build the parts list shall be updated to reflect the as designed configuration
   - Assembly Name/Number
   - Next Level of Assembly
   - Need Quantity
   - Reference Designator(s)
   - Item number (if applicable)

   Phase C/D: Once flight hardware fabrication has completed the list shall be updated to reflect the as built configuration
   - Assembly serial number
   - Item revision
   - Next Level of Assembly serial number
   - Lot/Date/Batch/Heat/Manufacturing Code, as applicable
   - Manufacturer's Cage Code (specific plant location when relevant)
   - Distributor/supplier, if applicable
   - Part number
   - Part serial number (if applicable)

Title: Materials and Processes Selection, Control, & Implementation Plan	**DID No.: 8-1**
MAR Paragraph: 8.1	**CDRL No.:**

Use:

- Defines the implementation of NASA-STD-6016 with prescribed changes as described in the Preparation Information.

Reference Documents:

- NASA GSFC/JSC Materials and Processes Inter-center Agreement (Dated 1992) – ISS Payloads Only
- NASA-STD-6016 Standard Materials and Processes Requirement for Spacecraft

Place/Time/Purpose of Delivery:

- Provide to the Project Office sixty (60) days after contract award for approval.

Preparation Information:

1. The plan shall address each paragraph in Section 4 of NASA-STD-6016, with the changes prescribed below, 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 the plan, which meet or exceed the stated requirements. This tailoring approach will allow for the approval of alternate requirements.
2. The plan shall address the following:
   a. Organizational authority and responsibility for review and approval of M&P specified prior to release of engineering documentation.
   b. Identification and documentation of M&P.
   c. Procedures and data documentation for proposed test programs to support materials screening and verification testing.
   d. Materials Usage Agreement (MUA) procedures.
   e. The process for submitting a MUA for a material or process that does not meet the requirements of NASA-STD-6016 or developer's standard and does not affect reliability or safety when used. MUAs that effect safety will require GSFC Project approval.
   f. Determination of material design properties, including statistical approaches to be employed.
   g. Identification of process specifications used to implement requirements in NASA-STD-6016.
   h. In addition to the requirements of paragraph 4.2.2.11, the developer shall address the requirements of GEIA-STD-0005-1 and GEIA-STD-0005-2 for solders and surface finishes that are less than 3% lead by weight. The LFCP shall comply with the Level "2C" requirements set.
   i. In paragraph 4.1.2, the developer may use GFSC forms or the developer's equivalent forms in lieu of the MAPTIS format.
   j. The developer may use the GSFC outgassing database (URL http://outgassing.nasa.gov) in addition to MAPTIS (URL http://outgassing.nasa.gov).
3. Prescribed changes to NASA-STD-6016:
   a. Instead of NASA-STD-6008, the developer may use 541-PG-8072.1.2 or a demonstrated successful developer practice for procuring, receiving and storing fasteners used for spaceflight hardware with counterfeit protections.
   b. Paragraph 4.2.6.6 does not apply. Note: The contamination control plan shall be defined per DID 9-1.

Title: Materials Identification and Usage List (MIUL)	**DID No.: 8-2**
MAR Paragraph: 8.2	**CDRL No.:**
Use: ▪ Establishes the Materials Identification and Usage List (MIUL).	
Reference Documents: ▪ NASA-STD-6016 Standard Materials and Processes Requirement for Spacecraft	
Place/Time/Purpose of Delivery: ▪ Provide to the Project Office thirty (30) days prior to PDR for review ▪ Provide to the Project Office thirty (30) days prior to CDR approval ▪ Provide updates to the Project Office within thirty (30) days of identification for review	
Preparation Information: 1. Soldering flux shall be included in the MIUL. 2. Solvents used for cleaning flight electronic assemblies, other than isopropyl alcohol or deionized water shall be included in the MIUL. 3. The MIUL documentation approach shall be defined in the Materials and Processes Selection, Control, and Implementation Plan (see DID 8-1).	

Title: Contamination Control Plan and Data	**DID No.: 9-1**
MAR Paragraph: 9.1	**CDRL No.:**

Use:

- To establish contamination allowances, methods for controlling contamination, and record test results

Reference Documents:

- GSFC-STD-7000 General Environmental Verification Standard (GEVS)
- GSFC-STD-1000 Rules for the Design, Development, Verification, and Operation of Flight Systems
- ASTM E595 Standard Test Methods for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
- Outgassing Data for Selecting Spacecraft Materials (URL: http://outgassing.nasa.gov/)
- NAS 412 Foreign Object Damage/Foreign Object Debris (FOD) Prevention

Place/Time/Purpose of Delivery:

- Provide to the Project Office thirty (30) days before PDR for GSFC review.
- Provide to the Project Office thirty (30) days before the CDR for approval.
- Final thermal vacuum bakeout results provided to the Project Office within thirty (30) of completion for review.
- Provide contamination certificate of compliance with End Item Acceptance Data Package (DID 12-1) for review

Preparation Information:

1. The developer shall provide: material properties data; design features; test data; system tolerance of degraded performance; methods to prevent degradation.
2. The items below shall be addressed in the plan:

   Beginning of life and end of life requirements for contamination sensitive surfaces or subsystems

   Methods and procedures used to measure and maintain the levels of cleanliness required during each of the various phases of the item's lifetime (e.g., protective covers, environmental constraints, purges, cleaning/monitoring procedures)

   Materials
   - Outgassing as a function of temperature and time.
   - Nature of outgassing chemistry.
   - Areas, weight, location, view factors of critical surfaces.

   Venting: size, location and relation to external surfaces.

   Thermal vacuum test contamination monitoring plan, to include vacuum test data, QCM location and temperature, pressure data, system temperature profile, and shroud temperature.

   On-orbit spacecraft and instrument performance as affected by contamination deposits.
   - Contamination effect monitor
   - Methods to prevent and recover from contamination in orbit
   - Evaluation of on-orbit degradation
   - Photopolymerization of outgassing products on critical surfaces
   - Space debris risks and protection
   - Atomic oxygen erosion and re-deposition

   Analysis of contamination impact on the satellite on orbit performance

   In orbit contamination impact from other sources such as STS, space station, and adjacent instruments

   Ground/Test support equipment controls to prevent contamination of flight item(s)

   Facility controls and processes to maintain hardware integrity (protection and avoidance)

   Training

   Data package on test results for materials and as-built product

   Foreign Object Debris (FOD) prevention

   Preservation of product with respect to foreign object debris prevention per requirements of NAS 412

Title: End Item Acceptance Data Package	**DID No.: 12-1**
MAR Paragraph: 12	**CDRL No.:**

Use:

- The End Item Acceptance Data Package documents the design, fabrication, assembly, test, and integration of the hardware and software being delivered and is included with the end item delivery.

Reference Documents:

Place/Time/Purpose of Delivery:

- Provide the End Item Acceptance Data Package to the Project seven (7) days prior to end item delivery for approval.
- Note: End Item Acceptance Data Package should be maintained throughout the projects life cycle and available during inspections, acceptance test, and upon request.

Preparation Information:

1. The developer prepares the End Item Acceptance Data Package as part of design development and implementation such that it is completed prior to delivery.
2. The following items shall be included:
   a. The deliverable item name, serial number, part number, and classification status (e.g., flight, non-flight, ground support, etc.).
   b. Appropriate approval signatures (e.g., developers quality representative, product design lead, government Representative, etc.)
   c. List of shortages or open items at the time of acceptance with supporting rationale.
   d. As-built serialization
   e. As-built vs. As-designed configuration (revisions)
   f. In-process Work Orders (available for review at developers--not a deliverable)
   g. Final assembly and test Work Order
   h. Major MRB records
   i. Major Anomaly/problem failure reports with root cause and corrective action dispositions
   j. Acceptance testing procedures and report(s), including environmental testing
   k. Trend data
   l. Master EEE parts list
   m. As-built materials identification and usage list
   n. Chronological history, including:
      - Total operating hours and failure-free hours of operation
      - Total number of mechanical cycles and remaining cycle life
   o. Limited life items, including data regarding the life used and remaining
   p. As-built final assembly drawings
   q. PWB coupon results
   r. Photographic documentation of hardware (pre and post-conformal coating for printed wiring assemblies, box or unit, subsystem, system, harness, structure, etc.)
   s. Waivers
   t. Certificate of Compliance which is signed by management

Appendix B: Abbreviations and Acronyms

ABPL	As-Built Parts List	O&SHA	Operating and Support Hazard Analysis
ADPL	As-Designed Parts List	ODAR	Orbital Debris Assessment Report
AF	Air Force	OHA	Operations Hazard Analysis
ANSI	American National Standards Institute	OSHA	Occupational Safety and Health Administration
ASCII	American Standard Code for Information Interchange	PADS	Netlist from automated electronic design software tool
ASIC	Application Specific Integrated Circuit	PAL	Programmable Array Logic
ASME	American Society of Mechanical Engineers	PAPL	Project Approved Parts List
ASNT	American Society of Non-Destructive Testing	PCB	Parts Control Board
CCB	Change Control Board	PDF	Portable Document Format
CDRL	Contact Data Requirements List	PIL	Parts Identification List
CIL	Critical Items List	PLA	Programmable Logic Array
COTS	Commercial Off The Shelf Software	RPP	Reliability Program Plan
DID	Data Item Deliverable	SCORE	Signature Control Request
EEE	Electrical, Electronic, and Electro-mechanical	SDP	Safety Data Package
ELV	Expendable Launch Vehicle	SRP	System Review Program
EOMP	End of Mission Plan	SSPP	System Safety Program Plan
ESD	Electro-Static Discharge	STD	Standard
FAR	Federal Acquisition Requirements	TBD	To Be Determined
FMEA	Failure Modes and Effects Analysis	TBR	To Be Revised
FMECA	Failure Modes and Effects Criticality Analysis	TBS	To Be Scheduled
FPGA	Field Programmable Gate Array	TDMS	Technical Data Management System
FTA	Fault Tree Analysis	V&V	Verification & Validation
GIDEP	Government-Industry Data Exchange Program	VHDL	VSIC Hardware Description Language
GOTS	Government Off The Shelf Software	VTL	Verification Tracking Log
GSFC	Goddard Space Flight Center		
I&T	Integration & Test		
IPC	International trade association for electronic assemblies		
ISAR	Instrument Safety Assessment Report		
IV&V	Independent Verification & Validation		
KSC	Kennedy Space Center		
MAR	Mission Assurance Requirements		
MGC	Netlist from automated electronic design software tool		
MIUL	Material Identification and Usage List		
MOTS	Modified Off The Shelf Software		
MRB	Material Review Board		
MUA	Material Usage Agreement		
NASA	National Aeronautics and Space Administration		
NCCCO	National Commission for Certification of Crane Operators		
NDE	Non-Destructive Evaluation		
NPR	NASA Procedural Requirement		

Appendix C: Document List

Document Number	Title
	NASA Fault Tree Handbook with Aerospace Applications (http://www.hq.nasa.gov/office/codeq/doctree/fthb.pdf)
	NASA GSFC/JSC Materials and Processes Inter-center Agreement (Dated 1992) – ISS Payloads Only
500-PG-8700-2.7	Design of Space Flight Field Programmable Gate Arrays
ANSI/ESD S20.20	Protection of Electrical and Electronic Parts, Assemblies and Equipment [Excluding Electrically Initiated Explosive Devices]
ANSI/NCSL Z540.1-1994 (R2002)	Calibration Laboratories & Measuring & Test Equipment - General Requirements
ANSI/NCSL Z540.3-2006	Requirements for the Calibration of Measuring and Test Equipment
ASTM E595	Standard Test Methods for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
Federal Acquisition Regulations	Parts 46.103, 46.104, 46.202-2, 46.4, 46.5, and 52.246
GSFC EEE-INST-002	Instruction for EEE Parts Selection, Screening, Qualification, and De-rating
GSFC-STD-1000	Rules for the Design, Development, Verification, and Operation of Flight Systems
GSFC-STD-1001	Criteria for Flight and Flight Support Systems Lifecycle Reviews
GSFC-STD-6001	Ceramic Column Grid Array Design and Manufacturing Rules for Flight Hardware
GSFC-STD-7000	General Environmental Verification Standard
IEEE Standard 730-2002	Software Quality Assurance Plans
IPC A-600	Acceptability of Printed Boards
IPC-2221	Generic Standard on Printed Board Design
IPC-2222	Sectional Design Standard for Rigid Organic Printed Boards
IPC-2223	Sectional Design Standard for Flexible Printed Boards
IPC-2225	Sectional Design Standard for Organic Multichip Modules (MCM-L) and MCM-L Assemblies
IPC-6011	Generic Performance Specification for Printed Boards
IPC-6012	Qualification and Performance Specification for Rigid Printed Boards
IPC-6013	Qualification and Performance Specification for Flexible Printed Boards
IPC-6015	Qualification and Performance Specification for Organic Multichip Module (MCM-L) Mounting and Interconnecting Structures
IPC-6018	Microwave End Product Board Inspection and Test
IPC-J-STD-001FS	Joint Industry Standard, Space Applications Electronic Hardware Addendum
ISO 17025-2002	General requirements for the competence of testing and calibration laboratories
ISO 9001	Quality Management System
JERG-1-007	Safety Regulations for Launch Site Operations/Flight Control Operations
JMR-002B	Launch Vehicle Payload Safety Standard
JSC 26943	Guidelines for the Preparation of Payload Flight Safety Data Packages and Hazard Reports
JSX-2008041B	HTV Cargo Safety Review Process
JSX-2009059A	HTV Cargo Safety Certification Process for Disposal
KDP-99105	Safety Guide for H-II/H-IIA Payload Launch Campaign
KNPR 8715.3	KSC Safety Practices Procedural Requirements (applicable at KSC property, KSC-controlled property, and offsite facility areas where KSC has operational responsibility)

Document Number	Title
KNPR 8715.3	KSC Safety Practices Procedural Requirements
MIL-PRF-50884F	Performance Specification: Printed Wiring Board, Flexible or Rigid-Flex, General
MIL-PRF-55110H	Performance Specification: Printed Wiring Board, Rigid, General Specification For
NAS 412	Foreign Object Damage/Foreign Object Debris (FOD) Prevention
NASA-STD-8719.9	Standard for Lifting Devices and Equipment
NASA-STD-6016	Standard Materials and Processes Requirement for Spacecraft
NASA-STD 8719.14	Process for Limiting Orbital Debris
NASA-STD 8719.24	(with Annex) NASA Expendable Launch Vehicle Payload Safety Requirements
NASA-STD-8719.13	Software Safety Standard
NASA-STD-8719.13	NASA Software Safety Standard
NASA-STD-8739.1	Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies
NASA-STD-8739.4	Crimping, Interconnecting Cables, Harnesses, and Wiring
NASA-STD-8739.5	Fiber Optic Terminations, Cable Assemblies, and Installation
NASA-STD-8739.6	Implementation Requirements for NASA Workmanship Standards
NASA-STD-8739.8	NASA Standard for Software Assurance
NASA-STD-8739.13	NASA Software Safety Standard
NPR 7120.5	NASA Space Flight Program and Project Management Requirements
NPR 7150.2	NASA Software Engineering Requirements
NPR 8705.4	Risk Classification for NASA Payloads
NPR 8715.3	NASA General Safety Program Requirements
NPR 8715.7	Expendable Launch Vehicle Payload Safety Program
S-311-M-70	Specification for Destructive Physical Analysis
S0300-BT-PRO-010	GIDEP Operations Manual
S0300-BU-GYD-010	GIDEP Requirements Guide
SAE AS5553	Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition
SAE AS9100	Quality Systems - Aerospace - Model for Quality Assurance in Design, Development, Production, Installation and Servicing
SSP-50038	Computer–Based Control System Safety Requirements