Description of document:	National Oceanic and Atmospheric Administration (NOAA) Reliability Analysis and Failure Modes Analysis for JPSS-1 Polar Satellite 2017-2018
Requested date:	29-November-2021
Release date:	03-May-2022
Posted date:	10-October-2022
Source of document:	Freedom of Information Request National Oceanic and Atmospheric Administration Public Reference Facility (SOU1000) 1315 East-West Highway (SSMC3) Room 9719 Silver Spring, MD 20910 FOIA Online

May 3, 2022

Re: FOIA Request DOC-NOAA-[2022-000262]

This letter is in response to your Freedom of Information Act (FOIA) request entered into FOIAonline, our request tracking database, on November 29, 2021 in which you requested:

"1) A copy of the reliability analysis document and the FMECA (failure mode effects and criticality analysis) document for NOAA-20 (formerly JPSS-1) joint polar satellite system. 2) A copy of the reliability analysis document and the FMECA document for JPSS-2."

We are releasing the following four documents responsive to this request with the redactions noted.

1. 6470-AR23B00_A, FAILURE MODE AND EFFECTS ANALYSIS AND CRITICAL ITEMS LIST, CDRL MA 4-3.pdf
   - All redactions in this document are made under FOIA Exemption U.S.C.552(b)(3) which exempts from disclosure "Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page." and FOIA Exemption U.S.C.552(b)(4) which exempts from disclosure "Information concerning business trade secrets or other confidential commercial or financial information is exempt."
   - 17 pages are released in entirety. 2 pages are partially redacted. 628 pages are fully redacted.
2. 6470-AR23B02_B, RELIABILITY ASSESSMENT AND PREDICTION, CDRL MA 4-7.pdf
   - All redactions in this document are made under FOIA Exemption U.S.C.552(b)(3) which exempts from disclosure "Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page." and FOIA Exemption U.S.C.552(b)(4) which exempts from disclosure "Information concerning business trade secrets or other confidential commercial or financial information is exempt."
   - 12 pages are released in entirety. 35 pages are fully redacted.
3. MA 04-03 2396799 REV C JPSS-1 FAILURE MODES EFFECTS ANALYSIS_CRITICAL ITEMS LIST (CIL).pdf
   - All redactions in this document are made under FOIA Exemption U.S.C.552(b)(3) which exempts from disclosure "Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page." and FOIA Exemption U.S.C.552(b)(4) which exempts from disclosure "Information concerning business trade secrets or other confidential commercial or financial information is exempt."
   - 1 page is released in entirety. 40 pages are fully redacted.

4. MA 04-07 2396906 REV B JPSS-1 RELIABILITY ASSESSMENT AND PREDICTIONS.pdf

    - All redactions in this document are made under FOIA Exemption U.S.C.552(b)(3) which exempts from disclosure "Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page." and FOIA Exemption U.S.C.552(b)(4) which exempts from disclosure "Information concerning business trade secrets or other confidential commercial or financial information is exempt."
    - 2 pages are released in entirety. 98 pages are fully redacted.

You have the right to file an administrative appeal if you are not satisfied with our response to your FOIA request. All appeals should include a statement of the reasons why you believe the FOIA response was not satisfactory. An appeal based on documents in this release must be received within 90 calendar days of the date of this response letter at the following address:

Assistant General Counsel for Employment, Litigation, and Information
U.S. Department of Commerce Room 5896
1401 Constitution Ave. NW
Washington, DC 20230

An appeal may also be sent by email to FOIAAppeals@doc.gov or by FOIAonline at https://foiaonline.gov.

For your appeal to be complete, it must include the following items:

- a copy of the original request,
- our response to your request,
- a statement explaining why the determination was in error; and
- "Freedom of Information Act Appeal" must appear on your appeal letter. It should also be written on your envelope, email subject line, or your fax cover sheet.

FOIA appeals posted to the email box, FOIAonline, or Office after normal business hours will be deemed received on the next business day. If the 90th calendar day for submitting an appeal falls on a Saturday, Sunday or legal public holiday, an appeal received by 5:00 p.m., Eastern Time, the next business day will be deemed timely.

FOIA grants requesters the right to challenge an agency's final action in federal court. Before doing so, an adjudication of an administrative appeal is ordinarily required.

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Fax: 301-837-0348
Toll-free: 1-877-684-6448

If you have questions regarding this correspondence please contact Maria Burke at maria.burke@noaa.gov or by phone at (202) 308-4959, or the NOAA FOIA Public Liaison Tony LaVoi at tony.lavoi@noaa.gov or by phone at (843) 740-1274. Please refer to your FOIA request tracking number DOC-NOAA-2022-000262 when contacting us.

Sincerely,

Mark S. Paese

Mark S. Paese
Deputy Assistant Administrator for
Satellites and Information Services

JOINT POLAR SATELLITE SYSTEM (JPSS)

FAILURE MODE EFFECTS ANALYSIS (FMEA)

CONTRACT NO. NNG10AZ13B
D.O. NNG15VE5D, CDRL MA 4-3

Date: September 1, 2017

Prepared by
ORBITAL ATK
Space Systems Group (SSG) – Gilbert
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REVISION HISTORY			
REV	DATE	REASON FOR CHANGE	SECTION(s) AFFECTED
-	08/05/2016	Production Release, RN43576	All
A	09/01/2017	Production Release, ECN084266	All

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LIST OF ACRONYMS

AC	Alternating Current
ACS	Attitude Control Subsystem
ADC	Analog to Digital Converter
AH	Amp Hour
AHI	Amp Hour Integrator
ALE	Address Latch Enable
APA	Antenna Pointing Assembly
ARM	Autonomous Redundancy Manager
ATMS	Advanced Technology Microwave Sounder
BBB	Battery Bus Board
BCB	Battery Control Board
BJT	Bipolar Junction Transistor
C&DH	Command and Data Handling
CB	Circuit Breaker
CBB	Cell Balancing Board
CBE	Cell Balancing Electronics
CC	Constant Current
CCB	Charge Control Board
CCHP	Constant Conductance Heat Pipe
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CIL	Critical Items List
CKT	Circuit
CMD	Command
COMM	Communication
cPCI	Compact Peripheral Component Interconnect
CPU	Central Processor Unit
CrIS	Cross-track Infrared Sounder
CSB	Current Sense Board
CSS	Coarse Sun Sensor
CTB	Command and Telemetry Board
CV	Constant Voltage

LIST OF ACRONYMS

DAC	Digital to Analog Converter
DC	Direct Current
DFB	Data Formatting Board
DID	Data Item Description
ECU	Electronic Control Unit
EEPROM	Electronically Erasable Programmable Read Only Memory
EGSE	Electrical Ground Support Equipment
EMF	Electromagnetic Field
EMI	Electromagnetic Interference
EOC	End of Charge
EPC	Electrical Power Converter
EPS	Electrical Power Subsystem
ESB or ESS	Essential Bus
ESD	Electrostatic Discharge
ETR	Electronic Torque Rod
FET	Field-Effect Transistor
FMC	Flash Memory Card
FMEA	Failure Modes and Effects Analysis
FPGA	Field Programmable Gate Array
FSW	Flight Software
GCE	Gimbal Control Electronics
GNC	Guidance, Navigation and Control
GN2	Gaseous Nitrogen
GPIO	General Purpose Input/Output
GPS	Global Positioning System
GPSR	Global Positioning System Receiver
GSFC	Goddard Space Flight Center
HIB	Harness Interface Box
HK	Housekeeping
HKPS	House Keeping Power Supply
HRT	High Rate Telemetry
IC	Integrated Circuit

LIST OF ACRONYMS

IEM	Integrated Electronics Module
I/F	Interface
I/O	Input/Output
IPCM	IEM Power Converter Module
JPSS	Joint Polar Satellite System
IEM	Integrated Electronics Module
IMU	Inertial Measurement Unit
LCB	Load Control Board
LED	Light Emitting Diode
LVDS	Low Voltage Differential Signal
MAR	Mission Assurance Requirements
MLI	Multi-layer Insulation
MOSFET	Metal Oxide Silicon Field Effect Transistor
NEB	Non-essential Bus
OBS	Observatory
OMPS	Ozone Mapping and Profiler Suite
PACI	Payload and Attitude Control Interface
PCM	Power Converter Module
PDE	Propulsion Drive Electronics
PDR	Preliminary Design Review
PDU	Power Distribution Unit
PIE	Payload Interface Electronics
POR	Power On Reset
PROM	Programmable Read Only Memory
PT	Pressure Transducer
PWM	Pulse Width Modulator
QPSK	Quadrature Phase Shift Keying
RAM	Read Only Memory
RBI	Radiation Budget Instrument
RIB	Redundancy Interface Board
RTD	Resistance Temperature Detector
RTS	Relative Time Sequence

LIST OF ACRONYMS

RWA	Reaction Wheel Assembly
RX	Receive
SA	Solar Array
SADA	Solar Array Drive Assembly
SARM	Solar Array Release Mechanism
SC	Spacecraft
SDRAM	Synchronous Dynamic Random Access Memory
SOC	State of Charge
SOH	State of Health
SPAM	SpaceWire and Memory
SPF	Single Point Failure
SpW	Spacewire
SRAM	Static Random Access Memory
SSG	Space Systems Group
STA	Star Tracker Assembly
STAT	Status
SUROM	Start up ROM
SV	Space Vehicle
SW	Software
TAM	Three-Axis Magnetometer
TBD	To Be Determined
TCS	Thermal Control Subsystem
TCXO	Temperature Controlled Crystal Oscillator
TDRSS	Tracking and Data Relay Satellite System
TIB	Thermal Interface Board
TLM	Telemetry
TOD	Time of Day
TSTAT	Thermostat
TTL	Transistor-Transistor-Logic
TWT	Traveling Wave Tube
TX	Transmit
UART	Universal Asynchronous Receiver-Transmitter

LIST OF ACRONYMS

UDL	Uplink/Downlink
V	Voltage
VCC	Common Collector Voltage
VCID	Virtual Channel Identification
VDC	Direct Current Voltage
VIIRS	Visible Infrared Imaging Radiometer Suite
VREF	Voltage Reference

1 INTRODUCTION

1.1 Purpose

This document contains the Failure Mode and Effects Analysis (FMEA) for the Joint Polar Satellite System (JPSS) Spacecraft Bus hardware and electrical subsystems. The FMEA provides insight into the overall reliability of the bus design by describing the effects of failure modes of the bus subsystems and components. The results of the FMEA are used to determine whether onboard flight software fault protection algorithms, hardware redundancy, or contingency mission operation procedures should be developed.

The Critical Items List (CIL) analysis provides a summary of selected hardware related items whose related failure modes can result in serious injury, loss of life (flight or ground personnel), loss of launch vehicle; or the loss of one or more mission objectives (when no redundancy exists) as defined by the Goddard Space Flight Center (GSFC) project office. Specific criteria for hardware being included in the CIL are contained within this report.

This FMEA & CIL report is intended to be a living document that will reflect changes being made throughout the development process.

1.2 Scope

The JPSS spacecraft bus FMEA looks at failure modes for each spacecraft subsystem and major component at a functional level. The analysis is based on the JPSS Spacecraft bus design at Spacecraft Critical Design Review (CDR).

1.3 MA 4- 3 Compliance Matrix

This document is intended to meet the criteria of MA 4-3 in the JPSS-2 Contract Data Requirements List (CDRL), Rapid III Satellite RFO Attachment D. Table 1-1 contains the compliance matrix showing the Data Item Description (DID) section, Preparation Information and the section(s) where the information is located in this document.

Table 1-1. MA 4-3 Compliance Matrix

DID Section	Preparation Information	MA 4-4 Section(s)
1	The Contractor shall prepare and deliver a FMEA, in accordance with GSFC FAP P-322-208, which includes the following:	All
1a	Approach on the analysis, methodologies, assumptions, results, conclusions, and recommendations	3 and 4
1b	Objectives	1.1 and 3.1
1c	Level of the analysis	1.2 and 3.1
1d	Ground rules and assumptions	3.2
1e	Functional description	5
1f	Functional block diagrams	5
1g	Reliability block diagrams	3.4
1h	Equipment analyzed	5

Table 1-1. MA 4-3 Compliance Matrix

DID Section	Preparation Information	MA 4-4 Section(s)
1i	Data sources used	4.1
1j	Problems identified	Appendix A Appendix B
1k	Single-point failure analysis, to include the root cause, mitigation, and retention rationale for those with severity categories 1, 1S, or 2	4.2
1l	Corrective actions	Appendix A Appendix B
1m	FMEA worksheets identifying failure modes, causes, severity category, and effects at the item, next higher level, and mission level, detection methods, and mitigating provisions	Appendix A Appendix B
1n	CIL for severity categories 1, 1R, 1S, 2, and 2R, including item identification, cross-reference to FMEA line items, and retention rationale. Appropriate retention rationale includes design features, historical performance, acceptance testing, manufacturing product assurance, elimination of undesirable failure modes, and failure detection methods	4.2 Appendix A Appendix B

1.4 MA 4- 3 Requirements Verification

The following requirements as shown in Table 1-2 are verified within this analysis/document/report.

Table 1-2. MA 4-3 Requirements Verification

Req. ID	Requirement	MA 4-3 Section(s)
J-MAR-158	The Contractor shall perform a FMEA and prepare and maintain a CIL for severity categories 1, 1R, 1S, 2, and 2R per Table 4.1 (CDRL MA 4-3).	4.1 4.2 Appendix A Appendix B
J-FM-88	A single fault occurring on the A or B side of the command, power, and telemetry path shall not propagate to the redundant system.	4.1 4.2 Appendix A Appendix B
J-ACS-902	The ACS shall be designed such that no single credible failure permanently precludes the Spacecraft from meeting the requirements defined in the SPS throughout the mission design life.	4.1 4.2 Appendix A Appendix B
J-ACS-903	The ACS shall be designed so that there are no credible single-point failures at the component/box level, where “credible” is defined as	4.1 4.2

Table 1-2. MA 4-3 Requirements Verification

Req. ID	Requirement	MA 4-3 Section(s)
	having a probability of occurrence greater than 0.01% at end of lifetime.	Appendix A Appendix B
J-ACS-904	ACS redundant systems shall be independent, such that failure of one component or command path does not propagate to the other component or command path.	4.1 4.2 Appendix A Appendix B
J-SMS-151	All SMS single point failures that prevent functional capability or meeting mission performance requirements of the Observatory shall be designed so that there are no credible single point failures at the component level where "credible" is defined as having a probability of occurrence greater than .01% at end of lifetime, all SMS single point failures shall be identified, and the risk associated with each shall be characterized, managed, and tracked.	4.1 4.2 Appendix A Appendix B

2 APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable Documents

Unless otherwise specified, the following documents in their current issue form a part of this document to the extent specified herein.

2.1.1 Orbital ATK Documents

a. None

2.1.2 Government Documents

a. GSFC FAP P-322-208 (Draft) Standard for Performing a Failure Mode and Effects Analysis (FMEA) and Establishing a Critical Items List (CIL)

2.1.3 Other Documents

a. None

2.2 Reference Documents

The documents listed contain useful facts or are recommended for additional information.

2.2.1 Orbital ATK Documents

a. TO-GR1031 Reliability Assurance Documentation Requirements

b. 6470-AR23B02 Reliability Assessment and Prediction

c. 6470-HP43400 Battery Handling Plan

d. 6470-ER43400 RFA 7 Battery Cell-Short Response

e. LEO3-AR23600 Critical Item Control Plan

2.2.2 Government Documents

a. None

2.2.3 Other Documents

a. None

3 [redacted]

Pages 14 - 16 are redacted under Exemptions (b)(3) and (b)(4).

[redacted]

Exemption 3: Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page.
Exemption 4: Information concerning business trade secrets or other confidential commercial of financial information is exempt.

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4 FMEA RESULTS

4.1 FMEA Data and Worksheets

Appendix A and Appendix B provide a complete set of FMEA worksheets for the JPSS spacecraft systems in which all detailed data required to conduct a FMEA are tabulated. The component FMEAs are the source of the data collected for this FMEA. The columns of the worksheets contain the following information.

a. ID Number - Unique identifier for each failure mode evaluated. Enter in numerical order.

b. Functional Block - Unique identifier for each functional failure. Usually the subsystem name.

c. Item and Function - Unique equipment or equipment's identifier with a brief description.

d. Failure Mode - Identify the specific failure mode.

e. Failure Effects - List failure effect for each of the hardware levels being considered. List in column for Local Level, Next Higher Level, and Mission Level:

f. Local Level: Enter a brief description of the failure effect at the component level.

g. Next Higher Level: Enter the failure effect at the next assembly level above the component.

h. System or Mission Level: Enter the effect of the failure mode on the mission. If the failure has no effect, enter None.

i. Fault Detection Method: Enter how the failure would be detected in the data.

j. Fault Recovery Method/Approach: Enter redundant or work around features in the design.

k. Severity Classification: Assign a criticality classification number as defined in Section 3.3.

l. Include in CIL?: Used to indicate if the associated row is included in the CIL

m. Rational for Retention: Used to list the reasons why the failure mode is retained in the design (i.e. historically reliable part, design life, Trade study etc.). This column is only filled out if “Include in CIL” indicates “Yes”.

n. Mitigation Plan: Used to list specific plans and processes to insure the failure mode likelihood is minimized (i.e. testing, inspection, analysis etc.). This column is only filled out if “Include in CIL” indicates “Yes”.

4.2 Critical Items List

4.2.1 Critical Items List (CIL) Requirements

As required per Section 4.3 of the Mission Assurance Requirement (MAR) for JPSS, a Critical Items List (CIL) must be provided in conjunction with the FMEA to itemize all potential catastrophic or critical failure items that meet the criteria in the following Section 4.2.2. The CIL provides a listing of failure ID number, function, failure mode, severity classification, mitigation, and justification for the item retention.

4.2.2 Critical Items List Criteria

The JPSS CIL comprises items meeting the following criteria:

a. FMEA line items with severity categories 1, 1R, 1S, 2 and 2R shall be placed on the CIL. Severity category 2R items with the failure cause of random EEE Part Failure and a likelihood of occurring during the mission less than 0.01% are not required to be included in the CIL as these items, in addition to the mitigations provided through redundancy, receive thorough vetting from the Parts Control Board.

b. Line items with a severity category of 1, 1S, or 2 are considered single point failures.

Table 4-1 contains the CIL items with severity categories of 1, 1R, 1S and 2. The CIL items with severity categories of 2R are not listed in this table. These CIL items can be found by looking at the "Include in CIL?" column in Appendix A and Appendix B.

Pages 19 - 38 are redacted under Exemptions (b)(3) and (b)(4).

Exemption 3: Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page.
Exemption 4: Information concerning business trade secrets or other confidential commercial or financial information is exempt.

APPENDIX A.

REDUCED FAILURE MODE AND EFFECTS ANALYSIS WORKSHEETS

Pages 57 - 244 are redacted under Exemptions (b)(3) and (b)(4).

Exemption 3: Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page.
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APPENDIX B.

NOT REDUCED FAILURE MODE AND EFFECTS ANALYSIS WORKSHEETS

Pages 246 - 647 are redacted under Exemptions (b)(3) and (b)(4).

Exemption 3: Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page.
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JOINT POLAR SATELLITE SYSTEM (JPSS)

RELIABILITY ASSESSMENT AND PREDICTION

CONTRACT NO. NNG10AZ13B,

D.O. NNG15VE05D, CDRL MA 4-7

Date: May 10, 2018

Prepared by

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RELEASED BY:	CONFIGURATION/DATA MANAGEMENT	JILL PETERSON

REVISION HISTORY			
REV	DATE	REASON FOR CHANGE	SECTION(s) AFFECTED
-	06/27/2016	Production Release (I-PDR) Ref RN39596	All
A	10/19/2017	Ref ECN095369; Updated to incorporate final design changes, results and related items CDR update with revised Reliability model, assumptions, part stress failure rates provided by vendors, and internal Orbital ATK parts stress predictioin based on the WCA/thermal analysis for nominal operating conditions	All
B	05/10/2018	Ref ECN120848; Added Spacecraft Thermal Analysis to Applicable Document section along with the Subsystem level thermal analysis (CBE, IEM, PDU, and PIE). Incorporated section explaining the delta between the early version of the spacecraft thermal model used for the reliability analysis and the results presented at CDR. Added the PIE failure rates and updated results for JPSS IEM/PDU WQS model based on comments received from the customer.	All

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ACRONYMS/ABBREVIATIONS

ACS	Attitude Control System
ATMS	Advance Technology Microwave Sounder
BBB	Battery Bus Board
BCB	Balancing Control Board
BPF	Bandpass Filter
C&DH	Command and Data Handling
CBB	Cell Balancing Board
CBE	Cell Balancing Electronics
CCB	Charge Control Board
CMD	Command
CTB	Command Telemetry Board
cPCI	Compact Peripheral Component Interconnect
CPU	Central Processing Unit
CDRL	Contract Data Requirements List
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DID	Data Item Description
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ETR	Electron Torque Rod
FIT	Failure In Time
FMEA	Failure Modes Effects Analysis
FMC	Flash Memory Card
GCE	Gimbal Control Electronics
GPIO	General Purpose Input/Output
GPS	Global Positioning System
GSE	Ground Support Equipment
HIB	Harness Interface Box
HRD	High Rate Data
ICESat-2	Ice, Cloud, and Land Elevation Satellite
IEM	Integrated Electronics Module
IMU	Inertial Measurement Unit

ACRONYMS/ABBREVIATIONS

IPCM	IEM Power Converter Module
JPSS	Joint Polar Satellite System
LCB	Load Control Board
LDCM	Landsat Data Continuity Mission
Li	Lithium
MAIP	Mission Assurance Implementation Plan
MAR	Mission Assurance Requirement
MIMU	Miniature Inertial Measurement Unit
MLI	Multi-Layer Insulation
OMPS	Ozone Mapping and Profile Suite
PACI	Payload and Attitude Control Interface
PDE	Propulsion Drive Electronics
PDR	Preliminary Design Review
PIE	Payload Interface Electronics
Ps	Probability of Success
PSL	Parts Selection List
RBD	Reliability Block Diagram
RBI	Radiation Budget Instrument
REA	Rocket Engine Assembly
RIB	Redundancy Interface Board
RFO	Request for Offer
RWA	Reaction Wheel Assembly
SADA	Solar Array Drive Assembly
SADE	Solar Array Drive Electronics
SC	Spacecraft
SEMP	System Engineering Management Plan
SF	Spaceflight
SNPP	Suomi National Polar-orbiting Partnership
SPAM	Spacewire And Memory
SpW	Space Wire
SRD	Satellite Requirements Document
SSG	Space Systems Group
STA	Star Tracker Assembly
TAM	Three Axis Magnetometer
TBD	To Be Determined
TCS	Thermal Control Subsystem

ACRONYMS/ABBREVIATIONS

TDRSS	Tracking & Data Relay Satellite System
TIB	Telemetry Interface Board
TLM	Telemetry
TWT	Traveling Wave Tube
TWTA	Traveling Wave Tube Amplifier
UDL	Uplink/Downlink
VIIRS	Visible Infrared Imaging Radiometer Suite

1 INTRODUCTION

1.1 General

This report presents the Reliability Assessment and Prediction for Joint Polar Satellite System (JPSS). This document was prepared in accordance with paragraph 3.6.2, 4.4, and 4.7.6 of the JPSS System Requirements Document, 4.7 of the JPSS Mission Assurance Requirement (MAR) and Data Item Description (DID) DID 4-7, the JPSS Mission Assurance Implementation Plan (MAIP), and the JPSS System Engineering Management Plan (SEMP) .

1.2 Scope

The JPSS Reliability Assessment and Prediction Report provides a numerical assessment of reliability using parts stress methods for the baseline physical and functional configuration of the JPSS spacecraft..

1.3 Compliance Matrix

This document is intended to meet the criteria of MA 4-7 in the JPSS-2 Contract Data Requirements List (CDRL), Rapid III Satellite Request for Offer (RFO) Attachment D. Table 1-3 contains the compliance matrix showing the Data Item Description (DID) section, Preparation Information and the section(s) where the information is located in this document.

Table 1-3. MA 4-7 Compliance Matrix

DID Section	Preparation Information	MA 4-7 Section(s)
1a	Methodology and results of comparative reliability assessments including mathematical models	4.0
1b	Reliability block diagrams	Appendix A Appendix B
1c	Component failure rates, data source, temperature the failure rate is derived at, and MTBF	Appendix C Table 4-1
1d	Reliability Model (in Excel, Relex, or equivalent form), built from lowest component/subsystem level as practicable, that is used to generate the reliability prediction computation	4.0 Appendix D
1e	Failure definitions	5.4
1f	Degraded operating modes	5.5
1g	Trade offs	5.6
1h	Assumptions	4.0
1i	Any other pertinent information used in the assessment process	N/A-none
1j	Discussion to show reliability was considered as a discriminator in the design process	5.7

1.4 Requirements Verification

Table 1-2 identifies the requirements verified by this document and where the detailed information demonstrating compliance can be found.

Table 1-2. Reliability Requirements

Requirement ID	Requirement Description	MA 4-3 Section(s)
MAR-170	MAR-170 The Contractor shall perform comparative numerical reliability assessments and reliability predictions (CDRL MA 4-7) to demonstrate reliability performance.	4.0
MAIP-1397	MAIP-1397 Reliability Analysis and Prediction shall be performed for components as defined in the JPAR.	4.0 Appendix C
MAIP-1396	MAIP-1396 A SC level Reliability Assessments and Prediction Report (CDRL MA 4-7) shall be prepared and delivered in accordance with IEEE Standard Methodology for Reliability Prediction and Assessment for Electronic Systems and Equipment, Std 1413, and will include the following: a. Methodology and results of comparative reliability assessments including mathematical models b. Reliability block diagrams c. Component failure rates, data source, temperature the failure rate is derived at, and MTBF d. Reliability Model (in excel, Relex, or equivalent form), built from lowest component/subsystem level as practicable, that is used to generate the reliability prediction computation e. Failure definitions f. Degraded operating modes g. Trade-offs h. Assumptions i. Any other pertinent information used in the assessment process j. Discussion to show reliability was considered as a discriminator in the design process	4.0 5.0 Appendix C
ACS-898	ACS-898 The ACS shall meet all requirements at the completion of a 7-year on-orbit mission life.	5.0
ACS-899	ACS-899 The ACS shall meet all requirements, at the completion of a Ground Storage Phase lasting 5 years.	5.0
ACS-410	ACS-410 The ACS shall be designed for an overall Probability of Success of at least 0.9800 at the end of the specified mission life. Table ACS-456 shows the ACS component reliability allocations.	5.0 Appendix A

Table 1-2. Reliability Requirements

Requirement ID	Requirement Description	MA 4-3 Section(s)
ACS-116	ACS-116 The ACS shall be designed for a Probability of Success for controlled re-entry of at least 0.989 at the end of the specified mission life. Table ACS-456 shows the ACS component reliability allocations.	5.0 Appendix A
CDH-210	CDH-210 The C&DH shall have a probability of success of at least 0.9750 at the end of mission design life.	5.0 Appendix A
CDH-211	CDH-211 The C&DH components necessary for controlled re-entry shall be designed for an overall Probability of Mission Success of at least 0.9800 at the end of the specified mission life (84 months).	5.0 Appendix A
CDH-216	CDH-216 The C&DH shall meet all design specifications for the 7-year design mission life.	5.0 Appendix A
EPS-837	EPS-837 The EPS components shall be designed for an overall Probability of Mission Success of 0.9350 or better at the end of design mission lifetime.	5.0 Appendix A
EPS-21	EPS-21 The EPS components necessary for controlled re-entry shall be designed for an overall Probability of Success of at least 0.9400 at the end of the specified mission life (84 months).	5.0 Appendix B
EPS-838	EPS-838 A Ps calculation shall be made at 10.5 years, the minimum required deorbit lifetime of the propulsion systems.	5.0 Appendix B
EPS-44	EPS-44 The EPS shall be designed such that there are no credible single point failures, where “credible” is defined as having a probability of occurrence greater than 0.01% at end of lifetime.	N/A JPSS FMEA
SMS-1142	SMS-1142 The SMS shall meet all mission requirements, including design lifetime at the completion of a Ground Storage Phase lasting 5 years. The equivalent operating time for the storage period to be used in reliability calculations is specified in Section 4.3.1.2 of 6470-PF23200.	5.0
JPAR-66	JPAR-66: The supplier shall calculate failure rates and a probability of success for the deliverable end item to demonstrate reliability performance as required by the product specification.	5.0 Appendix C
JPAR-67	JPAR-67: The standard used for performing reliability prediction shall be MIL-HDBK-217F, Notice 2, or an Orbital ATK approved alternate industry standard.	4.0

Table 1-2. Reliability Requirements

Requirement ID	Requirement Description	MA 4-3 Section(s)
JPAR-68	JPAR-68: The parts count methodology of MIL-HDBK-217F is acceptable for predictions made early in the design phase. For final design, a parts-stress reliability prediction shall be performed and submitted per the SOW (SDRL 057), using nominal thermal loads and operating conditions for all electronic circuits.	4.0
JPAR-69	JPAR-69: The mission average case temperature used in the reliability analysis shall be 35C unless specified in the PFS.	4.0
JPAR-71	JPAR-71: Reliability analysis shall include a reliability model (Reliability Block Diagram (RBD)).	Appendix A
JPAR-72	JPAR-72: Any changes to the design, part usage or environment shall require the reliability analysis to be updated and submitted per the SOW (SDRL 057) to Orbital ATK for review and approval.	TBD

1.5 Summary

The JPSS design exceeds the program reliability requirements.

1.6 Recommendations

None

1.7 Open Items

None

2 APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable Documents

The following documents provide guidelines from which program requirements are established. These documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue in effect at the time of contract award shall apply. In the event of conflict between the documents referenced herein and the detailed requirement contents of this plan, this plan supersedes any reference documents.

2.1.1 Orbital SSG-Gilbert Documents

a. 6470-QP22100 JPSS Mission Assurance Implementation Plan (MAIP)
b. 6470-PP23100 JPSS Systems Engineering Management Plan (SEMP)
c. 6470-A32B00 JPSS Spacecraft Failure Modes Effects Analysis (FMEA)
d. 6470-AR23B01 JPPS Fault Tree Analysis
e. 6470-AR42100 JPSS Spacecraft Thermal Model Report
f. 6470-AR44302 Payload Interface Electronics (PIE) Thermal Analysis
g. 6470-AR43302 Cell Balancing Electronics (CBE) Thermal Analysis

h. 6470-AR43202 Power Distribution Unit (PDU) Thermal Analysis
i. 6470-AR44202 Integrated Electronics Module (IEM) Analysis

2.1.2 Government Documents

a. Attachment B JPSS System Requirements Document Rev B
b. Attachment C Mission Assurance Requirements (MAR) Rev B

2.2 Reference Documents

The documents listed contain useful facts or are recommended for additional information.

2.2.1 Orbital SSG – Gilbert Documents

a. 6470-QP22100 JPSS Mission Assurance Implementation Plan
b. 6470-PP23100 JPSS System Engineering Management Plan

2.2.2 Government Documents

a. MIL-HDBK-217F2 Reliability Prediction of Electronic Equipment

2.2.3 Reference Documents

a. IEEE-Standard 1413 IEEE Guide for Selecting and Using Reliability Predictions Based on IEEE 1413

3 FUNCTIONAL DESCRIPTION OF JPSS SPACECRAFT BUS

The JPSS Mission consists of a Space Segment, Launch Segment, Ground Segment and external interfaces. The Space Segment, the primary concern of the Orbital ATK contract, includes the Spacecraft and instruments that are integrated to form the Satellite. The Launch Segment includes the launch vehicle and associated launch services. The Ground Segment includes the facilities and resources necessary to support the mission operations and data product generation. External interfaces include data consumers and other entities that provide resources required to support the JPSS Mission objectives, but are not necessarily controlled by the JPSS Program. The three JPSS spacecraft are planned to succeed both the currently operational Suomi National Polar-orbiting Partnership (SNPP) Mission and the planned JPSS-1 Mission in order to provide continuity of environmental sensing. The JPSS Mission objectives are to provide environmental sensing from a polar sun-synchronous orbit, generate calibrated/validated/geo-located data products that serve the meteorological and global climate change communities and provide real-time broadcast of environmental data to the distributed user community.

The Space Segment consists of the Spacecraft and the instruments, which are integrated together to form the Satellite and the pre-launch Ground Support Equipment (GSE). The Mission instrument complement includes the government furnished Advanced Technology Microwave Sounder (ATMS), Cross-Track Infrared Sounder (CrIS), Visible Infrared Imaging Radiometer Suite (VIIRS), Ozone Mapping and Profile Suite (OMPS) and Radiation Budget Instrument (RBI) instruments. Instrument data are acquired continuously, stored on-board the Spacecraft and subsequently down-linked to a ground network for capture, preprocessing and routing to product processing and distribution centers. Orbital ATK provides its LeoStar-3 spacecraft modified to host the mission instruments and to meet the requirements of the Delivery Order. A block diagram is provided in Figure 3-1.

Pages 13-47 of this document are redacted under Exemptions (b)(3) and (b)(4).

Exemption 3: Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption are available on the Department of Justice FOIA Resources page.

Exemption 4: Information concerning business trade secrets or other confidential commercial or financial information is exempt.

Ball Aerospace & Technologies Corp.

February 26, 2016
C&DM.33815.16.016

JPSS-1 Observatory Manager.COTR
Mail Code 472
JPSS Flight Project Office
NASA.Goddard Space Flight Center
Green, MD 20771
.

Attention: Heidi Wood (DM Lead)

Subject: Document Transmittal of CDRLs

Reference: NNG10AZ45D – JPSS-1 Contract

Heidi:

In accordance with the **JPSS-1 Rapid III Satellite RFO Attachment D CDRL**, 472-00006, this is a formal and contractual transmittal which satisfies the Contractual Data Requirement Document (CDRL).

COPY OF RECORD

CDRL No.	Document No.	Rev	Title/Description	Submission Category
MA 4-3	2396799	C	JPSS-1 Failure Modes Effect Analysis & Critical Items List (CIL)	Information

This CDRL is provided for your information only.

Sincerely,

Faith Sexson-Rayl

Faith Sexson-Rayl
JPSS-1 Principal Configuration Engineer
Ball Aerospace & Technologies Corp.
Operational Space Systems
Mail Stop RA-6

FSR

cc: Bill Bolingbroke (CO)
cc: John Deily (COTR)
cc: Shelly Williams (DMO)
cc: Dave Ward

Pages 2 - 41 are redacted under Exemptions (b)(3) and (b)(4).

Exemption 3: Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page.

Exemption 4: Information concerning business trade secrets or other confidential commercial or financial information is exempt.

[redacted]

Ball Aerospace
& Technologies Corp.

March 26, 2014
C&DM.33815.14.027

JPSS-1-1 Observatory Manager.COTR
Mail Code 472
JPSS Flight Project Office
NASA.Goddard Space Flight Center
Green, MD 20771

Attention: Heidi Wood (DM Lead)

Subject: Document Transmittal of CDRLs

Reference: NNG10AZ45D – JPSS-1 Contract

Heidi:

In accordance with the **JPSS-1 Rapid III Satellite RFO Attachment D CDRL**, 472-00006, this is a formal and contractual transmittal which satisfies the Contractual Data Requirement Document (CDRL).

CDRL No.	Document No.	Rev	Title/Description	Action Req'd
MA 4-7	2396906	B	JPSS-1 Reliability Assessments and Predictions	Information

This CDRL is provided for your information only and is closed.

Sincerely,

Faith Sexson-Rayl

Faith Sexson-Rayl
JPSS-1 Sr. Configuration Engineer
Ball Aerospace & Technologies Corp.
Operational Space Systems
Mail Stop RA-6

FSR

cc: Bill Bolingbroke (CO)
cc: Bill Anselm (COTR)
cc: Shelly Williams (DMO)

Pages 2-3 are redacted under Exemptions (b)(3) and (b)(4).

Exemption 3: Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page.

Exemption 4: Information concerning business trade secrets or other confidential commercial or financial information is exempt.

REVISION RECORD

Revision	Date	Reason for Revisions	Agile RELEASED
1	1/8/2012	Draft Release	See Agile
A	2/12/2013	Added 5 year mission duration calculations to analysis per GSFC review. The summary is in Table 9. Revision details added to GSFC review and attached to the submittal as Attachment 13. Added equation 7 and 8 for the common cause modeling per GSFC review. Updated PCDU Reliability Model for Rev B of the PCDU prediction. Updated Attachment A8 for EPDS analysis. Updated Attachment A9 for the spacecraft bus RBD.	See Agile
B	3/19/2014	Updated supplier analysis and replace heritage data with the latest prediction numbers. Incorporate GSFC revision A review comments into the Prediction. Add the JPSS-1 harness Reliability Model and reliability numbers to the prediction.	See Agile

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Exemption 3: Information prohibited from disclosure by another federal law. Additional resources for invoking Exemption 3 are available on the Department of Justice FOIA Resources page.

Exemption 4: Information concerning business trade secrets or other confidential commercial or financial information is exempt.

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