

Radiation Budget Instrument (RBI)

Contract # NNL14AQ00C

Exhibit A

Statement of Work (SOW)



**Langley Research Center
Hampton, VA**

Change History Log

Revision	Effective Date	Description of Changes
DRFP	04-10-2013	Draft RFP
RBI-PMT- SOW-001	06-06-2013	SOW for 6 June 2013 RFP
Contract Exhibit A	Contract Award Date	Header, Contract # on title page
Conformed to Mod 9 (Rev A)	10-09-2014 Effective with the release of Mod 9	1. Update GEVS GSFC-STD-7000 to Rev A. 2. Update CV-03, and TRL definition references. 3. Omit NPR 7150.2A section numbers from Table A.
Conformed to Mod 10 (REV B)	05-07-2015	Table A: Added Document numbers & corrected titles for JPSS ICD & MICD Changed text in SOW-4.2-05 and SOW-4.3-06 from “results” to “status”
Conformed to Mod 14 (Rev C)	01-29-2016	Table A: Updated the JPSS ICD Revision to Rev. D.
Conformed to Mod 16 (Rev D)	02-08-2016	Added a 2.5 month extension from 54 to 56.5 months in SOW-1.1-03
Conformed to Mod X (Rev E)	04-18-2016	Added section 5.5 and sub-items for Simulator Software. Appendix A: added Simulator Software. See RBI-CR-025
Conformed to Mod 18 (Rev F)	06-06-2016	Table A: Added RBI Simulator Specification and RBI Simulator ICD documents. Updated SOW-5.5-14 to reflect that validation is a test and that the government will provide an Interface Simulator to support the test. Associated Rev F to Mod 18. See RBI-CR-032
Conformed to Mod 23 Rev G	08-04-2016 09-19-2016 10-28-2016	Added requirements SOW-6.1-05, SOW-6.5-03 Added Section 11.0 Risk Reduction, 11.1 I&T requirements SOW-11.1-01 & SOW-11.1-02 Added D.CC-5 & D.CC-6 to Appendix A Deliverables <u>Admin Change:</u> Changed Headers to “Mod X” & Change History Log to “Mod X”. See RBI- CR-042 <u>Admin Change:</u> Changed Headers to “Mod 23” & Change History Log to “Mod 23”; Updated the Table of Contents for Section 11.0 See RBI-CR-045
Rev H	08-26-2016	Revision Not Used
Rev I	03-27-2017	Removed “Conformed to Mod X” from all headers

		<p>Table A: Updated the document numbers and revisions for the JPSS-2 Spacecraft ICD and MICD</p> <p>Typo correction: duplicate requirement numbers only for SOW-1.1-28, the correction was to SOW-1.1-30</p> <p>See RBI-CR-052</p>
Rev J	5/05/2017	<p>Added requirement SOW-7.2-11</p> <p>Incorporation of changes from SE-02-001:</p> <p>SOW-4.3-01: Added word “representative”</p> <p>SOW-4.3-03: Removed text referencing the mechanical vibration and EMC tests</p> <p>See RBI-CR-054</p>
Rev K	10/10/2017	<p>Table A: Updated the revisions for RBI-SIMSPEC-02-008 Rev B and RBI-SIMICD-02-009 Rev A</p> <p>SOW-1.1-03 changed 56.5 months to February 5, 2019, due to adding 4 days to delivery per the SCT modification & identified as Instrument Completion</p> <p>SOW-3.6-07 Use of Splices: modified requirement to align with JPSS Instrument Mission Assurance Requirements. (RBI-CR-071)</p> <p>Appendix A: Added D.FH-1.1 Flight Instrument Completion</p> <p>See RBI-CR-076</p>
Rev L	11/08/2017	<p>SOW-1.1-03 edited to remove actual timeframe and refer to Appendix A</p> <p>Added SOW-1.1-04.1</p> <p>SOW-4.1-01 edited to include On Dock reference</p> <p>SOW-9.3-04 edited clarify Contract Delivery</p> <p>Added SOW-9.3-05</p> <p>Appendix A: Deleted D.FH-1; Edited D.FH-1.1 to clarify On Dock date; and Added D.FH-1.2 Flight Instrument to establish On Hook date</p> <p>See RBI-CR-079</p>

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I. INTRODUCTION

The Clouds and the Earth's Radiant Energy System (CERES) instruments have provided accurate world-class measurements of Earth's reflected solar and Earth's emitted thermal radiation since 1998. Earth radiation budget (ERB) measurements are essential to understanding the Earth's weather and climate. The CERES data are used to provide fundamental inputs to atmospheric and oceanic energetics, a basic input to extended range (10 day or longer) weather forecasting, provide measurements of the space and time distribution of the ERB, and to develop a quantitative understanding of the links between ERB and the properties of the atmosphere and surface that define that budget. Continuity of CERES data is essential to understanding the effect of clouds on the balance between energy coming in from the sun and energy radiating out from the Earth. Currently, clouds are one of the largest sources of uncertainty in modeling of the climate.

In order to acquire accurate measurements of the Earth's radiation budget that can give an uninterrupted extension of the CERES data, NASA will develop a new generation of instrument, the Radiation Budget Instrument (RBI). The first RBI will fly on the Joint Polar Satellite System (JPSS) 2 Mission scheduled for a 2021 launch. The notional JPSS mission plan has a replacement satellite launched every six years. To ensure RBI data continuity, the RBI will have a performance life of seven years.

II. SCOPE

This Statement of Work (SOW) defines the work required of the Contractor. This includes development and delivery of 1) one fully qualified RBI flight instrument; 2) one Radiometric Test Model (RTM) to validate the performance of the sensor, including optics and electronics; 3) one non-flight Engineering Development Unit (EDU) that has the same form fit and function as the RBI instrument and is used for ground-based qualification; 4) critical spaceflight qualified spare parts; and 5) nominal consultation to the Government in its performance of mission Phases D and E, observatory integration and test and on-orbit operations. Appendix A contains a list of RBI contract deliverables. The Government has responsibility for performing all Instrument post-delivery support activities following the Contractor's successful completion of the Instrument Bench Acceptance Test at the Spacecraft integration facility.

This SOW details the requirements for business and technical management, design, engineering analyses, data reduction, data presentations, technical reviews and related Government discussions, development, fabrication, integration, test, evaluation, delivery, and support of the RBI instrument in support of the JPSS 2 mission. This SOW defines the roles, responsibilities, and obligations between the Government and the Contractor.

III. DEFINITIONS

All acronyms used in this document are defined in Appendix B. Below are definitions of important terms used in this document.

Contractor – The developer of the item of reference. If the term Contractor is used in this document without specific reference to an item (e.g. Spacecraft), then the term implies the RBI

Contractor. In all cases, the term Contractor also implies any and all associated suppliers and subcontractors.

Government – Federal Civil Servants acting in their official capacities.

Shall – Compliance by the Contractor is mandatory. Any deviations from these contractually imposed mandatory requirements require the approval of the Contracting Officer.

May – At the discretion of the Contractor or Government.

Will – Designates the intent of the Government.

Heritage – Hardware, software, or design from a previous project, program, or mission.

Qualification by Similarity – Qualification of flight hardware or software for the present application and mission based on prior qualification of the hardware / software for a similar application and mission.

Soft Lien – A lien with an unknown or low likelihood.

Hard Lien – A lien with a high likelihood of occurring.

Encumbered Lien – A lien that has become a reality. Once a lien becomes a reality the lien funds are encumbered (booked) in the financial system to prevent further planning against those lien funds.

Suppliers – Lower-tier subcontractors, vendors, suppliers, distributors or any other source used by the Contractor to complete the requirements of the contract.

The following definitions define level-of-assembly terms for the RBI Project. The definitions are adapted from GSFC-STD-7000A, “General Environmental Verification Standard (GEVS) for GSFC Flight Programs and Projects”. The definitions are arranged from highest-to-lowest level-of-assembly to illustrate the hierarchy.

Observatory – Spacecraft with all science instruments integrated. Equivalent terms are Payload and Satellite.

Spacecraft – Spacecraft bus without instruments integrated. The Spacecraft (or Spacecraft bus) includes the components and subsystems which support the science instruments and provide housekeeping functions such as orbit and attitude maintenance, navigation, power, command, telemetry and data handling, structure, rigidity, alignment, heater power, temperature measurements, etc.

Instrument – An assemblage of sensors and associated hardware for making measurements or observations in space. Examples are the RBI, CrIS, VIIRS, ATMS, and OMPS instruments. An equivalent term is Instrument System.

Subsystem – A functional subdivision of an Instrument consisting of two or more components. Examples are an in-flight calibration subsystem, scanning subsystem, pointing control subsystem, and thermal control subsystem.

Component – A functional subdivision of a subsystem and generally a self-contained combination of items performing a function necessary for the subsystem's operation. Examples

are electronic box, actuator, encoder, blackbody calibration source. An equivalent term is Module.

Assembly – A functional subdivision of a component consisting of parts or subassemblies that perform functions necessary for the operation of the component as a whole. Examples are an integrated set of fully populated circuit cards, a gear train, and an integrated set of optical parts.

Card – A single, fully populated electronic circuit card.

Part – A hardware element that is not normally subject to further subdivision or disassembly without destruction of design use. Examples include resistor, integrated circuit, relay, connector, bolt, and gaskets.

IV. APPLICABLE DOCUMENTS

The documents listed in Table A, which include standards, regulations, specifications, manuals, and other special publications are applicable to the extent specified herein.

Table A. List of Instrument Contract Applicable Documents

<i>Contract Specifications</i>		
Document No.	Description	
472-00283 Rev E	JPSS-2 Spacecraft to RBI Interface Control Document (ICD)	
472-00287 Rev C	JPSS-2 Spacecraft to Radiation Budget Instrument (RBI) Instrument Mechanical Interface Control Document (MICD)	
RBI-SIMSPEC-02-008 Rev B	RBI Simulator Specification for JPSS-2 Flight Software Emulator	
RBI-SIMICD-02-009 Rev A	RBI Simulator Interface Control Document	
<i>Standards, Directives and Requirements</i>		
Document No.	Description	SOW/CDRL Requirement
NASA		
NPD 8720.1	NASA Reliability and Maintainability (R&M) Program Policy	DRDs MA-11, MA-15
NPR 2810.1A	Security of Information Technology	DRD PM-22
NPR 6000.1 H	Requirements for Packaging, Handling, and Transportation for Aeronautical and Space Systems, Equipment, and Associated Components	DRD IT-05
NPR 7120.8 App J	NASA Research and Technology Program and Project Management Requirements, Terminology Development Terminology	DRD CV-03
NPR 7123.1B	NASA Systems Engineering Processes and Requirements	DRD CV-03, RE-01, RE-02, RE-03, RE-04, RE-05, SE-01
NPR 7150.2A	NASA Software Engineering Requirements, Appendix D, and Appendix E.	SOW 5.1-01, 5.1-02, 5.1-14, DRD PM-08,

		PM-09, SW-01, SW-02, SW-03, SW-04, SW-05, SW-06, SW-07, SW-08, SW-10, SW-11, SW-12, SW-13, SW-14, SW-15
NPR 8000.4A	Risk Management Procedural Requirements	DRD PM-06
NPR 8621.1B	NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping	DRD MA-06
NPR 8705.4	Risk Classification for NASA Payloads	DRD MA-11, MA-12, MA-13, MA-15
NPR 8705.5	PRA Procedures for NASA Programs and Projects	DRD MA-11
NPR 8715.3	NASA Safety Manual KSC Form 16-294 NS Radiation Training and Experience Summary KSC Form 16-295 NS Radiation Use Request/Authorization KSC Form 16-447 Laser Device Use Request/Authorization KSC Form 16-450 NS Radiation Training & Experience Summary KSC Form 16-451 NS Radio Frequency/Microwave System Use Request	DRDs MA-05, MA-06, MA-09, MA-13
NPR 8715.6A	Procedural Requirements for Limiting Orbital Debris	DRD AM-13
NPR 8715.7	Expendable Launch Vehicle Payload Safety Program	DRD MA-01, MA-05, MA-06, MA-07, MA-08, MA-09,
NPR 8735.2	Management of Government Quality Assurance Functions for NASA Contracts	DRD MA-01
NPR 9501.2E	NASA Contractor Financial Management Reporting	DRD PM-12
NASA-STD-0005	NASA Configuration Management Standard	DRD PM-08, PM-09, SE-02
NASA-STD-5002	Load Analyses of Spacecraft and Payloads	DRD AM-03, AM-04
NASA-STD-5009	Nondestructive Evaluation Requirements for Fracture-Critical Metallic Components	DRD MA-01
NASA-STD-6016	Standard Materials and Processes Requirement for Spacecraft	SOW 3.8-12 DRD MA-01, MA-25, MA-27, MA-28
NASA-STD-8709.2	NASA Safety and Mission Assurance Roles and Responsibilities for Expendable Launch Vehicle Services	DRD MA-01

NASA-STD-8709.22	Safety and Mission Assurance Acronyms, Abbreviations, and Definitions	SOW 3.3-10, 3.3-11 DRD MA-06
NASA-STD-8719.9	NASA Standard for Lifting Devices and Equipment	DRD MA-01, MA-06
NASA-STD-8719.13B w/Change 1	NASA Software Safety Standard	SOW-3.5-02, 5.1-03, DRD MA-01, MA-06, MA-18
NASA-STD-8719.24	NASA Expendable Launch Vehicle Payload Safety Requirement (Base + Annex)	DRD MA-01, MA-06, MA-07, MA-08, MA-09
NASA-STD-8719.14	Process for Limiting Orbital Debris	DRD MA-25, AM-13
NASA-STD-8720.1C	NASA Reliability and Maintainability (R&M) Program Policy	DRD MA-15
NASA-STD-8729.1	Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program	DRD MA-01, MA-04, MA-11, MA-15
NASA-STD-8739.1A	NASA Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies	SOW-3.6-01
NASA-STD-8739.4 w/Change 3	NASA Technical Standard, Crimping, Interconnecting Cables, Harnesses, and Wiring	SOW-3.6-01
NASA-STD-8739.5	NASA Technical Standard, Fiber Optics Terminations, Cable Assemblies, and Installation	SOW-3.6-01
NASA-STD-8739.6	NASA Technical Standard, Fiber Optic Terminations, Cable Assemblies, and Installation	SOW-3.6-01, 3.6-05
NASA-STD-8739.8 w/Change 1	NASA Software Assurance Standard	SOW-3.5-02, DRD MA-18
NASA/SP-2010-3406	NASA IBR Handbook	DRD PM-05
NCR/CAS	NASA Non-compliance Report/Corrective Action System	DRD MA-09
KNPR 8715.3	KSC Safety Practices Procedural Requirements	DRD MA-09
LF 170	Nonstandard Part Approval Request (NSPAR)	SOW 3.7-02, 3.7-05, DRD MA-19
LF147	Contractor Deviation/Waiver Requests (LaRC) form	DRD MA-03
LPR 7120.7, paragraph 4.4, paragraph 8.4	Space Flight Independent Life Cycle Review Procedural Requirements	DRD RE-01, RE-02, RE-03, RE-04, RE-05
MSFC-STD-3029	Stress Corrosion Cracking Evaluation Form	DRD MA-27
GSFC-PPL-21	Goddard Space Flight Center (GSFC) Preferred Parts List, PPL-21	DRD MA-01, MA-22, MA-23
GSFC-STD-1000E	GSFC GOLD Rules, Section 3.02	DRD SW-02, MA-01, MA-26

GSFC-STD-7000A	General Environmental Verification Standard (GEVS)	SOW-7.2-01, 4.3-03, DRD SE-03, IT-02, MA-26
GSFC-EEE-INST-002	GSFC Instructions for EEE Parts Selection, Screening, Qualification, Derating	SOW-3.4-08, 3.7-01, DRD MA-04, MA-14, MA-21, MA-22, MA-23
GSFC-500-PG-8715.1.2	AETD Safety Manual (for GSFC I&T operations)	DRD MA-06
GSFC-541-PG-8072.1.2	GSFC Fastener Integrity Requirements	SOW-3.8-02 DRD MA-25
GSFC FAP P-322-208	GSFC Flight Assurance Procedure, FAP P-322-208, Performing a Failure Mode and Effects Analysis (<i>Available at Rapid Spacecraft Development Office (RSDO) website: http://rsdo.gsfc.nasa.gov/documents/Rapid-III-Documents/MAR-Reference/GSFC-FAP-322-208-FMEA-Draft.pdf</i>)	SOW 3.4-05 DRD MA-12
<i>Military Requirements, Standards and Handbooks</i>		
DI-MGMT-81466A	Data Item Description for Cost Performance Report	DRD PM-13
MIL-HDBK-217	Military Handbook Reliability Prediction of Electronic Equipment	SOW-3.4-10, DRD MA-14, MA-16
MIL-HDBK-6870	Inspection Program Requirements	DRDs MA-01
aMIL-STD-882E	Department of Defense Standard Practice: System Safety	DRDs MA-01, MA-06
MIL-STD-975	Military Standard NASA Standard Electrical, Electronic, and Electromechanical (EEE) Parts List	DRD MA-14
<i>Industry/International Standards, Guides, Specifications, Manuals, and Requirements</i>		
ANSI/NCSL Z540.1-1994	Requirements for the Calibration of Measuring and Test Equipment.	SOW-3.10-01, DRD MA-01
ANSI/ESD S20:20-2007	Protection of Electrical and Electronic Parts, Assemblies and Equipment (EXCLUDING ELECTRICALLY INITIATED EXPLOSIVE DEVICES)	SOW-3.6-01, 3.6-05, DRDs MA-01, MA-20
ANSI/EIA-748-C	Earned Value Management Systems	SOW-1.1-12 DRD PM-04
ASME-Y14.5-100	Engineering Drawings	DRD SE-06
29 CFR Part 1910	Occupational Safety and Health Standards for General Industry	DRD MA-06
IEEE-STD-1413	Standard Methodology for Reliability Prediction and Assessment for Electronic Systems and Equipment	DRD MA-16
IEEE-STD-730-2002	Software Quality Assurance Plans	DRD MA-18
IEST-STD-CC1246D	Product Cleanliness Levels and Contamination Control Program	SOW-3.9-02
IPC-SM 840	Permanent Solder Mask, Type B2	SOW-3.8-21
IPC 2221B	Generic Standard on Printed Board Design	SOW-3.6-01, 3.8-14, DRD MA-29

IPC 2222	Sectional Design Standard for Rigid Organic Printed Boards	SOW-3.6-01
IPC 2223	Sectional Design Standard for Flexible Printed Boards	SOW-3.6-01
IPC 2225	Sectional Design Standard for Organic Multichip Modules (MCM)	SOW-3.6-01
IPC A 600	Acceptability of Printed Boards (Class 3 requirements)	SOW-3.6-01, DRD MA-29
IPC 6011, Class 3	Generic Performance Specification for Printed Boards	SOW-3.6-01, DRD MA-29
IPC 6012B w/ Class 3 A Requirements	Qualification and Performance Specification for Flexible Printed Boards	SOW-3.6-01, DRD MA-29
IPC 6013	Qualification and Performance Specification for Flexible Printed Boards (Class 3 requirements)	SOW-3.6-01, DRD MA-29
IPC 6015	Qualification and Performance Specification for Organic Multichip Module (MCM)	SOW-3.6-01
IPC 6018	Microwave End Product Board Inspection and Test	SOW-3.6-01, DRD MA-29
ISO 17025	General Requirements for the Competence of Testing and Calibration Laboratories	SOW 3.10-02
J-STD-001 E	Requirements for Soldered Electrical and Electronic Assemblies	SOW-3.6-01
J-STD-001 ES	Space Addendum Requirements for IPC Certification	SOW-3.6-01
GEIA –STD-0005-1	Performance Standard for Aerospace and High Performance Electronics Systems Containing Lead-free Solder	SOW-3.8-17
GEIA-STD-0005-2	Standard for Mitigating the Effects of Tin Whiskers in Aerospace and High Performance Electronic Systems, per Control Level 2C	SOW-3.8-17
RADC-TR-85-229	Reliability Prediction for Spacecraft	DRD MA-16
S-311-M-70	Specification for Destructive Physical Analysis	DRD MA-21
SAE AS5553	Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition	DRD MA-21
SAE AS9100	Quality Systems – Aerospace – Model for Quality Assurance in Design, Development, Production, Installation and Servicing standard during the term of this contract.	SOW-3.2.01, DRDs MA-03, MA-04
GIDEP Requirements Guide S0300-BU-GYD-010	Requirements Guide	SOW-3.11-01, DRD MA-30, MA-31
GIDEP Operations Manual S0300-BT-PRO-010	Operations Manual	SOW-3.11-01, DRD MA-30, MA-31
29 CFR Part 1910	Occupational Safety and Health Standards for General Industry	DRD MA-06

V. REFERENCE DOCUMENTS

Reference documents listed in Table B are provided for guidance.

Table B. List of Instrument Contract Reference Documents

Document No.	Description	SOW/CDRL Reference
JPSS472-00083	JPSS-1 Drill Template Design Guidelines	
JPSS472-00228	JPSS Project Contamination Control Plan	DRD MA-10
NASA		
NPD 1600.2E	NASA Security Policy	DRD PM-22
NPR 1600.1	NASA Security Program Procedural Requirements	DRD PM-22
NPD 9501.11	NASA Contractor Financial Management Reporting System	DRD PM-12
NPR 7120.5E	NASA Spaceflight Program and Project Management Requirements	DRD PM-01 through PM-10
NPR 7120.8	NASA Research and Technology Program and Project Management Requirements	
NPR 7150.2A Sections 3.2, 3.4	NASA Software Engineering Requirements, SWE-115	DRDs SW-03, SW-05, SW-06, SW-12, SW-09
NPR 8000.4A	Risk Management Procedural Requirements	DRD PM-07
NASA-STD-5002	Load Analyses of Spacecraft and Payloads	DRD AM-01, AM-02
NASA-STD-5019	Fracture Control Requirements for Spaceflight Hardware	DRD AM-01, AM-02
NASA-STD-5020	Requirements for Threaded Fastening Systems in Spaceflight Hardware.	DRD AM-01, AM-02
NASA-STD-6016	Standard Materials and Processes Requirement for Spacecraft	DRD MA-26
NASA-SP-2010-3403	NASA Schedule Management Handbook	DRD PM-02, PM-03
NASA SP/-2007-6105	NASA Systems Engineering Handbook	DRD SE-01, RE-01, RE-02, RE-03, RE-04, RE-05
NASA-TM-86556	Lubrication Handbook for the Space Industry	DRD MA-26
NASA-CR-2005-213424	Lubrication for Space Applications	DRD MA-26
	NASA Fault Tree Handbook with Aerospace Applications	DRD MA-13
	NASA Parts Selection List	DRD MA-14
LPR 8739.21	Langley Research Center (LaRC) Procedures and Guidelines for Electrostatic Discharge (ESD) Control of ESD-Sensitive (ESDS) Devices Program (Excluding Electrically Initiated Explosive Devices)	DRD MA-20
GSFC-STD-7000A	General Environmental Verification Standard for GSFC Programs and Projects”, April 2005, Section 2.1.1.6.	DRD SE-08
GSFC Form 4-37	Problem Impact Statement Parts, Materials and Safety	DRD MA-30
P417-R-CONOPS-0008	GOES-R Series Concept of Operations (CONOP)	DRD OO-01
CERES Science Papers		
	CERES Collection Guides:	

CERES-CG-ES-4 CERES-CG-ES-8 CERES-CG-ES-9 CERES-CG-SSF CERES-CG-BDS	ES-4 Collection Guide ES-8 Collection Guide (Draft) ES-9 Collection Guide SSF Collection Document BDS Collection Document	
<i>Other NASA References</i>		
NPR 7123.1B App E NPR 7120.8 App J	Technology Readiness Levels Technology Development Terminology	
<i>Military</i>		
MIL-STD-975	NASA EEE Parts Selection List (NPSL)	
MIL-DTL-31000C	Technical Data Packages	DRD SE-05
<i>Industry/International</i>		
AIAA S-114-2005	Moving Mechanical Assemblies for Space and Launch Vehicles Aerospace Report No. TR-2004(8583)-1 Test Requirements for Launch, Upper-Stage, and Space Vehicles	DRD MA-26
ANSI-IEEE STD 1042-1987	Guide to Software Configuration Management	DRDs PM-08, PM-09
ASME-Y14.5-100	Engineering Drawings	DRDs SE-05
Aerospace Report No. TR-2004(8583)-1	Test Requirements for Launch, Upper-Stage, and Space Vehicles	DRD MA-26

VI. PRECEDENCE

In the case of conflicting requirements, contract FAR Clause 52.215.8 defines the order of precedence between the contract, SOW, CDRL, and IPRD. In the event of an identified inconsistency within or between these documents, the Contractor has responsibility to notify the Government and seek a resolution.

1.0 MANAGEMENT

1.1 PROJECT MANAGEMENT

SOW-1.1-01 - The Contractor shall appoint a Project Manager responsible for management of technical performance, resources, schedule, subcontracts, and risks.

SOW-1.1-02: The Contractor shall develop, maintain, and execute to a Project Management Plan in accordance with DRD PM-01.

SOW-1.1-03: The Contractor shall conduct a successful Instrument System Acceptance Review (DRD RE-05) to meet the On Dock requirement identified in Appendix A.

SOW-1.1-04: The Contractor shall store the instrument at the Contractor's facility, in the interval between the System Acceptance Review and shipping to meet the On Dock Requirement identified in Appendix A.

SOW-1.1-04.1: The Contractor shall conduct a successful Instrument Pre-Ship Review (DRD RE-06) to meet the On Dock requirement identified in Appendix A.

Contract Work Breakdown Structure (CWBS)

SOW-1.1-05: The Contractor shall develop and maintain a product-oriented Contract Work Breakdown Structure (CWBS) and CWBS Dictionary in accordance with DRD PM-02.

SOW-1.1-06: The Contractor shall use the CWBS as the organizational framework for contract work planning, scheduling, and budgeting, as well as for reporting of the technical progress, schedule, risk, and cost.

SOW-1.1-07: The Contractor shall update the CWBS to reflect negotiations, new work, changes in work element distribution, and configuration changes over the duration of the project; obtaining the Government's approval for CWBS changes at Level 3 or higher.

Integrated Master Schedule (IMS)

SOW-1.1-08: The Contractor shall develop and maintain an Integrated Master Schedule (IMS) of tasks, events, and activities necessary to accomplish the total scope of the contracted work in accordance with DRD PM-03.

SOW-1.1-09: The Contractor shall utilize schedule management software that supports automated time phasing of tasks, logic-driven critical path analysis, schedule assessment, and schedule trend analysis.

SOW-1.1-10: The Contractor shall support the Government in developing RBI schedules and schedule reports for the Joint Polar Satellite System (JPSS) Program Office.

SOW-1.1-11: The Contractor shall track and report on Project Control Milestones representative of the overall work and schedule progress in accordance with DRD PM-03. The list of Project Control Milestones will be mutually agreed upon between the Contractor and the Government and will include key deliverables, important decisions and other critical steps that outline or affect the successful completion of the work.

Financial Management

SOW-1.1-12: The Contractor shall implement an Earned Value Management (EVM) System (EVMS) in the performance of the contract that is compliant with the guidelines in the American National Standards Institute/Electronic Industries Alliance Standard 748, Earned Value Management Systems (ANSI/EIA-748-C).

SOW-1.1-13: The Contractor shall develop an EVM Plan in accordance with DRD PM-04.

SOW-1.1-14: The Contractor shall establish and maintain a Performance Measurement Baseline (PMB) capturing the time-phased integrated development plan that is consistent with the developed IMS and WBS. The contractor shall ensure that the PMB includes the entire contract technical scope of work consistent with contract schedule requirements and has adequate resources assigned. Planning packages, describing work within each control account that will occur in the future, shall cover the entire scope and duration of the contract. The contractor shall define detailed work packages, consisting of tasks planned and budgeted in detail, for at least the next 12-month period or until the next milestone review; whichever is later.

SOW-1.1-15: The Contractor shall present its PMB at an Integrated Baseline Review (IBR) within 6 months after contract award, and subsequently following major changes to PMB. The Contractor shall brief the Government at the IBR on the PMB, cost and schedule risk, and other content as necessary to demonstrate that the Contractor has established and maintains a reliable PMB.

SOW-1.1-16: In support of the IBR, the Contractor shall prepare materials in accordance with DRD PM-05.

SOW-1.1-17: The Contractor shall control and maintain the configuration control of the PMB through a formal change control process for all Baseline Change Requests (BCR).

Risk Management

SOW-1.1-18: The Contractor shall develop and maintain a Risk Management Plan in accordance with DRD PM-06.

SOW-1.1-19: The Contractor shall perform comprehensive risk management per the Risk Management Plan across all contract elements and throughout the contract period of performance.

SOW-1.1-20: The Contractor shall develop and submit a Risk Assessment and Mitigations Report, assessing all identified risks and risk mitigations in accordance with DRD PM-07.

SOW-1.1-21: The Contractor shall support the Government in developing Instrument risk reports for the JPSS Program Office.

SOW-1.1-22: The Contractor shall participate in the monthly Government Risk Management Working Group telecons to address common risks, elevated risks and risks that the Government assesses to be High (or Red) in Likelihood x Consequence.

Configuration Management

SOW-1.1-23: The Contractor shall develop a Configuration and Data Management Plan in accordance with DRD PM-08.

- SOW-1.1-24: The Contractor shall perform comprehensive configuration and change management per the Configuration and Data Management Plan across all contract elements and throughout the contract period of performance.
- SOW-1.1-25: The Contractor shall maintain change control records including evidence supporting change classifications and internal configuration verification audits.
- SOW-1.1-26: The Contractor shall invite Government representatives to all Contractor CCB meetings that address Class I changes (as defined in NASA-STD-0005), and shall obtain written Government approval prior to the implementation of any Class I change.
- SOW-1.1-27: The Contractor shall prepare and provide the Configuration Item Identification List in accordance with [DRD PM-09](#).
- SOW-1.1-28: The Contractor shall perform configuration verification audits when incorporating parts and assemblies into higher-level assemblies and at major project milestones.
- SOW-1.1-29: The Contractor shall support periodic configuration audits by the Government to confirm that deliverable products meet requirements and that the products and all associated documentation, drawings and configuration records are accurate and complete. The Government will conduct configuration audits primarily as part of the acceptance process prior to final delivery; however, the Government may perform occasional spot-check audits at any time during the contract.
- SOW-1.1-30: The Contractor shall support the development and review of all JPSS Program-level configuration items that affect the Contractor (such as ICDs and observatory-level test plans) by authoring RBI specific elements and reviewing spacecraft elements affecting RBI.

1.2 GOVERNMENT INSIGHT AND OVERSIGHT

Communications and Access

- SOW-1.2-01: The Contractor shall provide access during contract performance to records and data that underlie and support the cost and schedule data reported.
- SOW-1.2-02: The Contractor shall allow access by the Government to all Contractor facilities used for the RBI project, and shall provide any required badging and training for certifications needed for that access.
- SOW-1.2-03: The Contractor shall permit Government attendance at all Contractor and subcontractor/supplier reviews, audits, tests, meetings, and other activities within the scope of the contract where the Government has determined a need based on performance or risk to the project, except those mutually agreed to be Contractor only.
- SOW-1.2-04: The Contractor shall notify the Government 10 working days in advance of each designated Contractor and subcontractor/supplier review, test, joint meeting or key activity.
- SOW-1.2-05: The Contractor shall provide the access and insight necessary for Government and Government Support Service Contractors to gain knowledge of instrument theory and operations sufficient to perform instrument operations after instrument delivery.

Government Resident Office Support

- SOW-1.2-06: The Contractor shall provide private, securable office space facilities at the Instrument development/build site(s) for one Government in-plant representative from

contract award through Instrument delivery. Facilities shall include office furniture, file/storage area, telephone and broadband internal- and external-network access as well as access to a copier and a shared conference room.

SOW-1.2-07: The Contractor shall provide temporary office space facilities at the Instrument development/build site for up to five additional Government representatives during the scheduled meetings, reviews, inspections, and major system testing events. Facilities shall include office furniture, telephones, and broadband or wireless external network access.

SOW-1.2-08: The Contractor shall provide the Government with access to the electronic document and test data repositories.

Reporting

SOW-1.2-09: The Contractor shall prepare and submit the contract reports listed in Table 1.

Table 1. Reporting Requirements

Report	CDRL DRD
Project Management Reports	DRD PM-10
Technical Progress Reports	DRD PM-11
Integrated Master Schedule and Schedule Reports	DRD PM-03
Contractor 533 Financial Management Reports	DRD PM-12
Contract Performance Reports	DRD PM-13
Contract Final Report	DRD PM-14
Material Inspection and Receiving Report	DRD PM-15
New Technology Reports	DRD PM-16
Invention Disclosure Reports	DRD PM-17
NASA Property in Custody of Contractor Reports	DRD PM-18
Veterans Employment Reports	DRD PM-19
Subcontracting Reports	DRD PM-20

Note: Refer to SOW Section 3 for additional reporting requirements for Mission Assurance.

Meetings/Telecons

SOW-1.2-10: The Contractor key personnel shall support and attend an off-site Project Kickoff Meeting near NASA Langley Research Center to occur within 90 days after contract award to establish:

- 1) Processes for working together
- 2) Project goals and schedule
- 3) Mutual expectations
- 4) Mutual understanding of processes, methodologies and constraints
- 5) Points-of-Contact between team members and stake-holders
- 6) Project risks, challenges, and opportunities

SOW-1.2-11: The Contractor shall lead weekly status telecons focused on technical progress and issues. The Contractor shall provide, via email, the discussion content in advance of each meeting. At a minimum, the telecons shall cover significant progress, problems and anomalies, and resolution plans and status of the problems/anomalies.

SOW-1.2-12: The Contractor shall support weekly Government-led team meeting telecons for programmatic coordination between all elements of the project.

SOW-1.2-13: The Contractor shall support additional, aperiodic telecons with the JPSS Program Office as needed to coordinate activities and resolve mission-level issues.

SOW-1.2-14: The Contractor shall support monthly, informal Project Management Review (PMR) meetings where the Contractor shall discuss a management-level view of schedule, cost, EVM performance, risks, and other pertinent activities as included in the latest Project Management Report.

PMRs will usually be conducted by telecon/WebEx, with face-to-face meetings approximately quarterly. Face-to-face meetings alternate between the Contractor's facility and NASA LaRC, and may include splinter meetings to address mutually-identified special topics.

SOW-1.2-15: From the Critical Design Review (CDR) through Instrument delivery, the Contractor shall support JPSS Quarterly PMRs as required.

SOW-1.2-16: The Contractor shall host and conduct quarterly, informal Technical Interchange Meetings (TIM), with Government participation at the facility and/or via telecon/WebEx, to discuss and resolve open technical items, issues, and concerns including such topics as interfaces definition, clarification of operations or analyses, planning for tests, calibration methodologies, and presentation and discussion of test and calibration results.

SOW-1.2-17: The Contractor shall inform the Government at least 10 working days in advance of Contractor-initiated TIMs.

SOW-1.2-18: The Contractor shall support quarterly JPSS-level TIMs as required to discuss and resolve open program-level technical items, issues and concerns.

Contractor in-person participation of a project manager and senior technical lead will be required approximately twice per year in quarterly JPSS-level TIMs. For TIMs not attended in person, participation will be via telecon/WebEx.

Contractor Processes and Certifications

SOW-1.2-19: The Contractor shall prepare and submit the plans and documentation listed in Table 2.

Table 2. Corporate Document Requirements

Document	CDRL DRD
Evidence of Insurance	DRD PM-21
IT Security Management Plan	DRD PM-22
Conflicts of Interest Avoidance Plan	DRD PM-23
Safety and Health Plan Revisions	DRD PM-24

1.3 REVIEWS

Engineering Peer Reviews (EPR)

SOW-1.3-01: The contractor shall conduct Engineering Peer Reviews (EPRs) to provide focused, in-depth technical review of the evolving design and development of a subsystem or

engineering discipline area and provide an examination of design, analysis, manufacturing, integration, testing, operations, drawings, processes and data as applicable to the review focus. The contractor shall provide necessary subject matter expertise to support each EPR.

SOW-1.3-02: The Contractor shall define and implement an EPR plan for the hardware and software subsystems (or engineering discipline areas) of the Instrument based on scope, complexity and acceptable risk. The Contractor shall summarize this plan in the Systems Engineering Management Plan (DRD SE-01).

SOW-1.3-03: The Contractor shall chair and host EPRs at the Contractor’s facilities with Government participation.

SOW-1.3-04: The Contractor shall report the results of the EPRs at the relevant Instrument System Review.

Instrument System Reviews (ISR)

ISRs are major milestones in the Instrument life cycle where the Contractor formally presents information to a panel of Government experts and external reviewers. The Government will log and track formal action items generated in the review. Review agendas will be established by the Government in coordination with the Contractor. Review entrance and success criteria will be established by the Government in accordance with NPR 7123.1B, tailored as appropriate. The Government, in coordination with the Contractor, will document the final agenda, entrance, and success criteria, and other pertinent review details in a review Terms of Reference (ToR) document prepared for each review. The ToR will serve as the guiding document for conduct of each review.

SOW-1.3-05: The Contractor shall prepare, host, and present the ISRs listed in Table 3, providing review packages in accordance with the stated CDRL DRD for each review.

Table 3. Instrument System Reviews

Review	Phase	CDRL DRD
ISRR - Instrument Systems Requirements Review	Phase A	DRD RE-01
IPDR - Instrument Preliminary Design Review	Phase B	DRD RE-02
ICDR - Instrument Critical Design Review	Phase C/D	DRD RE-03
IPER - Instrument Pre-Environmental Review	Phase C/D	DRD RE-04
ISAR - Instrument System Acceptance Review	Phase C/D	DRD RE-05
IPSR - Instrument Pre-Ship Review	Phase C/D	DRD RE-06

SOW-1.3-06: The Contractor shall coordinate review preparations with the Government by sharing plans, draft presentation charts and supporting documentation to the extent necessary to demonstrate that the Contractor is prepared for the review per the ToR.

SOW-1.3-07: The Contractor shall respond as required to action items assigned by the review panel at each review. Reviews are not successful until the Government review Chair approves closure of all formal actions generated at the review.

SOW-1.3-08: If a review panel determines the success criteria for a review are not fully met, the Contractor shall prepare, host, and conduct a “delta” review of the non-compliant areas, including delivery of updated CDRL Data Items.

Other Instrument Reviews

Mission Assurance requirements in SOW section 3 specify additional review requirements focusing on Mission Assurance.

SOW Section 5 specifies additional review requirements focusing on Software Development.

Spacecraft and Program Reviews

SOW-1.3-09: For each year of development, the Contractor shall provide support for one review per year to the JPSS program as required.

2.0 SYSTEMS ENGINEERING

2.1 SYSTEMS ENGINEERING MANAGEMENT

SOW-2.1-01: The Contractor shall develop a Systems Engineering Management Plan in accordance with **DRD SE-01**.

SOW-2.1-02: The Contractor shall perform systems engineering to support all Instrument-related activities during all stages of development. The Contractor's systems engineering effort shall include the following activities:

- 1) Technical direction and oversight throughout all phases of the project
- 2) Analyses of technical requirements
- 3) Functional and performance allocation of derived requirements
- 4) Traceability, definition and maintenance of all interfaces
- 5) System studies, trades and risk assessments necessary to develop the Instrument design
- 6) Instrument design and verification of all defined, allocated, and derived requirements
- 7) Systems analyses and special studies
- 8) Risk management support
- 9) Leading preparation and support for all peer reviews and ISRs.
- 10) Performing all necessary coordination, studies and analyses required to interface the Instrument to the Spacecraft, including Instrument-specific support to ground system requirements development and operations
- 11) Supporting system-level TIMs, including technical issue resolution, performance verification plan buy-offs, pending configuration change requests, test data review, anomaly resolution activities, and test support planning.

SOW-2.1-03: The Contractor shall develop and maintain a Dynamic Object Oriented Requirements System (DOORS) requirements management database, and use the DOORS database to track and document the successful completion of the Verification and Validation (V&V) activities.

SOW-2.1-04: The Contractor shall submit all Class I Change Requests per **DRD SE-02**.

2.2 REQUIREMENTS ANALYSES, DERIVATIONS, AND ALLOCATIONS

SOW-2.2-01: The Contractor shall define the specification, allocation, derivation and traceability of requirements and the verification approach with decomposition to the level necessary to support full verification traceability of RBI requirements.

SOW-2.2-02: The Contractor shall perform analyses and simulations in support of technical requirements compliance demonstrations to establish, define, maintain and control allocations for all required performance and design parameters.

SOW-2.2-03: The Contractor shall develop and maintain functional and performance requirement derivations, allocations, flow-down and traceability of Instrument requirements in accordance with **DRD SE-04**.

SOW-2.2-04: The Contractor shall include end item specifications for all subcontracted and purchased items in accordance with **DRD MA-32**.

2.3 SYSTEMS DESIGN, ANALYSIS AND VERIFICATION

SOW-2.3-01: The Contractor shall perform and document analyses of the design characteristics and test data as required ensuring that the Instrument meets performance requirements.

SOW-2.3-02: The Contractor shall develop the analytical models necessary to support the completion of designs, analyses, and associated documentation.

SOW-2.3-03: The Contractor shall prepare and deliver the analytical models and design analyses reports specified in Table 4 plus any additional data necessary to demonstrate that all applicable performance requirements are satisfied. The Contractor may submit existing analyses for any level-of-assembly for which space qualification has been demonstrated to comparable requirements.

Table 4. Analytical Models and Analysis Reports

	Analysis Report DRDs	Modeling DRDs
Structural / Mechanical	DRD AM-01 DRD AM-02	DRD AM-03 DRD AM-04 DRD AM-22
Thermal	DRD AM-05	DRD AM-06 DRD AM-07
Contamination Control	DRD AM-08 DRD AM-12	
Electronics	DRD AM-09 DRD AM-10 DRD AM-11	
Orbital Debris	DRD AM-13	
Control Systems	DRD AM-14	
Pointing and Jitter	DRD AM-15	
Optical Subsystem	DRD AM-16	DRD AM-17
Radiometric Performance	DRD AM-18	DRD AM-19
Uncertainty Analyses	DRD AM-20 DRD AM-21	

Engineering Drawings

SOW-2.3-04: The Contractor shall develop and deliver Indentured Drawing Lists and Drawing Trees per DRD SE-05.

SOW-2.3-05: The Contractor shall prepare and deliver Engineering Drawings per DRD SE-06.

Verification

SOW-2.3-06: The Contractor shall develop, deliver and execute a comprehensive System Performance Verification Plan per DRD SE-03.

SOW-2.3-07: The Contractor shall prepare and deliver an Instrument System Performance Verification Report per DRD SE-08.

SOW-2.3-08: The Contractor shall prepare, maintain, and deliver Requirements Verification Matrices per DRD SE-15.

2.4 INTERFACE DEFINITION, VERIFICATION AND CONTROL

SOW-2.4-01: The Contractor shall assist the Government and the Spacecraft Contractor in the development and update of the Instrument-to-Spacecraft ICDs, as required. This includes mechanical, electrical, thermal, I&T, and command and data handling (C&DH) interfaces.

SOW-2.4-02: The Contractor shall verify all Instrument mechanical, electrical, thermal and environmental interfaces specified in the ICDs.

2.5 TECHNICAL PERFORMANCE MEASURES AND TREND DATA

SOW-2.5-01: The Contractor shall implement a plan for managing Technical Performance Measures (TPM), including tracking, trending and reporting status, and changes.

SOW-2.5-02: The Contractor shall develop a list of TPMs documented in accordance with **DRD PM-11**.

SOW-2.5-03: The Contractor shall acquire, analyze, evaluate, and document trend data of all critical functions throughout the Instrument development to demonstrate that system integrity is maintained through delivery and acceptance of the instrument, and that all end of life (EOL) performance requirements will be met.

SOW-2.5-04: The Contractor shall develop a list of trend parameters to be included in **DRD SE-10**.

SOW-2.5-05: The Contractor shall provide a final Instrument Performance Trend Analysis Report per **DRD SE-10**.

3.0 MISSION ASSURANCE

3.1 GENERAL SAFETY AND MISSION ASSURANCE REQUIREMENTS

Systems Safety and Mission Assurance Program

SOW-3.1-01: The Contractor shall prepare and implement a Mission Assurance Implementation Plan (MAIP) in accordance with DRD MA-01.

SOW-3.1-02: The Contractor shall continually review and verify the proper implementation of the MAIP.

SOW-3.1-03: Following approval of the MAIP Compliance Matrix by the RBI Configuration Control Board, the Contractor shall submit MAIP revision change requests for any follow-on IMAR waivers that affect the MAIP Compliance Matrix.

Management

SOW-3.1-04: The Contractor shall designate a PAM for mission assurance activities; this person will be referred to as the ContractPAM.

SOW-3.1-05: The Contractor shall ensure that the ContractPAM has direct access to contractor management that is independent of the contractor project management, and has the functional freedom and authority to interact with all elements of the contractor project.

SOW-3.1-06: The Contractor shall maintain a Safety and Mission Assurance Action Item Tracking List in accordance with DRD MA-02.

SOW-3.1-07: The Contractor shall conduct a weekly mission assurance status telecom with the Government.

SOW-3.1-08: The Contractor shall distribute an updated and current Action Item Tracking List to the NASA Mission Assurance Representative on a weekly basis prior to the weekly mission assurance status telecom meetings.

Requirements Flowdown

SOW-3.1-09: The Contractor shall be responsible for Supplier adherences to applicable Instrument Mission Assurance Requirements based upon the work that the Supplier is performing.

Surveillance

SOW-3.1-10: The Contractor shall provide detailed explanations of how internal procedures or specifications not accessible by Government reviewers comply with applicable Government standards.

SOW-3.1-11: The Contractor shall grant access for Government mission assurance representatives to conduct an audit, assessment, or survey of work conducted at the Contractor's site(s), including work conducted at the Contractor's Suppliers in accordance with FAR 52.246-8.

SOW-3.1-12: The Contractor shall supply documents, records, equipment, and a work area within the Contractor's facilities for the NASA mission assurance representatives.

SOW-3.1-13: The Contractor shall provide their initial workflow 1 month prior to commencing the instrument build phase, and 4 days prior to all processes previously not defined, to enable the Government representative to include the Government Mandatory Inspection Points (GMIPs) in the workflow. The NASA Mission Assurance Representative will identify a minimum set of GMIPs within the build flow of all mission hardware and GSE.

SOW-3.1-14: At key milestone review, the Contractor shall include the status of the MA disciplines, including but not limited to System Safety, Design Assurance and Reliability, Quality Assurance, Parts, Materials and Processes, Contamination Control of facilities, Material Review Board/Failure Review Board and GIDEP closure status/tracking metrics and instrument hardware.

3.2 QUALITY MANAGEMENT SYSTEM

General

SOW-3.2-01: The Contractor shall have a Quality Management System certified to the requirements of SAE AS9100 Quality Systems - Aerospace - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing standard during the term of this contract. This means that the Contractor will continuously comply with the AS9100, even as the standard is revised.

SOW-3.2-02: The Contractor's quality system shall encompass all RBI hardware deliverables identified in Appendix A of the SOW, as well as flight and ground support software.

SOW-3.2-03: The Contractor shall subject each level of assembly to in-process manufacturing and assembly screens per AS9100 requirements.

Control of Nonconforming Product

SOW-3.2-04: The Contractor shall classify material nonconformances and workmanship discrepancies as follows:

- 1) Major:
 - a) Nonconformances that adversely affect form, fit, function, safety, reliability, durability, interchangeability, weight, or requirements of the contract;
 - b) Any substitution of approved parts/hardware/software with non-identical or non-preapproved parts/hardware/software;
 - c) Any discrepancy that is the result of an unexplained anomaly, e.g. cannot duplicate;
 - d) Where corrective action requires development of new procedures/processes, or the unique or nonstandard application of preexisting procedures/processes;
 - e) Disposition to scrap hardware over a dollar value of \$50,000; and
 - f) A collection of Minor nonconformances that signal a systematic problem.
- 2) Minor: Nonconformances other than those specified as Major.

SOW-3.2-05: The Contractor shall have a documented closed loop (CL) system for identifying, reporting, and correcting nonconformances. The CL system will ensure that (a) positive corrective action is implemented to preclude recurrence, (b) that objective evidence is collected, and (c) that the adequacy of corrective action is determined by audit or test.

SOW-3.2-06: The contractor shall apply the CL system to both flight hardware and GSE that will be directly attached to, or temporarily connected to, or come in contact with the flight hardware at or above the subsystem level.

SOW-3.2-07: The Contractor shall provide the Government access to their nonconformance reporting/tracking system so that the on-site Government representative can directly search for, access and review all major and minor nonconformance records for the RBI project.

Quality Status Stamp Control

SOW-3.2-08: The Contractor shall establish and maintain a documented Quality Status Stamp (QSS) control system, including written procedures, which provide for the following:

Stamps, decals, seals, torque wax, paints, and signatures that identify that articles and materials have undergone source and receiving inspection, in-process fabrication and inspection, end-item fabrication and inspection, end-item testing, storage, and shipment.

- 1) Signatures include electronic signatures.
- 2) Traceability to each individual responsible for their use
- 3) Differentiation between fabrication and inspection QSS's
- 4) Appropriate direct or indirect application procedures such that stamping does not compromise the article's quality.

Material Review Board (MRB)

SOW-3.2-09: Disposition types for material nonconformances and workmanship discrepancies shall be:

- 1) Scrap (the product is not usable);
- 2) Rework (the product will be reworked to-print to conform to requirements);
- 3) Return to Supplier (the product shall be returned to the supplier);
- 4) Repair (the product will be repaired using a repair process approved by the MRB); or
- 5) Use-As-Is (the product will be used as-is).

SOW-3.2-10: The Contractor shall classify material nonconformances as Major or Minor. The NASA Mission Assurance Representative may, at their discretion, promote any Minor discrepancy to the MRB for further evaluation.

SOW-3.2-11: The Contractor shall disposition all Minor nonconformances and implement corrective action.

SOW-3.2-12: The Contractor shall submit Major discrepancies to the MRB for disposition.

SOW-3.2-13: The Contractor shall have a documented process for the establishment and operation of a MRB to process Major nonconformances. The Government will approve all MRB dispositions of Major nonconformances.

SOW-3.2-14: The Contractor shall appoint an MRB chairperson who is responsible for implementing the MRB process.

SOW-3.2-15: The Contractor shall assemble the MRB voting membership to include the following at a minimum:

- 1) ContractPAM;
- 2) Contractor Engineering Representative;

- 3) NASA Mission Assurance Representative; and
- 4) NASA Engineering Representative.

SOW-3.2-16: The Contractor shall include a GMIP for all “repair” or “rework” operations; after completion and while the work remains uncovered, visible, and easily inspected. This requirement applies to both Major and Minor nonconformances.

SOW-3.2-17: The Contractor shall include a summary of MRB actions during monthly technical progress reports (DRD PM-11).

SOW-3.2-18: The Contractor shall include a summary of Minor nonconformances in the weekly Safety and Mission Assurance Action Item Tracking List (DRD MA-02).

Anomaly & Failure Review

SOW-3.2-19: The Contractor shall classify anomalies and failures in accordance with NASA STD-8709.22, including minor and major anomalies as defined below:

- 1) Major Anomaly - Anomalies that have resulted in hardware or software test failures, damage or potential damage to flight hardware or ground support equipment that connects to flight hardware. Examples of major anomalies are overvoltage/current conditions, exceedance of test limits resulting in overstress, blown fuses, unexpected system response such as safe hold, etc.
- 2) Minor Anomaly - Anomalies that can be shown to have no damaging effect to hardware or require no flight software change. Examples of minor anomalies are those capable of being resolved on the spot, or those resulting from procedural errors, database problems and operator errors, including exceedance of test limits not affecting the end item.

SOW-3.2-20: The Contractor shall document hardware and software anomalies and failures, beginning with the first application of power at the component level for hardware failures, beginning with flight software acceptance testing and when interfacing with flight hardware for software failures; and beginning with first operation for mechanical system anomalies.

SOW-3.2-21: The Contractor shall ensure that all failures are investigated and analyzed, and their causes are determined.

SOW-3.2-22: The Contractor shall disposition minor anomalies and implement corrective action.

SOW-3.2-23: The Contractor shall submit initial reports for major anomalies and failures to the Anomaly & Failure Review Board (AFRB) in accordance with DRD MA-04.

SOW-3.2-24: The Contractor shall have a documented process for the establishment and operation of an AFRB to process and disposition anomalies and failures. The Government will approve all AFRB dispositions of Major anomalies and failures.

SOW-3.2-25: The Contractor shall appoint an AFRB chairperson who is responsible for implementing the AFRB process.

SOW-3.2-26: The AFRB voting membership shall include at a minimum:

- 1) ContractPAM;
- 2) Contractor Engineering Representative most cognizant of anomaly/failure;
- 3) NASA mission assurance representative; and

4) NASA Engineering Representative.

SOW-3.2-27: The Contractor shall determine that remedial corrective and preventative actions have been accomplished and verified in test, and that any intended or unintended collateral effects of such corrective and preventative actions are understood and verified prior to closing a major anomaly/failure investigation.

SOW-3.2-28: The Contractor shall submit the final Anomaly and Failure Reports in accordance with (DRD MA-04).

Traceability

SOW-3.2-29: The Contractor shall maintain inspection records, test records, and certificates of conformance (COC) where COCs are applicable on each component or subassembly by part number and serial number, to provide traceability from instrument usage to production lot data for the component.

SOW-3.2-30: The Contractor shall maintain complete records for the instrument items and have them available for review throughout the service life of the instrument.

SOW-3.2-31: The records shall indicate all relevant test data; all rework or modifications; and all installations and removals for whatever reason.

Requirements Waiver

SOW-3.2-32: The Contractor shall submit a waiver in accordance with DRD MA-03 for Government approval for any requirements deviation.

3.3 SYSTEM SAFETY

General

SOW-3.3-01: The Contractor 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 (DRD MA-05)

SOW-3.3-02: The Contractor shall identify, and submit for review, procedures for all foreseen hazardous operations, including observatory Integration and Test (I&T) and launch site operations per DRD MA-06.

SOW-3.3-03: The Contractor shall provide safety oversight for all hazardous operations.

SOW-3.3-04: The Contractor shall direct the suspension of any work activity that presents a present hazard, imminent danger, or future hazard to personnel, property, or mission operations resulting from unsafe acts or conditions identified by inspection, test, or analysis.

Design Safety

SOW-3.3-05: The Contractor shall incorporate three independent inhibits in the system design for dual failure tolerance, if a system failure may lead to a catastrophic hazard, where a catastrophic hazard is a condition that may cause death or a permanent disabling injury, or the destruction of a major system or facility on the ground, during launch, or on-orbit.

SOW-3.3-06: The Contractor shall incorporate two independent inhibits in the system design for single failure tolerance, if a system failure may lead to a critical hazard, where a critical hazard is a condition that may cause severe injury or occupational illness to personnel or major property damage to facilities, systems, or flight hardware.

SOW-3.3-07: The Contractor shall prepare a Design Safety Requirements Compliance Checklist to demonstrate that the payload complies with NASA and range safety requirements (DRD MA-07).

Hazard Analyses

SOW-3.3-08: The Contractor shall conduct and document Preliminary Hazard Analyses (PHA) (DRD MA-06)

SOW-3.3-09: The Contractor shall document Operations Hazard Analysis (OHA) and a Hazard Tracking Log to demonstrate that hardware operations, test equipment operations, and I&T activities comply with facility safety requirements and that hazards associated with those activities are mitigated to an acceptable level of risk (DRD MA-06).

SOW-3.3-10: The Contractor shall meet the safety requirements of NASA-STD-8719.9, Standard for Lifting Devices and Equipment, for all lifts performed in support of the contract.

SOW-3.3-11: The Contractor shall perform and document a recognized safety hazard analysis on all lifting devices and equipment to be used for critical lifts per NASA Standard 8719.9 (DRD MA-06).

Reports, assessments, forms, logs and investigations.

SOW-3.3-12: The Contractor shall generate an Instrument Safety Assessment Report (ISAR) per DRD MA-06 to document the comprehensive evaluation of the risk being assumed prior to the testing or operation of the instrument.

SOW-3.3-13: The Contractor shall prepare, implement, and maintain a Hazards and Verification Tracking Log (VTL) as defined in DRD MA-08.

SOW-3.3-14: The Contractor shall submit Safety Waivers, per DRD MA-09, for variations from the applicable safety requirements.

SOW-3.3-15: The Contractor shall provide inputs necessary to support the Orbital Debris Assessment (ODA), (DRD AM-13).

SOW-3.3-16: The Contractor shall prepare a Pre-Mishap Plan that describes appropriate mishap and close-call notification, reporting, recording, and investigation procedures per NPR 8621.1 NASA Procedures and Guidelines for Mishap Reporting, Investigating, and Recordkeeping (DRD MA-06).

SOW-3.3-17: The contractor shall promptly investigate all accidents, test failures, or other mishaps or close calls to determine the dominant root cause.

3.4 RELIABILITY

Reliability Program Plan (RPP)

SOW-3.4-01: The Contractor shall prepare and implement a Reliability Program Plan (RPP) (DRD MA-11) that uses both qualitative and quantitative techniques to support decisions regarding mission success and safety throughout system development.

SOW-3.4-02: The Contractor shall include in the RPP a detailed approach to the analysis of hardware and software for their contributions to system reliability and mission success.

SOW-3.4-03: The Contractor shall present the implementation of these plans and related activities at milestone reviews beginning with the Instrument Preliminary Design Review (PDR).

Probabilistic Risk Assessment (PRA)

SOW-3.4-04: The Contractor shall provide inputs to the Government for use by the spacecraft Contractor in performing a limited scope Probabilistic Risk Assessment (PRA) for JPSS that includes mission critical maneuvers and ground system interactions required for the mission operations as applicable.

Failure Modes and Effects Analysis and Critical Items List

SOW-3.4-05: The Contractor shall perform, in accordance with GSFC Flight Assurance Procedure, FAP P-322-208, a Failure Modes and Effects Analysis (FMEA) identifying severity categories 1, 1R, 1S, 2, and 2R per Table 3.4-1, and prepare and maintain a Critical Items List (CIL) (DRD MA-12).

Table 3.4-1 Severity Categories

Category	Severity	Description
1	Catastrophic/ Critical	Catastrophic failure modes that may cause death or a permanent disabling injury, or the destruction of a major system or facility on the ground or of the vehicle during the mission. Critical failure modes that may cause a severe injury or occupational illness to personnel or major property damage to facilities, systems, or flight hardware.
1R		Failure modes of identical or equivalent redundant hardware or software elements that could result in Category 1 effects if all failed.
1S		Failure in a safety or hazard monitoring system that could cause the system to fail to detect a hazardous condition or fail to operate during such condition and lead to Category 1 consequences.

2	Critical	Failure modes that could result in loss of one or more mission objectives as defined by the LaRC project office.
2R		Failure modes of identical or equivalent redundant hardware or software that could result in Category 2 effects if all failed.

Fault Tree Analysis (FTA)

SOW-3.4-06: The Contractor shall perform qualitative fault tree analyses (FTA), per DRD MA-13, to address mission failures and degraded modes of operation. These qualitative fault tree analyses will include software contributions to loss of mission scenarios.

SOW-3.4-07: The Contractor shall quantify their FTAs where undesirable fault propagation scenarios/critical failures are identified as part of their mission PRA support.

Parts Stress Analysis (PSA)

SOW-3.4-08: The Contractor shall perform parts stress and derating analyses for electrical, electronic, and electromechanical (EEE) parts in accordance with GSFC INST-EEE-002 Instruction for EEE Parts Selection, Screening, Qualification, and Derating (DRD MA-14).

Worst Case Circuit Analysis (WCA)

SOW-3.4-09: The Contractor shall perform worst-case analyses for those circuits deemed critical per DRD MA-15.

Reliability Assessments and Predictions

SOW-3.4-10: The Contractor shall perform comparative numerical reliability assessments and reliability predictions, as described in DRD MA-16, providing rationale for use of the failure rates. The instrument shall meet the reliability design requirement stated in the IPRD 3.7.2. Prediction methodologies other than what is defined in MIL-HDBK-217 may be used if approved by the Government.

SOW-3.4-11: The Contractor shall consider common cause failures in redundant systems in the reliability prediction.

Limited Life Items

SOW-3.4-12: The Contractor shall prepare and implement a plan, in accordance with DRD MA-17, to identify and manage limited life items including moving mechanical components and bonded joints as applicable.

SOW-3.4-13: The Contractor shall provide rationale for selecting and using items with a life less than 2X required life including ground operations (DRD MA-17).

3.5 SOFTWARE ASSURANCE

Applicable Software Definitions

SOW-3.5-01: When identifying, developing, verifying, and maintaining software, the Contractor shall apply the following definitions:

- 1) Software is defined as computer programs, procedures, scripts, rules, and associated documentation and data 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 complex electronics that include microprocessors.
- 2) Safety-Critical Software - Software that can cause, contribute to, or mitigate human safety hazards or damage to flight hardware and 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). Safety-critical software is identified based on the results of the hazard analysis and the results of the Orbital Debris Assessment Report/End-Of-Mission Plan (where applicable). Examples of safety-critical software can be found in all types of systems, including Flight, Ground Support System, Mission Operations Support Systems, and Test Facilities.
- 3) 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. Mission-critical software is identified based on the results of the Failure Modes and Effects Analyses (FMEA) and the Probabilistic Risk Assessment (PRA). Examples of mission-critical software can be found in all types of systems, including Flight, Ground Support System, Mission Operations Support Systems, and Test Facilities.

Software Assurance Program

SOW-3.5-02: The Contractor shall develop and execute a Software Assurance Program Plan (SAPP), per DRD MA-18, that complies with the following:

- 1) NASA-STD-8739.8, NASA Standard for Software Assurance
- 2) NASA-STD-8719.13, Software Safety Standard, (Exception: Definitions in 3.5-01 take precedence)

SOW-3.5-03: The Contractor shall identify the person(s) responsible for directing and managing the software assurance program and interfacing with Government assurance personnel.

SOW-3.5-04: The Contractor shall address in the SAPP the disciplines of Software Quality, Software Safety, Software Reliability, Software Verification and Validation (V&V), and Independent Verification and Validation (IV&V) and detail the role of assurance and their activities in ensuring quality products and processes for each discipline.

SOW-3.5-05: When the Contractor performs IV&V, the Contractor shall coordinate with Government IV&V personnel to share information and address approved corrective actions.

Software Safety Analysis

SOW-3.5-06: The Contractor shall identify in the System Safety Program Plan (SSPP) safety critical software as defined in requirement SOW-3.5-01.

SOW-3.5-07: The Contractor shall incorporate the results of the Software Safety Analyses, including references to the associated software and fault management requirements, into all applicable hazard reports and delivered as part of the ISAR (DRD MA-06).

Software Reliability

SOW-3.5-08: The Contractor shall perform FTA to identify software that is mission critical, per the definitions in requirement SOW-3.5-01, and to evaluate safety hazards.

SOW-3.5-09: The Contractor shall produce a functional block diagram (FBD) for safety critical and mission critical software, as input into the FMEA, that accounts for the interfaces, corresponding inputs/outputs, and the sequence of operations between the software and other components of critical system, subsystem, or task-level functions.

SOW-3.5-10: The Contractor shall update requirement specifications associated with critical software, to uniquely identify the associated requirements, and capture fault and failure management requirements derived from the FMEA of critical software.

Government–Off-The-Shelf(GOTS), Modified-Off-The-Shelf (MOTS), and Commercial-Off-The-Shelf (COTS) Software:

SOW-3.5-11: The Contractor shall ensure that software provided as GOTS, MOTS, or COTS meets the functional, performance, and interface requirements.

SOW-3.5-12: The Contractor shall ensure that the software provided as GOTS, MOTS, COTS meets applicable standards, including those for design, code, and documentation.

Surveillance of Software Development, Maintenance, and Assurance Activities

SOW-3.5-13: The Contractor shall provide the following to the Government:

- 1) Direct access to the software problem reporting system;
- 2) Electronic access to the software documentation (i.e., management plans, assurance plans, configuration management plans, requirements specifications, design documents, test plans, test cases, test procedures, test results, schedule, maintenance plans);
- 3) Electronic access to the software review results;
- 4) Schedule of assurance reviews, audits, and assessments of the Contractor's processes and products;
- 5) Access to the corrective actions from process and product audits;
- 6) Notification of and Government participation in engineering peer reviews (e.g., code reviews, test plan/procedure reviews);
- 7) Access to review action item status and resolution;
- 8) Access to monthly Software Measurement/Metrics data;
- 9) Access to requirements traceability matrices and data;
- 10) Software Assurance Status Report (DRD PM-11); and
- 11) Electronic access to source code.

3.6 WORKMANSHIP

General

SOW-3.6-01: The Contractor shall implement a workmanship program that complies with the following standards*^{Note 1}:

- 1) NASA-STD-8739.1A Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Electronic Assemblies;
- 2) J-STD-001 E, Requirements for Soldered Electrical and Electronic Assemblies in conjunction with J-STD-001 ES, Space Addendum Requirements for IPC Certification;
- 3) NASA-STD-8739.4 Crimping, Interconnecting Cables, Harnesses, and Wiring;
- 4) NASA-STD-8739.5 Fiber Optic Terminations, Cable Assemblies, and Installation;
- 5) NASA-STD-8739.6 Implementation Requirements for NASA Workmanship Standards;
- 6) IPC-2221 Generic Standard on Printed Board Design;
- 7) IPC-2222 Sectional Design Standard for Rigid Organic Printed Boards;
- 8) IPC-2223 Sectional Design Standard for Flexible Printed Boards;
- 9) IPC-2225 Sectional Design Standard for Organic Multichip Modules (MCM-L) and MCM-L Assemblies;
- 10) IPC A-600 Acceptability of Printed Boards (Class 3 requirements);
- 11) IPC-6011 Generic Performance Specification for Printed Boards (Class 3 requirements);
- 12) IPC-6012B Qualification and Performance Specification for Rigid Printed Boards (Class 3/A requirements) *^{Note 2};
- 13) IPC-6013 Qualification and Performance Specification for Flexible Printed Boards (Class 3 requirements);
- 14) IPC-6015 Qualification and Performance Specification for Organic Multichip Module (MCM-L) Mounting and Interconnecting Structures;
- 15) IPC-6018 Microwave End Product Board Inspection and Test;
- 16) ANSI/ESD S20.20 For the Development of an Electrostatic Discharge Control Program for the Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices). Refer to NASA-STD-8739.6, chapters 6.1 and 7 for additional applicable ESD requirements.

*Note 1: NASA will accept ESA Workmanship standards in lieu of NASA Workmanship Standards, with the exception that IPC 6012B, with the 3/A Appendix or IPC-6012C as specified in Note 2 will be mandatory. Although a formal, documented gap analysis between NASA and ESA workmanship standards does not exist, prior work has established general equivalence between NASA and ESA workmanship standards. See Dunn, B.D., "Workmanship standards and their application on ESA projects", Soldering & Surface Mount Technology, Volume 20, Number 4, 2008, pages 37-44.

* Note 2: IPC-6012C, Class 3/A may be used in lieu of IPC-6012B, Class 3/A with the following additional requirements to be called out in the procurement documentation or the master drawing:

- Internal annular rings shall be 0.002" minimum.
- Breakout is prohibited.
- External laminate cracks are not allowed.
- Neither positive nor negative etchback is allowed.
- Plating folds/inclusions shall be enclosed.
- Filled through holes should be at least 85% filled (with fill material).
- Exposed/disrupted fibers are prohibited.

- Voids in cap plating are prohibited.
- Lifted lands after thermal stress shall not exceed the thickness of the foil.
- Continuity testing requirement shall be 10 ohm maximum.
- Delaminations are prohibited.
- Coupon wicking measurements shall include all copper intrusion behind etched back or desmeared hole walls.
- Use of labels to identify flight boards or coupons is prohibited.
- Supplier shall provide sufficient A, B or A/B coupons per IPC-2221B for both unstressed and thermally stressed micro sectioned coupon.

SOW-3.6-02: Prior to connecting or mating electrical flight hardware components, or GSE that will make contact with flight hardware, the Contractor shall visually inspect circuit card assemblies (CCAs), motherboards, and other critical electrical components under magnification, and record with high-resolution photography.

SOW-3.6-03: The Contractor shall have photos of CCAs taken prior to, and following, application of any protective coating and include all board sides and edges.

SOW-3.6-04: The Contractor shall obtain high-resolution photos of all flight hardware components and assemblies during the build/test phases, where practicable, using nonintrusive and low-risk methods, and include as part of the End Item Data Package (EIDP) (DRD MA-32).

Electrostatic Discharge Control (ESD)

SOW-3.6-05: The Contractor shall prepare and implement an electrostatic discharge control (ESD) plan that conforms to the requirements of the ANSI/ESD S20.20-2007 industry standards for ESD control (DRD MA-20). Refer to NASA-STD-8739.6, chapters 6.1 and 7 for additional applicable ESD requirements.

Circuit Board Trace Cuts, Jumper Wires, and Dead-Bug Parts

SOW-3.6-06: The contractor shall not use trace cuts, jumper wires, and dead-bug parts in flight circuit boards unless approved by the MRB.

Use of Splices

SOW-3.6-07: The use of splices as part of a repair, or as part of a deviation from released design engineering, is prohibited unless approved as a Class I disposition by the MRB. Splices, which are part of the original design of a cable, harness, or CCA connector wiring, are acceptable without MRB approval, provided they are not part of a repair operation, fully comply with the NASA-STD-8739.4, and are designated for Mandatory Government Inspection Points of workmanship.

3.7 EEE PARTS

General

SOW-3.7-01: The Contractor shall document and implement a parts control plan (PCP) per the Level 2 requirements of GSFC EEE-INST-002 Instruction for EEE Parts Selection, Screening, Qualification, and Derating (DRD MA-21). Project radiation

environment/requirements are contained in the Instrument Performance Requirements Document (IPRD).

Nonstandard Parts

SOW-3.7-02: The Contractor shall implement, execute, maintain and track a Non-Standard Parts Approval Request (NSPAR) Program to include preparation and submission of NASA Langley Form 170, NSPARs, for all non-standard EEE parts used for flight and/or critical applications (DRD MA-19).

SOW-3.7-03: By CDR, the Contractor shall identify parts that do not meet the criteria of “standard parts”, or parts included in a nonstandard process, as “nonstandard parts”.

SOW-3.7-04: The Contractor shall identify in its EEE Parts Control Plan (DRD MA-21) qualification-testing requirements for all nonstandard parts.

SOW-3.7-05: The Contractor shall perform qualification testing of any EEE parts subject for up screening. Any nonstandard parts require the submittal of NASA Langley Form 170, NSPAR, along with a supporting data package for Government consideration and approval.

Connector Selection/Usage:

SOW-3.7-06: The Contractor shall select/use connectors of different sizes, types, orientation, and color code, or uniquely keyed to prevent improper connection.

SOW-3.7-07: The Contractor shall not use cold formed solder cup contacts.

SOW-3.7-08: The Contractor shall perform parts obsolescence monitoring in accordance with EEE-INST-002, Instruction for EEE Parts Selection, Screening, Qualification, and Derating.

SOW-3.7-09: The Contractor should group parts for use in instrument equipment together in individual assembly lots during the various stages of their manufacture to assure that all devices assembled during the same time-period use the same materials, tools, methods, and controls.

Parts Control Board

SOW-3.7-10: The Contractor shall review and approve the Contractor’s procurement documents prior to release to ensure that RBI parts requirements are met.

SOW-3.7-11: The Contractor shall establish a parts control board (PCB) that is responsible for the planning, management, and coordination of the selection, application, and procurement requirements of EEE parts (DRD MA-21).

SOW-3.7-12: The PCB membership shall include the Government as a voting member.

SOW-3.7-13: The Government shall be invited to all PCB meetings.

EEE Parts Lists

SOW-3.7-14: The Contractor shall develop and maintain EEE parts lists per DRD MA-22.

Parts Identification List (PIL)

SOW-3.7-15: The Contractor shall prepare a list of EEE parts proposed for use in flight hardware and approved by the PCB (DRD MA-22).

Project Approved Parts List (PAPL)

SOW-3.7-16: The Contractor shall prepare a list of EEE parts approved for use in flight hardware by the PCB (DRD MA-22).

As-designed Parts List (ADPL)

SOW-3.7-17: The Contractor shall prepare a list of EEE parts used in the design of flight hardware (DRD MA-23).

As-built Parts List (ABPL)

SOW-3.7-18: The Contractor shall prepare a list of EEE parts used in the flight hardware (DRD MA-24).

3.8 MATERIALS AND PROCESSES

General

SOW-3.8-01: The Contractor shall prepare and implement a materials and processes selection, control, and implementation plan (DRD MA-25).

SOW-3.8-02: The Contractor shall comply with 541-PG-8072.1.2, GSFC Fastener Procurement, Receiving Inspection, and Storage Practices for Spaceflight Hardware.

SOW-3.8-03: The Contractor shall ensure that the instrument has no open fluid reservoirs at the time of delivery.

Life Test Plan for Mechanisms

SOW-3.8-04: The Contractor shall prepare and implement a life test plan for mechanisms and moving mechanical systems (DRD MA-26).

Materials Usage Agreement (MUA)

SOW-3.8-05: The Contractor shall prepare materials usage agreements (DRD MA-27).

Materials Identification and Usage List (MIUL)

SOW-3.8-06: The Contractor shall prepare and maintain a Materials Identification and Usage List (MIUL) that will include a Project Approved Materials and Processes List, an As-Built Materials and Processes List, and appropriate usage records prior to and during the hardware development (DRD MA-28).

SOW-3.8-07: The Contractor shall update and deliver the As-Built Materials and Processes List as part of the EIDP.

Materials and Processes Control Board (MPCB)

SOW-3.8-08: The Contractor shall establish and operate a Materials and Processes Control Board (MPCB) that is responsible for the planning, management, and coordination of the selection, application, and procurement requirements of space flight hardware materials and manufacturing processes.

SOW-3.8-09: The Contractor shall document the responsibilities, structure, planned membership, and planned operations of the MPCB within the Materials and Processes Selection, Control, and Implementation Plan (DRD MA-25).

SOW-3.8-10: The Contractor shall include the Government as a voting member to the MPCB.

SOW-3.8-11: The Contractor shall invite the Government to all MPCB meetings.

SOW-3.8-12: The Contractor shall report to the MPCB any materials or processes that do not meet the requirements of NASA-STD-6016 or the workmanship standards noted herein.

Non-destructive Evaluation (NDE) Plan

SOW-3.8-13: The Contractor shall prepare and implement a non-destructive evaluation (NDE) plan for use in the inspection of materials, including electronic assemblies (DRD MA-01).

Printed Wiring Board (PWB) Test Coupons

SOW-3.8-14: The Contractor shall require printed wiring board (PWB) test coupons from their PWB vendor(s), test the coupons as required by IPC-2221B, maintain the coupons, and deliver test results per DRD MA-29.

SOW-3.8-15: The Contractor shall not integrate PWBs into higher level circuit boards until the analysis results are received and have demonstrated that the PWB are acceptable.

SOW-3.8-16: If a PWB design includes solid copper micro vias, then the Contractor shall ensure that the coupons for that PWB shall also include representative examples of those solid copper micro vias for evaluation.

Lead-Free and Tin Whisker Control

SOW-3.8-17: The Contractor shall meet 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.

17) GEIA-STD-0005-1: Performance Standard for Aerospace and High Performance Electronics Systems Containing Lead-free Solder

18) GEIA-STD-0005-2: Standard for Mitigating the Effects of Tin Whiskers in Aerospace and High Performance Electronic Systems, per Control Level 2C

PWB Design Aspects

SOW-3.8-18: The Contractor shall ensure that polyimide laminates contain no discrete bromide particles – the polyimide matrix of the laminate must be fully homogeneous to avoid potential for Conductive Anodic Filament (CAF) failures.

SOW-3.8-19: The Contractor shall include laminate manufacturer, material reference number, and IPC designation in the Project Approved Materials and Processes List.

SOW-3.8-20: The Contractor shall clearly note on coupon submittal documentation if brominated material was used in the PWB fabrication.

SOW-3.8-21: The Contractor shall ensure that solder mask complies with Type B2 per IPC-SM-840 (i.e. dry film solder mask).

SOW-3.8-22: The Contractor shall only tent vias with the use of a film solder resist, and complete coverage of the via holes is mandatory. Liquid solder resist alone is not permitted for use as a via tent.

Titanium Alloy Test Coupons

SOW-3.8-23: The Contractor shall reduce design allowables to 110-ksi (758.42 MPa) yield and 120-ksi (827.37 MPa) ultimate for all Ti-6Al-4V hardware produced from billet and reduce other properties, such as shear and compression strength, by ten percent (10%).

SOW-3.8-24: The Contractor shall have billet properties independently verified if reduced allowables are insufficient to provide adequate safety margins and shall document the properties in a Materials Usage Agreement (MUA).

SOW-3.8-25: The Contractor shall conduct a thorough review of all titanium certifications to ensure that there is clear traceability to the foundry and that all documented properties meet the specifications of the controlling standard.

SOW-3.8-26: The Contractor shall conduct third party strength verification of titanium stock if any of the prior provisions of SOW-3.8-24 through 3.8-27 are not or cannot be followed.

Products that cannot be manufactured from a billet, such as sheet, rod, tubing, extruded stock, and fasteners, do not require additional testing.

3.9 CONTAMINATION CONTROL

General

SOW-3.9-01: The Contractor shall deliver procedures for the installation and removal of any "Remove-Before-Flight" covers with the EIDP.

SOW-3.9-02: The Contractor shall develop and implement an Instrument Contamination Control plan per DRD MA-10 during all phases of the Instrument design and development and through Instrument delivery, to assure mission success per IEST-STD-CC1246D, *Product Cleanliness Levels and Contamination Control Program*.

SOW-3.9-03: The Contractor shall deliver the Instrument contamination measurement history and data as part of the End Item Data Package, DRD MA-32.

SOW-3.9-04: The Contractor shall monitor the Instrument for contamination effects and validate Instrument contamination controls until Government acceptance of the Instrument.

SOW-3.9-05: The Contractor shall perform and document a Molecular Transport Analysis per DRD AM-08.

SOW-3.9-06: The Contractor shall pack and handle all deliverable items to protect them against vibrations, shocks, moisture, electrostatic charge/discharge, and contamination associated with ground or air transport such that calibrations, alignment, and performance are not degraded.

3.10 METROLOGY AND CALIBRATION

Metrology and Calibration Program

SOW-3.10-01: The Contractor shall comply with ANSI/NCSL Z540.3-2006, Requirements for the Calibration of Measuring and Test Equipment.

SOW-3.10-02: The Contractor shall use laboratories that are accredited to ISO 17025, General Requirements for the Competence of Testing and Calibration Laboratories, when used for RBI testing at the Contractor facilities and at subcontractor facilities.

Use of Non-calibrated Instruments

SOW-3.10-03: The Contractor shall limit the use of non-calibrated instruments to applications where substantiated accuracy is not required and for indication-only purposes in non-hazardous, noncritical applications.

3.11 GIDEP ALERTS AND PROBLEM ADVISORIES

Government-Industry Data Exchange Program (GIDEP)

SOW-3.11-01: The Contractor shall participate in Government-Industry Data Exchange Program (GIDEP) per the GIDEP Operations Manual S0300-BT-PRO-010 and GIDEP Requirements Guide S0300-BU-GYD-010

Reviews

SOW-3.11-02: The Contractor shall review the following, hereafter referred to collectively as Alerts, for effects on RBI and RBI products: GIDEP Alerts, GIDEP SAFE-ALERTS, GIDEP Problem Advisories, GIDEP Agency Action Relevant internal corporate alerts, NASA Advisories and component issues as distributed by the Government Project Office.

Actions

SOW-3.11-03: The Contractor shall take action to eliminate or mitigate the effects of Alerts on the RBI and RBI products.

Reporting

SOW-3.11-04: The Contractor shall report the results of Alert reviews and actions taken (DRD MA-30).

SOW-3.11-05: The Contractor shall prepare and submit failure experience data 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.

SOW-3.11-06: The Contractor shall report in accordance with DRD MA-31, EEE parts, materials, and safety problems identified as contributing to anomalies and failures of RBI products.

SOW-3.11-07: The Contractor shall report at program milestone reviews the status of RBI products affected by Alerts or by significant EEE parts, materials, and safety problems.

3.12 HERITAGE PRODUCT COMPLIANCE

General

SOW-3.12-01: The Contractor shall document the compliance of previously developed designs, processes, software, and hardware with the requirements of the SOW Section 2.4 and the IMAR (DRD MA-33).

4.0 HARDWARE DESIGN AND DEVELOPMENT

4.1 FLIGHT HARDWARE

SOW-4.1-01: The Contractor shall provide one flight instrument in accordance with the requirements of this contract to meet the On Dock requirement identified in Appendix A. This includes all work necessary to design, develop, fabricate, test and calibrate the flight hardware.

SOW-4.1-02: The Contractor shall manufacture all deliverable hardware from formally released drawings, utilizing parts, materials, processes and procedures as authorized by the contract.

SOW-4.1-03: The Contractor shall perform acceptance testing on existing heritage hardware qualified by similarity.

SOW-4.1-04: For all parts of heritage design that will be manufactured for use as flight hardware, the Contractor shall demonstrate continuity of design and manufacturability.

SOW-4.1-05: For all parts of heritage design that will be manufactured for use as flight hardware, the Contractor shall provide a gap analysis of any differences between the heritage and present design, materials, processes, and manufacturing methods, including a rationale for changes and an assessment of the impact on part reliability.

SOW-4.1-06: The Contractor shall deliver to the spacecraft provider two sets of spacecraft wiring harness-side connectors that will mate the harness(es) to the Instrument.

SOW-4.1-07: The Contractor shall deliver to the spacecraft provider two sets of all specialty Instrument-to-Spacecraft mounting hardware that has limited-off-the-shelf availability or requires a special fabrication lot.

4.2 RADIOMETRIC TEST MODEL (RTM)

SOW-4.2-01: The Contractor shall develop a Radiometric Test Model (RTM) of a single-channel detector, optics and electronics assembly of sufficient fidelity to demonstrate and validate the measurement concept.

SOW-4.2-02: The Contractor shall develop a RTM Test Plan and conduct tests in accordance with the RTM Test Plan to evaluate and demonstrate RTM performance.

SOW-4.2-03: The Contractor shall utilize RBI Total Channel radiometric and temporal response requirements as objectives for RTM performance.

SOW-4.2-04: The Contractor shall develop an RTM Characterization Report per DRD SE-12.

SOW-4.2-05: The Contractor shall present status of the RTM development and characterization at the Instrument Preliminary Design Review per DRD RE-02.

4.3 ENGINEERING DEVELOPMENT UNIT (EDU)

SOW-4.3-01: The Contractor shall develop an Engineering Development Unit (EDU) of sufficient fidelity to demonstrate the form, fit, function and representative performance of the flight Instrument design.

SOW-4.3-02: The Contractor shall develop and include EDU Test Plan as an element of DRD IT-02.

- SOW-4.3-03: The Contractor shall perform thermal vacuum testing to characterize the performance of the EDU instrument design.
- SOW-4.3-04: The Contractor shall plan and perform a radiometric calibration of the EDU to evaluate EDU radiometric performance versus flight Instrument requirements and to demonstrate that the calibration equipment, procedures, and algorithms are suitable for flight Instrument calibration.
- SOW-4.3-05: The Contractor shall develop an EDU Characterization Report per DRD SE-13.
- SOW-4.3-06: The Contractor shall present status of the EDU development, test, and calibration activities at the Instrument Critical Design Review per DRD RE-03.

4.4 SPARING

Sparing Philosophy:

The Contractor should provide enough spares for flight hardware and critical ground support equipment such that recovery from a failure can occur within (a) flight hardware - three months; (b) critical ground support equipment – one month. As a general guideline, fabricated items should be spared at a 1:2 ratio (spare to required). The Contractor should procure sufficient spare parts to account for typical attrition during the manufacturing process due to handling, random failure, programming, destructive physical analyses, etc. Do not spare items that are either (a) inherently durable or (b) for procured parts, can be rapidly obtained from vendors such that the three month / one month failure recovery timelines can be met. Contractor judgment should be used to determine the number of spares procured within a lot purchase of components having high recurring costs or that are difficult to reproduce, such as detectors, encoders, power converters, and specialty optics. The 1:2 sparing ratio guideline does not necessarily apply to these types of items.

- SOW-4.4-01: The Contractor shall define and implement a spares program for all flight and ground support equipment appropriate to minimize delivery schedule impacts created by failures, contamination or other plausible events or conditions.
- SOW-4.4-02: The Contractor shall provide a Spare Parts Plan and List for approval by the Government in accordance with DRD SE-11.
- SOW-4.4-03: The Contractor shall calibrate, as applicable, all flight spares to the same level as the corresponding flight part.
- SOW-4.4-04: The Contractor shall provide fully tested spares as identified in the Spare Parts Plan that are identical in design and material configuration to the qualified article.
- SOW-4.4-05: The Contractor shall certify spares for critical ground support equipment as “ready for use” in the same manner as the original primary component.
- SOW-4.4-06: The Contractor shall spare one complete set of flight electronic circuit cards at the “kit” level. This includes all printed circuit boards and electrical, electronic, and electro-mechanical parts necessary to build one flight spare of each circuit card.

5.0 SOFTWARE DESIGN AND DEVELOPMENT

5.1 SOFTWARE DEVELOPMENT REQUIREMENTS

SOW-5.1-01: The Contractor shall adhere to NPR 7150.2A software engineering requirements for Class C (non-safety-critical) software systems, for all Instrument Flight Software (FSW) and Ground Software (GSW) development, documentation, testing, delivery, and maintenance. This adherence applies to all software developed for this contract, including Commercial-off-the-Shelf (COTS), Government-off-the-shelf (GOTS), Modified-off-the-shelf (MOTS), reused software, custom software, firmware, and programmable logic devices. For COTS, GOTS, MOTS, and reused software, only SWE-027 of NPR 7150.2A applies.

SOW-5.1-02: As part of that adherence, the Contractor shall complete a NPR 7150.2A Tailoring Compliance Matrix per DRD SW-01.

SOW-5.1-03: All COTS, GOTS, MOTs, and reused software shall adhere to NASA Software Safety Standard, NASA-STD-8719.13, and the NASA Software Assurance Standard, NASA-STD-8739.8.

Software Development Plan

SOW-5.1-04: The Contractor shall develop and control the Instrument FSW and GSW under a Software Development Plan (SDP) per DRD SW-02.

SOW-5.1-05: The Contractor shall apply the Government-approved SDP to all software developed for this contract, whether developed by the Contractor or by a third party (i.e., COTS, GOTS, MOTS subcontractor).

Software Configuration Management

SOW-5.1-06: The Contractor shall develop and include a Software Configuration Management Plan as an element of the overall Configuration and Data Management Plan (CDMP) (DRD PM-08), to identify and characterize project Software configuration items, control changes to those configuration items, and detail Software change request processes.

SOW-5.1-07: The Contractor shall apply the Software Configuration Management element of the CDMP to all flight, ground, and test software developed for the RBI project, including all firmware and programmable logic devices.

Instrument Software Development Environment

SOW-5.1-08: The Contractor shall develop and maintain a software development and validation environment to support the development and test of the FSW and GSW.

SOW-5.1-09: The Contractor shall identify all hardware and software components of the software development environment, and document the maintenance for this environment and its components, in the Software Development Facility Specification, a component of DRD SW-02.

SOW-5.1-10: The Contractor shall initiate Software Development Folders (SDF) and Software Engineering Notebooks (SEN) for FSW and GSW at the start of software planning and maintain them through contract end.

SOW-5.1-11: The Contractor shall document the content and structure of the Instrument's SDFs and SENs, and the processes to be used for their maintenance, in DRD SW-05, the FSW Software Detailed Design (SDD), and DRD SW-11, the GSW DRD.

SOW-5.1-12: Delivery of the SDFs and SENs to the Government is not required, but the Contractor shall make them available for audit by the Government at the Contractor's facility.

SOW-5.1-13: The Contractor shall address issues identified during Government SDF and SEN audits within 60 days of the finding.

Software Verification and Validation

SOW-5.1-14: The Contractor shall develop and implement the project Software V&V Plan for all FSW and GSW, according to NPR-7150.2A, section 2.4, SWE-028, SWE-029, and SWE-102, and document that plan as part of DRD SW-02, the SDP.

SOW-5.1-15: Delivery of documents and other artifacts generated in the V&V process to the Government is not required, but the Contractor shall make them available for audit by the Government at the Contractor's facility.

Software Meetings/Telecons

SOW-5.1.16: The Contractor shall lead weekly software status telecons focused on software-related technical progress and issues. The Contractor shall provide the discussion content in advance of each meeting. At a minimum, this informal material shall cover significant progress, problems and anomalies, and resolution plans and status of the problems/anomalies.

Software Testing

SOW-5.1.17: The Contractor shall plan and implement a software testing program to ensure that all FSW and GSW satisfies the functional and performance requirements defined in DRD SW-04, the Flight Software Requirements Specification and DRD SW-10, the Ground Software Requirements Specification.

SOW-5.1.18: The Contractor's shall document the overall software testing approach and methodology in the Software Test Plan in accordance with DRD SW-03.

Software Reviews

SOW-5.1-19: The Contractor shall identify in the SDP (DRD SW-02) a list of planned Software EPRs to be conducted on the FSW and GSW documentation and code, and the content and procedure for performing these EPRs.

SOW-5.1-20: The Contractor shall conduct all Software EPRs, in accordance with NPR 7150.2A, section 4.3, SWE-087, SWE-137, SWE-088, and SWE-089.

SOW-5.1-21: The Contractor shall conduct and pass a FSW Test Readiness Review prior to performing final FSW Acceptance Tests, and shall deliver a FSW Test Readiness Review Data Package in accordance with DRD SW-16 in preparation for that review.

SOW-5.1-22: The Contractor shall conduct and pass a FSW Software Acceptance Review, and shall deliver a FSW Software Acceptance Review Data Package in accordance with DRD SW-17 in preparation for that review.

SOW-5.1-23: The Contractor shall conduct and pass a GSW Test Readiness Review prior to performing final GSW Acceptance Tests, and shall deliver a GSW Test Readiness Review Data Package in accordance with DRD SW-16 in preparation for that review.

SOW-5.1-24: The Contractor shall conduct and pass a GSW Software Acceptance Review, and shall deliver a GSW Software Acceptance Review Data Package in accordance with DRD SW-17 in preparation for that review.

SOW-5.1-25: The Contractor shall invite the Government to attend all Software EPRs and other Software Reviews.

Software Measures (Metrics)

SOW-5.1-26: The Contractor shall acquire software measures (metrics) from subcontractors and team members, as defined in the SDP, and provide them to the Government in both numeric and graphical form monthly. The collected software metrics will support the analysis of both software product quality and schedule/effort/cost performance. The collection and reporting of metrics should be automated to the fullest extent practical.

5.2 FLIGHT SOFTWARE

Flight Software Requirements Specification

SOW-5.2-01: The Contractor shall perform all analyses and software systems engineering required to identify, derive, and allocate the FSW requirements (given the system and subsystem requirements), while ensuring that all requirements are forward and backward traceable between system and software requirements and between software requirements, design, and test.

SOW-5.2-02: The Contractor shall submit a Flight Software Requirements Specification (SRS) documenting the Instrument FSW requirements per DRD SW-04.

Flight Software Detailed Design

SOW-5.2-03: The Contractor shall submit a FSW Software Design Document (SDD) per DRD SW-05 and maintain software design details as documented in the DRD.

SOW-5.2-04: The Contractor shall include a Requirements Traceability Matrix in the SDD (DRD SW-05) showing bi-directional traceability between the Instrument software requirements and the software design and test plan.

Flight Software Testing

SOW-5.2-05: The Contractor shall generate Flight Software Test Procedures per DRD SW-06, which contains detailed descriptions, procedures, and setup and evaluation information for all FSW tests described in DRD SW-03.

SOW-5.2-06: The Contractor shall generate and deliver Flight Software Test Reports per DRD SW-07, including the results of all key FSW tests, as identified in DRD SW-03.

Flight Software Version Description

SOW-5.2-07: The Contractor shall generate a Flight Software Version Description Document (VDD), per DRD SW-08, to be delivered with the Instrument FSW and firmware at

Instrument delivery, which describes the deliverable Flight Software, its components, and the associated supporting files and/or documentation.

Flight Software User's Guide

SOW-5.2-08: The Contractor shall generate and deliver a Flight Software User's Guide in accordance with **DRD SW-09** describing the installation, build, and operating procedures for the FSW.

5.3 GROUND SOFTWARE

SOW-5.3-01: The Contractor shall develop and deliver the following Ground Software Computer Software Configuration Items (CSCIs), as defined in Appendix A:

- Instrument Ground Operations Software – used to command, control, and monitor the instrument during ground testing
- Instrument Operations Support Software – software tools which perform tasks for supporting the FSW, such as building and verifying memory loads, creating scan profiles, and performing critical data diagnostics
- Instrument Performance Trending Software – enables trend analysis for performance of key instrument health, status, and functional performance parameters

Ground Software Requirements Specification

SOW-5.3-02: The Contractor shall perform all analyses and software systems engineering required to identify, derive, and allocate the GSW requirements (given the GSE system and subsystem requirements), and ensure that all requirements are forward and backward traceable between system and software requirements and between software requirements, design, and test.

SOW-5.3-03: The Contractor shall submit a GSW SRS per **DRD SW-10** documenting the functional requirements for all GSW CSCIs.

Ground Software Detailed Design

SOW-5.3-04: The Contractor shall deliver a GSW SDD per **DRD SW-11**, detailing the design of all GSW systems, and maintain GSW design details as documented in the DRD.

SOW-5.3-05: The Contractor shall include a Requirements Traceability Matrix in the GSW SDD (**DRD SW-11**) showing bi-directional traceability between the Instrument software requirements and the software design and test plan.

Ground Software Testing

SOW-5.3-06: The Contractor shall compile Ground Software Test Procedures per **DRD SW-12**, which contains detailed descriptions, procedures, and setup and evaluation information for all GSW tests described in **DRD SW-03**.

SOW-5.3-07: The Contractor shall generate and deliver Ground Software Test Reports per **DRD SW-13**, including the results of all key GSW tests, as identified in **DRD SW-03**.

Ground Software Version Description

SOW-5.3-08: The Contractor shall develop a GSW VDD, per DRD SW-14, to be delivered with the Instrument GSW systems at Instrument delivery, which describes the deliverable Ground Software, its components, and the associated supporting files and documentation.

Ground Software User's Guide

SOW-5.3-09: The Contractor shall prepare and deliver a Ground Software User's Guide per DRD SW-15 describing the installation, build, and operating procedures for each of the GSW systems.

5.4 SOFTWARE MAINTENANCE

SOW-5.4-01: The Contractor shall maintain the Instrument FSW, GSW, and documentation, along with the environments, emulators, systems, and test software necessary to develop, verify, and validate these CSCIs, through the duration of the contract.

5.5 SIMULATOR SOFTWARE

SOW-5.5-01: The Contractor shall develop and deliver simulator software (D.SIM-1) in accordance with NPR 7150.2A software engineering requirements for Class C (non-safety-critical) software systems.

SOW-5.5-02: The Contractor shall develop the simulator software as part of the JPSS-2 Flight Segment Emulator (FSE). The FSE is a tool that increases operational readiness for the JPSS-2 mission by providing the ability to validate commands, processes, procedures and memory loads to the spacecraft and instruments during operations.

SOW-5.5-03: The Contractor shall develop the simulator using Wind River® Simics®.

SOW-5.5-04: The Contractor shall develop the simulator software in accordance with the RBI Simulator Requirements Specification (RBI-SIMSPEC-02-008) and RBI Simulator Interface Control Document (ICD) (RBI-SIMICD-02-009).

Simulator Development Plan

SOW-5.5-05: The Contractor shall develop and control the simulator software under a Software Development Plan (SDP) in accordance with DRD SW-02.

Simulator Configuration Management

SOW-5.5-06: The Contractor shall comply with the Software Configuration Management element of the CDMP.

Simulator Software Development Environment

SOW-5.5-07: The Contractor shall develop and maintain a simulator software development and validation environment for the simulator that supports the development and test of the simulator software. The environment shall include host development computer operating systems, high-level language compilers and debuggers, autocode generator software systems, machine language emulators, and test scenarios and procedures. It shall include the software in the instrument test environment simulators that model the detectors and mechanisms.

Simulator Software Requirements Specification

SOW-5.5-08: The Contractor shall perform all analyses and software systems engineering required to identify, derive, and allocate the simulator software requirements.

SOW-5.5-09: The Contractor shall submit a simulator SRS (SIM SRS) in accordance with DRD SW-18 for Government review, documenting the functional requirements for the Simulator system.

SOW-5.5-10: The Contractor shall ensure the SIM SRS requirements meet the requirements and interfaces specified in the RBI Simulator Requirement Spec and RBI Simulator ICD.

Simulator Software Detailed Design

SOW-5.5-11: The Contractor shall submit a simulator Software Design Document (SDD) in accordance with DRD SW-19 and maintain software design details as documented in the DRD.

SOW-5.5-12: The Contractor shall include a Requirements Traceability Matrix in the SDD (DRD SW-19) showing bi-directional traceability between the simulator software requirements and the software design and test plan.

Simulator Software Development and Peer Review

SOW-5.5-13: The Contractor shall incrementally deliver simulator software for code EPRs in accordance with DRD SW-24.

Simulator Software Testing

SOW-5.5-14: The Contractor shall plan and implement a simulator software validation test to ensure that software being developed or maintained satisfies functional and performance requirements defined in the SIM SRS. The government will provide an Interface Simulator to support the testing.

SOW-5.5-15: The Contractor's testing approach and methodology for the simulator software shall be documented in the Software Test Plan in accordance with DRD SW-03.

SOW-5.5-16: The Contractor shall generate simulator software Test Procedures, containing detailed descriptions, procedures, and setup and evaluation information for all Simulator tests, in accordance with DRD SW-20.

SOW-5.5-17: The Contractor shall generate and deliver simulator Software Test Reports, to include the results on all key simulator tests, in accordance with DRD SW-21.

SOW-5.5-18: The Contractor shall deliver a simulator Interface Test Report in accordance with DRD SW-21 to document the verification of how each interface requirement of the RBI Simulator Requirement Spec and RBI Simulator ICD is accomplished by the simulator.

Simulator Version Description Document

SOW-5.5-19: The Contractor shall generate a simulator Version Description Document (VDD), in accordance with DRD SW-22, describing the deliverable simulator, its components, and the associated supporting files and/or documentation. The simulator VDD shall be delivered with the simulator.

Simulator User's Guide

SOW-5.5-20: The Contractor shall generate and deliver a simulator User's Guide, in accordance with DRD SW-23, describing the installation, build, and operating procedures for the simulator.

SOW-5.5-21: The Contractor shall develop and deliver training material for the simulator and provide training to government operators at the time of each simulator delivery.

Simulator Software Reviews

SOW-5.5-22: The Contractor shall conduct simulator Technical Interchange Meetings (TIMs) with Government participation.

SOW-5.5-23: In addition to the instrument-level EPRs, the Contractor shall conduct the following simulator-specific EPRs with Government participation:

- Simulator Requirements EPR
- Simulator Design EPR
- Simulator Code EPRs in accordance with DRD SW-24
- Simulator Test Readiness Review (TRR) and deliver a simulator Test Readiness Review Data Package in accordance with DRD SW-16
- Simulator Acceptance Review (SimAR) and deliver a simulator Acceptance Review Data Package in accordance with DRD SW-17

SOW-5.5-24: The Contractor shall complete all development and testing, and shall conduct a successful Simulator Acceptance Review (SimAR) by January 15, 2018.

Simulator Software Integration

SOW-5.5-25: Upon delivery of the simulator software to the government, the Contractor shall support the integration of the simulator software into the JPSS-2 FSE and the acceptance test.

SOW-5.5-26: As part of mission integration activities, the Contractor shall support Rehearsal Anomaly Definition including assisting in scripting anomalies for the simulator.

SOW-5.5-27: The Contractor shall maintain the simulator and supporting documentation, along with the environments, emulators, and test software necessary to develop and verify the simulator through the duration of the contract.

6.0 GROUND SUPPORT EQUIPMENT

6.1 MECHANICAL GSE

SOW-6.1-01: The Contractor shall design, develop, produce and deliver Mechanical GSE that includes all equipment and fixtures required to operate, test, handle, lift, protect, support, transport, optically align and maintain the Instrument at the Contractor's facilities, at the JPSS-2 spacecraft vendor facilities and at the launch site.

SOW-6.1-02: The Contractor shall design, develop and produce Mechanical GSE that includes all equipment required to provide the appropriate thermal and vibration test environments during Instrument qualification, testing and calibration.

SOW-6.1-03: The Contractor shall document the design, usage requirements, and development and maintenance plans for all Mechanical GSE in the Packaging, Handling, Storage, and Transportation (PHS&T) Plan and Procedures in [DRD IT-05](#).

SOW-6.1-04: At the time of instrument delivery, the Contractor shall recertify all Mechanical GSE that is 25% (or more) through its recertification period.

SOW-6.1-05: The Contractor shall design, develop, and produce two dedicated RBI integration carts for instrument integration.

6.2 DRILL TEMPLATE

SOW-6.2-01: The Contractor shall design, develop and deliver an RBI Drill Template for match-drilling of the Spacecraft mechanical interface in accordance with the RBI – JPSS-2 Spacecraft Mechanical Interface Control Document (MICD).

6.3 ELECTRICAL GSE

SOW-6.3-01: The Contractor shall design, develop, produce and deliver Electrical GSE that includes all equipment and fixtures required to connect, operate, test, monitor and maintain the Instrument at the Contractor's facilities, at the JPSS-2 spacecraft vendor facilities and at the launch site.

SOW-6.3-02: The Contractor shall design, develop, produce and deliver Electrical GSE necessary for performing safe-to-mate verifications of other EGSE.

SOW-6.3-03: The Contractor shall design, develop, produce and deliver Instrument Electrical GSE necessary for performing the Bench Acceptance Test identified in SOW 9.3.

SOW-6.3-04: The Contractor shall prepare and deliver an EGSE Operations Manual and Operating Procedures per [DRD IT-06](#).

SOW-6.3-05: The Contractor shall prepare and deliver an Instrument Electrical Ground Support Equipment Verification Report per [DRD SE-07](#).

SOW-6.3-06: The Contractor shall submit all maintenance procedures for approval for any GSE maintenance activities to be conducted by the Contractor at the Spacecraft integration facility per [DRD IT-06](#).

SOW-6.3-07: At the time of instrument delivery, the Contractor shall recertify all Electrical GSE, including recalibration of any metrology controlled equipment, that is 25% (or more) through its recertification period.

6.4 CONTAMINATION CONTROL EQUIPMENT

SOW-6.4-01: The Contractor shall design, develop, produce or procure and deliver all Contamination Control equipment required for monitoring and maintenance of the flight Instrument cleanliness.

6.5 SHIPPING AND STORAGE CONTAINERS

SOW-6.5-01: The Contractor shall provide environmentally controlled shipping and storage containers, purge equipment, environmental recorders and necessary ancillary equipment for shipment of the Instrument to the spacecraft vendor facility.

SOW-6.5-02: The Contractor shall provide shipping and storage containers for all other deliverable hardware.

SOW-6.5-03: The Contractor shall design, develop, and produce one dedicated RBI purge cart and two sets of Ground Support Equipment couplings for instrument integration, storage, transportation and delivery.

7.0 ASSEMBLY, INTEGRATION AND TEST

7.1 ASSEMBLY

SOW-7.1-01: The Contractor shall develop, maintain and deliver a Manufacturing (Fabrication and Assembly) Flow Plan, per DRD IT-01.

7.2 INTEGRATION AND TEST PROGRAM

SOW-7.2-01: The Contractor shall plan and conduct an integration and test program in accordance with GSFC-STD-7000A and the Instrument Performance Requirements Document. The test program shall include all tests at all levels of assembly and cover all phases of the hardware development and manufacture.

SOW-7.2-02: The Contractor shall document the Environmental Test and Verification Plan in accordance with DRD IT-02.

SOW-7.2-03: The Contractor shall base the test program on a “Test-As-You-Fly” philosophy.

SOW-7.2-04: The Contractor shall test the Flight Instrument in accordance with DRD-IT-02 to protoflight test levels defined in GSFC-STD-7000A.

SOW-7.2-05: The Contractor shall re-qualify items that incorporate changes in design, manufacturing processing, materials, environmental levels or performance requirements.

SOW-7.2-06: The Contractor shall obtain explicit approval from the Government for any qualification by similarity.

SOW-7.2-07: The Contractor shall report and treat all test problems, anomalies, failures and discrepancies as nonconformances in accordance with the IMAR (Section 3) requirements.

SOW-7.2-08: During testing, the Contractor shall document any consent to proceed, consent to break, consent to integrate, mini-TRRs or any other related test process decisions in the as-run test procedure or test report.

SOW-7.2-09: The Contractor shall notify the Government no later than 5 working days in advance of Instrument and subsystem acceptance tests.

SOW-7.2-10: The Contractor shall not delay tests if the Government’s representative is not available unless Government presence is required per explicit Contract requirements.

SOW-7.2-11: The Contractor shall verify through test and analysis that out-of-field energy to the detector meets the requirements in IPRD section 4.0 Instrument Science Performance Requirements.

7.3 TEST DOCUMENTATION

SOW-7.3-01: The Contractor shall provide test procedures for Government review in accordance with DRD IT-03.

SOW-7.3-02: The Contractor shall provide interim data files of the test data taken during the Instrument test sequence in the Contractor’s format and with appropriate logs in a timely manner for real-time discussion of test results with the Government upon request.

SOW-7.3-03: The Contractor shall deliver test reports and as-run test procedures per DRD IT-04.

SOW-7.3-04: Final Test Data Files shall be submitted as part of the End Item Data Package (EIDP) as described in the DRD MA-32.

SOW-7.3-05: The Contractor shall prepare and submit the Instrument Mass Properties Report per DRD SE-09.

8.0 CALIBRATION AND VALIDATION

8.1 CALIBRATION SYSTEM REQUIREMENTS AND PLANNING

SOW-8.1-01: The Contractor shall perform trades and analysis in order to develop and document the calibration requirements per DRD CV-01.

SOW-8.1-02: The Contractor shall develop a calibration plan, including a calibration schedule that demonstrates that the accuracy, precision, and uncertainty requirements can be met over the mission lifetime per DRD CV-05.

8.2 CALIBRATION SYSTEM DESIGN

SOW-8.2-01: The Contractor shall develop, document, and characterize analytical models that accurately describe the system performance, including, but not limited to, the following:

- 1) Radiometric Math Model/SPMM per DRD AM-19.
- 2) Optical Analytical Model per DRD AM-20.

SOW-8.2-02: The Contractor shall perform all trades and analyses necessary to develop and document the key calibration systems, parameters, and calibration data sets that fully document the system performance, including but are not limited to, the following:

- 1) Flight Calibration Sources per DRD CV-03.
- 2) Ground Calibration Sources and Parameters Report per DRD CV-04.

SOW-8.2-03: The Contractor shall measure Relative Spectral Response (RSR) of all optical components that contribute to the overall RSR or each radiometric channel and document results per DRD CV-02.

SOW-8.2-04: The Contractor shall determine the overall RSR for each radiometric channel and document the results per DRD CV-02.

8.3 CALIBRATION TEST EQUIPMENT

SOW-8.3-01: The Contractor shall define, design, manufacture, provide, maintain, and document all equipment necessary to calibrate and characterize the Instrument in DRD CV-05.

SOW-8.3-02: The Contractor shall perform tests necessary to demonstrate that all calibration test equipment is functioning within specification.

8.4 CALIBRATION AND VALIDATION

SOW-8.4-01: The Contractor shall develop and propose calibration/validation procedures that fully describe the calibration (ground and in-flight) of the Instrument per DRD CV-06.

SOW-8.4-02: The Contractor shall develop reports of all calibration/validation tests and analyses performed under this contract per DRD CV-07.

8.5 CALIBRATION FACILITIES

SOW-8.5-01: The Contractor shall provide the personnel, facilities, ground calibration systems, any transfer radiometers, and supporting GSE for the Instrument calibration facility.

9.0 INSTRUMENT DELIVERY

9.1 PACKAGING, HANDLING, STORAGE AND TRANSPORTATION

SOW-9.1-01: The Contractor shall be responsible and liable for the preservation, packaging, product marking, packing, transportation, shipping and delivery of all hardware deliverables specified in Appendix A.

SOW-9.1-02: The Contractor shall provide Packaging, Handling, Storage, and Transportation (PHS&T) Plans and Procedures per DRD IT-05.

SOW-9.1-03: The Contractor shall, in coordination with the Government, participate in a pre-ship Instrument delivery walk-through and facility survey at the Spacecraft integration facility prior to Instrument Pre-Ship Review.

SOW-9.1-04: The Contractor shall provide the personnel, facilities, and hardware necessary to prepare and pack all hardware deliverables specified in Appendix A for shipment.

SOW-9.1-05: The Contractor shall transport all hardware deliverables specified in Appendix A in appropriate shipping containers.

SOW-9.1-06: The Contractor shall install appropriate shorting plugs or caps on all external connectors for ESD protection during shipment.

SOW-9.1-07: The Contractor shall prepare, pack, and ship all related calibration, mechanical, and electrical GSE required to support the Instrument during Observatory integration and test.

9.2 INSTRUMENT SHIPPING APPROVAL

SOW-9.2-01: The Contractor shall obtain explicit clearance to proceed from the Government prior to shipping the Instrument and associated equipment.

9.3 BENCH ACCEPTANCE TEST

SOW-9.3-01: Following delivery of the instrument to the Spacecraft integration facility, the Contractor shall unpack and set up the instrument and GSE required to perform a comprehensive functional test of the Instrument prior to Spacecraft integration.

SOW-9.3-02: The Contractor shall perform a comprehensive functional test of the Instrument at the Spacecraft integration facility as a Bench Acceptance Test (BAT).

SOW-9.3-03: The Contractor shall review the as-run Bench Acceptance Test procedures and results with the Government.

SOW-9.3-04: The Contractor shall request Government acceptance (Contract Delivery) of the Instrument (DRD PM-15) after Contractor completes a successful Bench Acceptance Test.

SOW-9.3-05: The Contractor shall request Government acceptance (Contract Delivery) of the Instrument no later than On Dock + 15 days in order to support the Government's On Hook requirement as set forth in Appendix A.

10.0 OPERATIONS AND SUSTAINMENT

10.1 INSTRUMENT OPERATIONS AND CONSTRAINTS

SOW-10.1-01: The Contractor shall develop the Instrument Concept of Operations (CONOPS) in accordance with **DRD OO-01**.

SOW-10.1-02: The Contractor shall develop the Instrument User's Manual, including Launch, On-orbit Operations and Contingency Procedures in accordance with **DRD OO-02**.

SOW-10.1-03: The Contractor shall develop the Instrument Command Telemetry, Science, and Engineering Data Description in accordance with **DRD OO-03**.

SOW-10.1-04: The Contractor shall identify all commands that can potentially damage the Spacecraft, Instrument or cause injury to personnel and all environmental and operating constraints and restrictions pertaining to storage, integration, test, launch operations and on-orbit operations in accordance with **DRD OO-04**.

SOW-10.1-05: The Contractor shall support the Government's development of RBI Mission Operations plans and procedures by reviewing and providing comments on documentation related to instrument procedures, commanding, and telemetry.

SOW-10.1-06: The Contractor shall provide operations training to the Government, including up to 400 hours of support to train four government operators to use the EGSE to command the EDU. The Government will schedule this training in the period after the ISAR and prior to the BAT.

10.2 INSTRUMENT DATA SETS

SOW-10.2-01: The Contractor shall prepare and deliver Instrument data sets for ground system and data processing software testing per **DRD SE-14**.

10.3 INSTRUMENT POST-DELIVERY SUPPORT

The post-delivery support period commences when the Government accepts the Instrument and is defined here to be 21 months in duration (18 months to launch plus 3 months on-orbit through commissioning).

SOW-10.3-01: The Contractor shall provide 1000 hours of technical consultation related to troubleshooting, early on-orbit operations and data reviews throughout the Instrument post-delivery support period. These hours are in addition to any hours required for replacement or correction of work not meeting contract requirements in accordance with FAR 52.246-8.

SOW-10.3-02: The Contractor shall plan travel expenses during the post-delivery support period for six trips, each of five business days duration, for three personnel per trip, to the Spacecraft integration facility for attendance at up to six JPSS Program reviews, TIMs, technical consultation and troubleshooting, where labor hours are in addition to the hours identified in SOW-10.3-01.

11.0 RISK REDUCTION

11.1 INTEGRATION AND TEST RISK REDUCTION

SOW-11.1-01: The contractor shall design develop and produce a (surrogate) fixture capable of replacing the EDU Azimuth Rotation Module during integration and fixed azimuth EDU TVAC testing.

SOW-11.1-02: The contractor shall design, develop and produce electronics hardware to provide a standalone capability to test EDU circuit card assemblies.

APPENDIX A: TABLE OF DELIVERABLES

Deliverable Item Number	Item Name	SOW Reference	Description	Quantity	Delivery Schedule
<i>Flight Instrument Hardware (FH)</i>					
D.FH-1.1	RBI Flight Instrument Completion	SOW 1.1-03 SOW 1.1-04.1 SOW 4.1-01	A fully tested and calibrated RBI flight instrument; successful completion of SAR; successful completion of PSR; shipment to spacecraft integration facility.	1	On Dock April 30, 2019
D.FH-1.2	RBI Flight Instrument	SOW 9.3-04 SOW 9.3-05	Successful completion of BAT; completion of DD250; RBI ready for spacecraft integration. (Contract Delivery/Instrument Acceptance)	1	On Hook (On Dock + 30 days) May 30, 2019
D.FH-2	Spares and Residual Hardware	SOW 4.4	Space flight qualified spare parts and residual hardware such as sensors, electronic and optical components, on-board calibration sources, and mechanical scanners purchased under the contract.	All	After instrument delivery upon direction from the Government, or at Contract closeout
D.FH-3	Spacecraft Wiring Harness Connectors	SOW 4.1-06	Spacecraft wiring harness-side connectors (the mates to instrument connectors) for connecting harness(es) to instrument.	2 sets	Pre-Environmental Review
D.FH-4	Specialty Instrument – Spacecraft Mounting Hardware	SOW 4.1-07	Hardware required to mechanically attach the instrument to the spacecraft (bolts, washers, isolators, etc.) that has limited-off-the-shelf availability or requires a special fabrication lot.	2 sets	Pre-Environmental Review
<i>Non-Flight Instrument Hardware (NF)</i>					
D.NF-1	Radiometric Test Model	SOW 4.2	A single channel detector, optics and electronics assembly unit identical to that used in the RBI for sensor channel radiometric performance validation and risk reduction.	1	After instrument delivery upon direction from the Government, or at Contract closeout
D.NF-2	Engineering Development Unit	SOW 4.3	A non-flight form, fit and function equivalent to the RBI flight instrument; used for risk reduction and testing to flight qualification levels.	1	After instrument delivery upon direction from the Government, or at Contract closeout
<i>Flight Software (FS)</i>					

Deliverable Item Number	Item Name	SOW Reference	Description	Quantity	Delivery Schedule
D.FS-1	Instrument Flight Software	SOW 5.2	All source code, libraries, tables, databases, and executable code that comprise the instrument on-board flight software.	2 copies on CD/DVD	System Acceptance Review
<i>Mechanical Ground Support Equipment (MGSE)</i>					
D.MGSE-1	Lifting Assembly	SOW 6.1-01	Hardware for lifting RBI instrument via overhead crane.	1 set	With Instrument Delivery
D.MGSE-2	Drill Template	SOW 6.2	Drill template used to drill instrument baseplate and spacecraft mounting surface.	1	Pre-Environmental Review
<i>Electrical Ground Support Equipment (EGSE)</i>					
D.EGSE-1	Instrument EGSE	SOW 6.3	Electrical / electronic / computing equipment necessary to operate and monitor the instrument during ground testing. Includes hardware and/or software necessary to verify proper performance of instrument EGSE prior to connecting to flight hardware.	1 set	With Instrument Delivery
D.EGSE-2	Cabling for Instrument EGSE	SOW 6.3	All electrical cabling required to operate and monitor the instrument using the Instrument Electrical Ground Support Equipment.	1 set	With Instrument Delivery
D.EGSE-3	Break-out Boxes	SOW 6.3	Electrical break-out boxes for performing instrument-to-spacecraft wiring harness safe-to-mate checks.	1 set	System Acceptance Review
D.EGSE-4	Connector Savers	SOW 6.3	One complete set of connector savers that mate to instrument connectors.	1 set	With Instrument Delivery
<i>Ground Software (GS)</i>					
D.GS-1	Instrument Ground Operations Software	SOW 5.3-01	All source code, libraries, tables, databases, and executable code that comprise the ground software used to command, control, and monitor the instrument during ground testing.	2 copies on CD/DVD	System Acceptance Review
D.GS-2	Instrument Operations Support Software	SOW 5.3-01	All source code, libraries, tables, databases, and executable code that comprise software essential for instrument flight operations, such as utilities for developing table loads, memory loads, or critical diagnostic tools.	2 copies on CD/DVD	System Acceptance Review

Deliverable Item Number	Item Name	SOW Reference	Description	Quantity	Delivery Schedule
D.GS-3	Instrument Performance Trending Software	SOW 5.3-01	All source code, libraries, tables, databases, and executable code that comprise software for performing basic performance trending of key instrument health, status, and functional performance parameters.	2 copies on CD/DVD	System Acceptance Review
<i>Contamination Control Hardware (CC)</i>					
D.CC-1	GN2 Purge Panel	SOW 6.4	Purge panel to filter and regulate the flow of gaseous nitrogen (GN2) purge gas to the instrument.	1	With Instrument Delivery
D.CC-2	GN2 Purge Cover(s)	SOW 6.4	Non-flight instrument covers that facilitate GN2 purge to sensitive instrument components.	2 of each cover	With Instrument Delivery
D.CC-3	GN2 Purge Tubing	SOW 6.4	Tubing and interconnects to connect the GN2 Purge Panel to the GN2 Purge cover(s).	1 set	With Instrument Delivery
D.CC-4	Optical Witness Samples and Holders	SOW 6.4	Optical Witness Samples for instrument contamination monitoring and associated witness sample holders.	4	With Instrument Delivery
D.CC-5	Purge Cart	SOW-6.5-03	Purge cart for instrument delivery to spacecraft integration facility.	1	With EDU and Instrument Delivery
D.CC-6	Purge Cart GSE Couplings	SOW-6.5-03	Sets of purge cart GSE couplings for instrument delivery to spacecraft integration facility.	2	With EDU and Instrument Delivery
<i>External Targets / Sources (ET)</i>					
D.ET-1	Targets and External Sources	SOW 8.3	All targets, sources, or stimuli external to the instrument that are required for use during observatory ground testing to verify instrument functional or radiometric performance.	1 set	With Instrument Delivery
<i>Miscellaneous (MISC)</i>					
D.MISC-1	Shipping Containers	SOW 6.5	Shipping containers, as appropriate, for all deliverable hardware.	1 of each	With Hardware Delivery
<i>Data, Analyses, and Documentation (CDRL)</i>					

Deliverable Item Number	Item Name	SOW Reference	Description	Quantity	Delivery Schedule
D.CDRL-1	CDRL Items	As specified in each DRD	Data, analyses, and reports in accordance with the Contract Data Requirements List (CDRL) and Data Requirements Descriptions (DRDs).	As specified in each DRD	As specified in the CDRL
<i>Simulator Software</i>					
D.SIM-1	Simulator Software	SOW 5.5	All source code, models, libraries, tables, databases, licenses, and executable code that comprise the simulator software.	7 copies on CD/DVD	Simulator Acceptance Review

APPENDIX B: ABBREVIATIONS AND ACRONYMS

ABPL	As-built Parts List
ADPL	As-designed Parts List
AETD	Applied Engineering and Technology Directorate
AFRB	Anomaly & Failure Review Board
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
BAT	Bench Acceptance Test
BCR	Baseline Change Request
C&DH	Command and Data Handling
CAF	Conductive Anodic Filament
CCA	Circuit Card Assemblies
CCB	Configuration Control Board
CCR	Contract Change Request
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CERES	Clouds and the Earth's Radiant Energy System
CIL	Critical Items List
CL	Closed Loop
COC	Certificate of Conformance
CONOPS	Concept of Operations
ContractPAM	Contractor Product Assurance Manager
COTS	Commercial off the Shelf
CSCI	Computer software configuration items
CWBS	Contract Work Breakdown Structure
DOORS	Dynamic Object Oriented Requirements System
DRD	Data Requirement Description
EDU	Engineering Development Unit
EEE	Electrical, Electronic, and Electromechanical
EGSE	Electrical Ground Support Equipment
EIA	Electronic Industries Alliance
EIDP	End Item Data Package
EMC	Electromagnetic Capability
EOL	End of Life
EPR	Engineering Peer Review
ERB	Earth Radiation Budget
ESD	Electrostatic Discharge Control
EVM	Earned Value Management
EVMS	Earned Value Management System
FAR	Federal Acquisition Regulation
FBD	Functional Block Diagram
FMEA	Failure Modes and Effects Analysis
FRB	Failure Review Board
FSW	Flight Software
FTA	Fault Tree Analysis

GEVS	GSFC Environmental Verification Specifications
GIDEP	Government-Industry Data Exchange Program
GMIP	Government Mandatory Inspection Point
GOLD	Goddard Open Learning Design
GOTS	Government-Off-the-Shelf
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
GSW	Ground Software
I&T	Integration and Test
IBR	Integrated Baseline Review
ICD	Interface Control Document
ICDR	Instrument Critical Design Review
IMAR	Instrument Mission Assurance Requirements
IMS	Integrated Master Schedule
IPDR	Instrument Preliminary Design Review
IPER	Instrument Pre-Environmental Review
IPRD	Radiation Budget Instrument (RBI) Performance Requirements Document
IPSR	Instrument Pre-Ship Review
ISAR	Instrument System Acceptance Review
ISR	Instrument System Review
ISRR	Instrument Systems Requirements Review
IT	Information Technology
ITAR	International Traffic in Arms Regulations
IV&V	Independent Verification and Validation
JPSS	Joint Polar Satellite System
KSC	Kennedy Space Center
LaRC	Langley Research Center
LPR	Langley Procedural Requirements
LW	Long Wave
MA	Mission Assurance
MAIP	Mission Assurance Implementation Plan
MCM	Multichip Modules
MGSE	Mechanical Ground Support Equipment
MICD	Mechanical Interface Control Document
MIP	Mandatory Inspection Point
MIUL	Materials Identification and Usage List
MOTS	Modified off the Shelf
MPCB	Materials and Processes Control Board
MPSR	Monthly Project Status Review
MRB	Material Review Board
MUA	Materials Usage Agreement
NASA	National Aeronautics and Space Administration
NDE	Non-destructive Evaluation
NFAR	NASA FAR
NFS	NASA FAR Supplement
NIST	National Institute of Standards and Technology

NPD	NASA Policy Directive
NPP	NPOESS Preparation Project
NPR	NASA Procedural Requirement
NSPAR	Non-Standard Parts Approval Requests
ODA	Orbital Debris Assessment
OHA	Operations Hazard Analysis
PAM	Product Assurance Manager
PAPL	Project Approved Parts List
PCB	Parts Control Board
PCP	Parts Control Program
PHA	Preliminary Hazard Analyses
PHS&T	Packaging, Handling, Storage and Transportation
PIL	Parts Identification List
PM	Project Management
PMB	Performance Measurement Baseline
PMR	Program Management Review
PRA	Probabilistic Risk Assessment
PSA	Parts Stress Analysis
PWB	Printed Wiring Board
QSS	Quality Status Stamp
R&M	Reliability and Maintainability
RBI	Radiation Budget Instrument
RPP	Reliability Program Plan
RSDO	Rapid Spacecraft Development Office
RSR	Relative Spectral Response
RTM	Radiometric Test Model
S&MA	Safety and Mission Assurance
SA	Software Assurance
SAPP	Software Assurance Program Plan
SDD	Software Detailed Design
SDF	Software Development Folders
SDP	Software Development Plan
SE	Systems Engineering
SEN	Software Engineering Notebook
SOW	Statement of Work
SPMM	Sensor Performance Math Model
SRS	Software Requirements Specification
SSPP	System Safety Program Plan
STD	Standard
SW	Software
SWE	Software Engineering Requirement
TBD	To Be Determined
TIM	Technical Interchange Meeting
ToR	Terms of Reference
TPM	Technical Performance Measures
TRL	Technology Readiness Level

TRR	Test Readiness Review
V&V	Verification and Validation
VDD	Version Description Document
VTL	Verification Tracking Log
WBS	Work Breakdown Structure
WCA	Worst Case Circuit Analysis