

Safety Review Process

International Space Station Program

Revision F

February 2015



National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
Houston, Texas Contract No.: NNJ12GA46C

REVISION AND HISTORY PAGE

REV.	DESCRIPTION	PUB. DATE
-	Baseline Issue (Reference SSCBD BB003229B EFF.)	10-93
A	Revision A (SSDBD 000085 EFF. 05-05-95) No cost change – ECP 85)	6-15-95
B	Revision B (Reference per SSCD 003405, EFF. 01-07-02)	02-13-02
C	Revision C (Reference per SSCD 007558, EFF. 07-08-04)	12-05-05
D	Revision D (Reference per SSCD 009840, EFF. 10-24-06) Early Released	11-01-06
	Program Released	11-16-09
E	Revision E (Reference per SSCD 011243, EFF. 07-20-09)	11-16-09
	DCN 001 (Reference per SSCD 011760, EFF. 11-06-09)	11-23-09
	DCN 002 (Reference per SSCD 012751, EFF. 05-18-11)	07-12-11
F	Revision F (Reference per SSCD 13547, EFF. 04-22-15)	10-28-15

PREFACE

SAFETY REVIEW PROCESS

The contents of this document are intended to be consistent with the tasks and products to be prepared by Program participants. SSP 30599 shall be implemented on all new International Space Station (ISS) contractual and internal activities and shall be included in any existing contracts through contract changes. This document is under the control of the Space Station Control Board and any changes or revisions will be approved by the Program Manager unless change authority is delegated to a lower level board/panel.



Michael Suffredini
Manager, International Space Station Program
National Aeronautics and Space Administration

4/22/2015
Date

INTERNATIONAL SPACE STATION PROGRAM

SAFETY REVIEW PROCESS

CONCURRENCE

FEBRUARY 2015


Concurred by: Delfina Bertolotto ASI
MANAGER, UNITA VOLO UMANO SPAZIALE, ORG
AGENZIASPAZIALE ITALIANA

See Directive Approval 07/08/15
SIGNATURE DATE


Concurred by: Bernardo Patti ESA
HEAD OF ISS PROGRAMME, AND EXPLORATION ORG
DEPARTMENT DIRECTORATE OF HUMAN
SPACEFLIGHT AND OPERATIONS, EUROPEAN
SPACE AGENCY

See Directive Approval 06/03/15
SIGNATURE DATE

Concurred by: Pierre Jean CSA
DIRECTOR, SPACE EXPLORATION OPERATIONS ORG
INFRASTRUCTURE,
PROGRAM MANAGER CANADIAN SPACE STATION
PROGRAM, CANADIAN SPACE AGENCY


SIGNATURE 21 MAY 2015
DATE

Concurred by: Masazumi Miyake JAXA
SPACE STATION PROGRAM MANAGER, OFFICE OF ORG
SPACE FLIGHT AND OPERATIONS, JAPAN
AEROSPACE EXPLORATION AGENCY

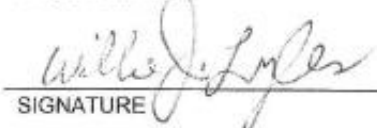

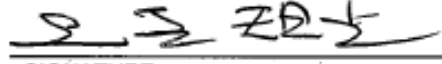

SIGNATURE 8/4/2015
DATE

INTERNATIONAL SPACE STATION PROGRAM

SAFETY REVIEW PROCESS

CONCURRENCE

FEBRUARY 2015

Concurred by:	<u>Willie Lyles</u> MANAGER, ISSP SAFETY AND MISSION ASSURANCE/ PROGRAM RISK	<u>NASA</u> ORG
	<u></u> SIGNATURE	<u>4/6/15</u> DATE
Concurred by:	<u>Victor Chang</u> CANADIAN SPACE AGENCY	<u>CSA</u> ORG
	<u></u> SIGNATURE	<u>28 MAR, 2015</u> DATE
Concurred by:	<u>Norimitsu Kamimori</u> JAPAN AEROSPACE EXPLORATION AGENCY	<u>JAXA</u> ORG
	<u></u> SIGNATURE	<u>6-30-2015</u> DATE
Concurred by:	<u>Rosario Nasca</u> EUROPEAN SPACE AGENCY	<u>ESA</u> ORG
	<u>See Directive Approval</u> SIGNATURE	<u>06/03/15</u> DATE
Concurred by:	<u>Not Applicable</u> ROSCOSMOS	<u>ORG</u>
	<u>SIGNATURE</u>	<u>DATE</u>

INTERNATIONAL SPACE STATION PROGRAM

SAFETY REVIEW PROCESS

CONCURRENCE

FEBRUARY 2015

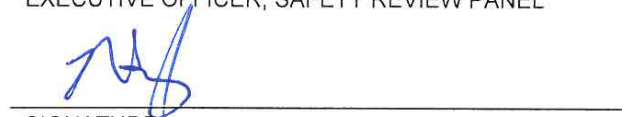
Prepared by: Mirka C. Caro NASA
SAFETY PANEL ENGINEER ORG



SIGNATURE

March 06, 2015
DATE

Prepared by: Richard W. Guidry NASA
EXECUTIVE OFFICER, SAFETY REVIEW PANEL ORG



SIGNATURE

March 5, 2015
DATE

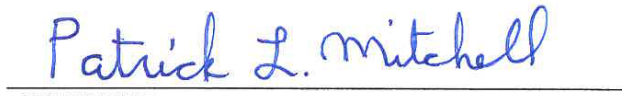
Prepared by: Teresa K. Tan NASA
SAFETY PANEL ENGINEER ORG



SIGNATURE

March 6, 2015
DATE

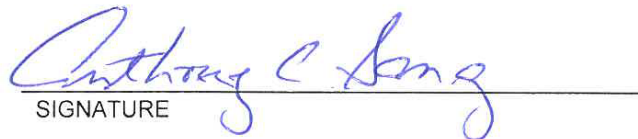
Supervised by: Patrick L. Mitchell NASA
EXECUTIVE OFFICER, SAFETY REVIEW PANEL ORG



SIGNATURE

03/06/2015
DATE

Supervised by: Anthony C. Sang NASA
CHAIR, SAFETY REVIEW PANEL ORG



SIGNATURE

5 Mar 2015
DATE

INTERNATIONAL SPACE STATION PROGRAM

SAFETY REVIEW PROCESS

CONCURRENCE

FEBRUARY 2015

Concurred by:

Kevin Mellett
CHAIR, GROUND SAFETY REVIEW PANEL

NASA
ORG


SIGNATURE

6 May 15
DATE

Concurred by:

Michael R. Surber
ISS SAFETY MANAGER

NASA
ORG


SIGNATURE

4/6/2015
DATE

MAPI DQA:

Delegated Representative
DATA MANAGEMENT

NASA
ORG


SIGNATURE

3/7/15
DATE

TABLE OF CONTENTS

PARAGRAPH		PAGE
1.0	INTRODUCTION	1-1
1.1	PURPOSE	1-1
1.2	SCOPE	1-2
1.3	PRECEDENCE.....	1-2
1.4	DELEGATION OF AUTHORITY	1-2
1.5	WAIVER/DEVIATIONS.....	1-2
1.6	APPENDICES	1-2
2.0	DOCUMENTS	2-1
2.1	APPLICABLE DOCUMENTS.....	2-1
2.2	REFERENCE DOCUMENTS	2-3
3.0	RESPONSIBILITIES.....	3-1
3.1	NASA SAFETY REVIEW PANEL.....	3-1
3.2	<END ITEMS> PROVIDERS.....	3-2
3.2.1	ISS SAFETY INTEGRATION	3-2
3.3	INTERNATIONAL PARTNERS	3-2
3.3.1	SAFETY REVIEW PANEL.....	3-2
3.3.2	<END ITEMS> PROVIDER	3-2
3.4	TRANSPORT VEHICLES CARGO SAFETY AND GROUND SAFETY	3-3
3.4.1	INTERNATIONAL PARTNER TRANSPORT VEHICLES	3-3
3.4.2	COMMERCIAL RESUPPLY SERVICE (CRS) TRANSPORT VEHICLES.....	3-3
3.4.3	TRANSPORT VEHICLE GROUND SAFETY	3-4
3.4.3.1	CENTRE SPATIAL GUYANAIS.....	3-4
3.4.3.2	TANEGASHIMA SPACE CENTER.....	3-4
3.4.3.3	BAIKONUR COSMODROME	3-4
3.4.3.4	COMMERCIAL RESUPPLY SERVICE (CRS) LAUNCH SITES.....	3-4
3.4.3.5	NASA WALLOPS FLIGHT FACILITY	3-4
4.0	ISS SAFETY REVIEW PROCESS	4-4
4.1	SAFETY REVIEW OBJECTIVES	4-2
4.2	TYPES OF MEETINGS	4-3
4.3	SAFETY REVIEW MEETINGS AND AGENDA	4-4
4.4	SAFETY REVIEW DATA LOGISTICS.....	4-5
4.4.1	SUBMITTAL OF PROPRIETARY OR LIMITED RIGHTS DATA	4-6
4.4.2	SUBMITTAL OF COPYRIGHTED DATA.....	4-7
4.4.3	SUBMITTAL OF TRANSLATED DATA	4-7
4.4.4	EXPORT CONTROL	4-7
4.4.4.1	U.S. <END ITEMS> PROVIDERS.....	4-8
4.4.4.2	IP <END ITEMS> PROVIDERS	4-8
4.5	HAZARD REPORTS	4-8
4.5.1	HAZARD REPORTS AND NON-COMPLIANCE REPORT DISPOSITION	4-9
4.6	SAFETY REVIEW COMPLETION.....	4-10
4.7	YELLOW TAG PROCESS.....	4-11

SSP 30599
Revision F

4.8	CERTIFICATION FOR GROUND PROCESSING	4-11
4.9	CERTIFICATION OF FLIGHT READINESS	4-11
4.10	<END ITEMS> CATEGORIES	4-11
4.10.1	CARGO CLASSIFICATIONS	4-12
4.10.1.1	CATEGORY 1, IP-TO-IP CARGO FLIGHT SAFETY PROCESS	4-12
4.10.1.2	CATEGORY 2, IP-TO-IP CARGO FLIGHT SAFETY PROCESS	4-13
4.10.2	COMMERCIAL OFF THE SHELF (COTS)	4-13
4.10.3	SERIES/REFLOWN <END ITEMS>	4-13
4.11	ISS_OE_906, FLIGHT SAFETY CERTIFICATE	4-13
4.12	SIMPLIFIED GROUND SAFETY REVIEW PROCESS	4-14
5.0	PHASED SAFETY REVIEW PROCESS	5-1
5.1	SAFETY REVIEW PHASING AND SCHEDULES	5-1
5.2	GENERAL REQUIREMENTS FOR ALL PHASES	5-2
5.3	PHASE 0 TECHNICAL INTERCHANGE MEETING DATA REQUIREMENTS	5-2
5.4	PHASE I SAFETY REVIEW	5-3
5.4.1	PHASE I DATA REQUIREMENTS	5-3
5.5	PHASE II SAFETY REVIEW	5-4
5.5.1	PHASE II DATA REQUIREMENTS	5-4
5.6	PHASE III SAFETY REVIEW	5-5
5.6.1	PHASE III DATA REQUIREMENTS	5-5
5.6.2	INTEGRATED HAZARD ASSESSMENTS	5-7
5.7	SAFETY VERIFICATION TRACKING LOG	5-8
5.8	POST PHASE III ACTIVITIES	5-8
5.8.1	GROUND SAFETY POST PHASE III CHANGES	5-9
5.8.2	ON-ORBIT RECONFIGURATION	5-9
5.8.3	NEAR REAL-TIME/REAL-TIME FLIGHT SAFETY REVIEW PROCESSES AND COORDINATION	5-9
6.0	NONCOMPLIANCE WITH ISS SAFETY REQUIREMENTS	6-1
6.1	NONCOMPLIANCE DEVELOPMENT AND PROCESSING	6-1
6.2	EFFECTIVITY OF SAFETY NCRS	6-2
7.0	SERIES AND REFLOWN EQUIPMENT	7-1
7.1	SIMPLIFIED SERIES/REFLIGHT CERTIFICATION (SSRC) PROCESS	7-2
8.0	TRANSPORT VEHICLE UNIQUE PROCESS REQUIREMENTS	8-1
8.1	<END ITEMS> PLANNED FOR RETURN	8-1
8.2	<END ITEMS> PLANNED FOR DISPOSAL	8-2

APPENDIX

A	ACRONYMS AND ABBREVIATIONS	A-1
B	GLOSSARY OF TERMS	B-1
C	OPEN WORK	C-1
D	LIST OF FORMS	D-1
E	ISS IP SAFETY CERTIFICATION DATA EXCHANGE FLOWCHART	E-1
F	SAFETY DATA SUBMITTAL	F-1
G	SUMMARY OF SAFETY REVIEW PROCESS	G-1
H	PHASE I (FLIGHT) TECHNICAL DATA SUBMITTAL	H-1

SSP 30599
Revision F

I	PHASE II (FLIGHT) TECHNICAL DATA SUBMITTAL	I-1
J	PHASE III (FLIGHT/GROUND) TECHNICAL DATA SUBMITTAL.....	J-1
K	EQUIVALENT SAFETY POLICY LETTER	K-1
L	EXAMPLE PRESSURE SYSTEM COMPLIANCE TABLE	L-1
M	NEW PROPELLANT DATA SUBMITTAL REQUIREMENTS	M-1
N	COMMERCIAL CREW PROGRAM APPLICABILITY	N-1

TABLE

3.4.1-1	IP TRANSPORT VEHICLES SAFETY DOCUMENTS	3-3
8.0-1	RETURN/DISPOSAL SAFETY ASSESSMENTS APPLICABILITY	8-1
C-1	TO BE DETERMINED ITEMS	C-1
C-2	TO BE RESOLVED ISSUES	C-1

1.0 INTRODUCTION

The International Space Station (ISS) Program has developed a safety review process to execute its responsibilities for the overall integrated safety of the ISS. This process will assess the design and operations of the ISS hardware/elements (including visiting vehicles during integrated ISS operations) and its ground support equipment in accordance with the applicable safety requirements as specified in Section 2.0.

The safety review process is required for all ISS hardware/elements (inclusive of Contractor Furnished Equipment (CFE) and Government Furnished Equipment (GFE)), its ground support equipment, payload/science hardware, and visiting vehicles, denoted here within as <END ITEMS>. This process includes a phased safety review process that assures that ISS safety requirements are incorporated into the ongoing design activities and covers all ISS mission phases. The phased safety review process contained in this document is consistent with the tasks and products agreed to by the National Aeronautics and Space Administration (NASA) and ISS International Partners (IPs) as specified in the appropriate ISS Program requirements and agreements. This document addresses preparation, maintenance, and reporting requirements of the safety analyses in support of the safety reviews.

As human spaceflight has expanded to multinational activities through the cooperation in the ISS Program, the ISS Program recognizes the responsibility and experience of the International Partner (IP) Safety Organizations, and it is appropriate that the safety review panel function not be limited to a single United States (U.S.) panel only. In some cases, the ISS Program has developed agreements of internal IP safety organization methodologies and processes that meet or exceed the standards of the NASA safety review panel and assure the safe implementation of the requirements dictated within this document. Such agreements are documented in appropriate ISS Program Charters, Memorandums of Arrangement or Agreement and/or other documented agreements, as applicable.

1.1 PURPOSE

This document defines the safety review process for ISS <END ITEMS>. The flight and ground safety review panel strive to address ISS safety review responsibilities as part of a single integrated process that covers all aspects of the <END ITEMS> project's life cycle, per NPR 7123.1B, NASA Systems Engineering Processes and Requirements, and NPR 8715.3C, NASA General Safety Program Requirements.

This document also accomplishes the following:

- Defines the safety reviews necessary to comply with the system safety requirements that are applicable to design, flight operations, return and disposal, Ground Support Equipment (GSE) design, and ground operations.
- Identifies the required content of the Safety Data Package (SDP).
- Describes preparation for and conduct of the safety review.
- Establishes the timeline for data submittal and establishes the depth of detail required for the various submittals.

SSP 30599
Revision F

- Provides guidance to the <END ITEMS> provider on the proper flight hardware, software, and firmware design to comply with the safety requirements.
- Explains safety review process variations.
- Defines the series/reflow safety review process.

1.2 SCOPE

This document defines the process to assess compliance with the ISS technical safety requirements. The ISS safety reviews are conducted to review and assess the safety hazards related to the design, operations, and functional capabilities of ISS <END ITEMS> and associated ground support equipment. <END ITEMS> shall be assessed to the applicable processing/launch site requirements, transport vehicle requirements, ISS requirements, and/or IP segment specification, as applicable. The applicability of this document to the Commercial Crew Program (CCP) is captured in Appendix N and CCT-PLN-1120.

1.3 PRECEDENCE

This document shall take precedence over any pre-existing requirements of SSP 30599 and NSTS/ISS 13830, Payload Safety Review and Data Submittal Requirements.

1.4 DELEGATION OF AUTHORITY

The ISS Safety and Mission Assurance/Program Risk (S&MA/PR) Office is responsible for preparation of changes to this document. However, approval of changes is maintained at the Space Station Program Control Board (SSPCB).

1.5 WAIVER/DEVIATIONS

Any request for waiver or deviation from the requirements of this document shall be made to the ISS Program in accordance with Configuration Management (CM) SSP 41170, Configuration Management Requirements.

1.6 APPENDICES

Additional technical data in support of the safety review process is provided in the appendices. The appendix reference is provided in each section.

2.0 DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents are a listing of technical and process specifications, models, standards, guidelines, handbooks, and other special publications. The documents listed in this paragraph, or IP equivalents, are applicable to the extent specified herein.

CCT-PLN-1120	Crew Transportation Technical Management Processes
CSG-RS-10A-CN	Centre Spatial Guyanais (CSG) Safety Regulations
CSA-111001B	System Safety Review Panel Process for HTV Cargo
ESA-ATV-1700.7b	Safety Requirements for Payloads/Cargo on board the ATV
ESA-ATV-PR-13830	ATV Pressurized Payload/Cargo Safety Certification Process
ISS PPD 507A	Charter for the ISS Mission Management Team (IMMT)
ISS PPD 1011	Multilateral International Space Station (ISS) Jettison Policy
JMR-002B	Launch Vehicle Payload Safety Standard
JPD 5150.2H	Industry Presentations and Related Nondisclosure Agreements
JSC 27472	Requirements for Submission of Data Needed for Toxicological Assessment of Chemicals to be Flown on Manned Spacecraft
JSC 63828	Biosafety Review Board Operations and Requirements Document
JSX-2008041B	HTV Cargo Safety Review Process
JSX-2009059A	HTV Cargo Safety Certification Process for Disposal
KNPR 8715.3 CHAPTER 20	NASA KSC Payload and Cargo Ground Safety Requirements
NPR 7123.1B	NASA Systems Engineering Processes and Requirements
NPR 8715.3C	NASA General Safety Program Requirements

SSP 30599
Revision F

OA-WI-003	International Space Station Commercial-Off-The-Shelf Certification Process Work Instruction
P32928-103	Requirements For International Partner Cargo Transported on Russian Progress and Soyuz Vehicles
P32958-106	Technical Requirements for Hardware to be Stored or Operated on the ISS Russian Segment
SSP 30233	Space Station Requirements for Materials and Processes
SSP 30237	Space Station Electromagnetic Emission and Susceptibility Requirements
SSP 30309	Safety Analysis and Risk Assessment Requirements Document
SSP 30558	Fracture Control Requirements for Space Station
SSP 30559	Structural Design and Verification Requirements
SSP 30560	Glass, Window, and Ceramic Structural Design and Verification Requirements
SSP 41163	Russian Segment Specification
SSP 41170	Configuration Management Requirements
SSP 50005	International Space Station Flight Crew Integration Standard (NASA-STD-3000/T)
SSP 50021	Safety Requirements Document
SSP 50038	Computer-Based Control System Safety Requirements
SSP 50094	NASA/RSA Joint Specifications Standards Document for the ISS Russian Segment
SSP 50108	ISS Program Certification of Flight Readiness Process Document
SSP 50123	Configuration Management Handbook
SSP 50146	NASA/RSA Bilateral S&MA Process Requirements for International Space Station
SSP 50223	International Space Station Export Control Plan

SSP 30599
Revision F

SSP 50231	ISS Safety and Mission Assurance/Program Risk Certification of Flight Readiness Implementation Plan
SSP 50481	Management Plan for Waste Collection and Disposal
SSP 50835	ISS Pressurized Volume Hardware Common Interface Requirements Document
SSP 50863	Multilateral Yellow Tag Process
SSP 50864	NASA Yellow Tag Process
SSP 50986	Commercial-Off-The-Shelf (COTS) Interface Certification Requirements and Processes for Hardware, Software and Payloads
SSP 51700	Payload Safety Policy and Requirements for the International Space Station (Includes NSTS/ISS 18798 Interpretation Letters)
SSP 52005	Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures
SSP 54500	International Ground Systems Specification Document
SSP 57012	ISS FRAM Based Payload Common Launch Interface Requirements Document (IRD)

2.2 REFERENCE DOCUMENTS

The following documents contain supplemental information to guide the user in the application of this document. These reference documents, or IP equivalents, may or may not be specifically cited within the text of this document.

No Number	Export Control Guidelines for the Development, Integration and Operation of Vehicles Visiting ISS (Revised December 16, 2009)
No Number	Memorandum of Understanding Between the National Aeronautics and Space Administration of the United States of America and the Canadian Space Agency Concerning Cooperation on the Civil International Space Station
No Number	Memorandum of Understanding Between the National Aeronautics and Space Administration of the United States of America and the European Space Agency Concerning Cooperation on the Civil International Space Station

SSP 30599
Revision F

No Number	Memorandum of Understanding Between the National Aeronautics and Space Administration of the United States of America and the Government of Japan Concerning Cooperation on the Civil International Space Station
No Number	Memorandum of Understanding Between the National Aeronautics and Space Administration of the United States of America and the Russian Space Agency Concerning Cooperation on the Civil International Space Station
No Number	ISSA Flight Safety Review Panel (SRP), International Space Station Alpha (ISSA) Management Directive, effective July 28, 1994
AFSPMAN 91-710	Range Safety User Requirements Manual – Launch Vehicles, Payloads and Ground Support Systems Requirements
ISS JPD 1018	Charter for the Payload Safety Review Panel
JPR 8730.2A	JSC Fastener Integrity Testing Program
JSC 20793	Crewed Space Vehicle Battery Safety Requirements
JSC 25863	Fracture Control Plan for JSC Flight Hardware
JSC 26943	Guidelines for the Preparation of Payload Flight Safety Data Packages and Hazard Reports
JSC 29353	Flammability Configuration Analysis for Spacecraft Applications
JWI 8705.3	Battery Processing
NASA-STD-5018	Strength Design and Verification Criteria for Glass, Ceramics, and Windows in Human Space Flight Applications
NASA-STD-5019	Fracture Control Requirements for Spaceflight Hardware
NASA-STD-5020	Requirements for Threaded Fastening Systems in Spaceflight Hardware
NASA-STD-6001B	Flammability, Offgassing, and Compatibility Requirements and Test Procedures

SSP 30599
Revision F

NASA-STD-6016	Standard Materials and Processes Requirements for Spacecraft
NPR 7120.8	NASA Research and Technology Program and Project Management Requirements
SSP 41000	System Specification for the International Space Station
SSP 50175	ISS Risk Management Plan, International Space Station Program
SSP 50417	Integrated Experiment Hazard Assessment Generic Baseline
SSP 50417 IP Addendum	Integrated Experiment Hazard Assessment IP Addendum
SSP 50808	International Space Station (ISS) To Commercial Orbital Transportation Services (COTS) Interface Requirements Document (IRD)
SSP 57008	Unique Pressurized Payload Non-Rack Interface Control Document Template
SSP 57061	Standard Payload Integration Agreement for ISS External Payloads
SSP 57072	Standard Payload Integration Agreement for ISS Pressurized Payloads

3.0 RESPONSIBILITIES

3.1 NASA SAFETY REVIEW PANEL

NASA is responsible for the overall integrated safety of the ISS and is required to provide the overall certification that all <END ITEMS> are safe. It is also the responsibility of NASA to establish the overall safety requirements of the ISS Program. NASA assures compliance with these overall safety requirements within the ISS Program by a structured safety review process.

The NASA safety review panel consists of the following:

- Ground Safety Review Panel (GSRP): responsible for assuring ground safety at Kennedy Space Center (KSC) in accordance with technical requirements KNPR 8715.3, Chapter 20, NASA KSC Payload and Cargo Ground Safety Requirements.
- ISS Safety Review Panel (SRP): responsible for assuring the safety of systems hardware, CFE, GFE, and visiting vehicles in accordance with technical requirements SSP 50021, Safety Requirements Document, and/or IP segment specification.
- Payload Safety Review Panel (PSRP): responsible for assuring the safety of research hardware in accordance with technical requirements as defined in SSP 51700, Payload Safety Policy and Requirements for the International Space Station.

Additional safety review panel responsibilities accomplish the following:

- Assure consistent interpretation of safety requirements.
- Conduct safety reviews during the development of the <END ITEMS>, associated GSE, and related on-orbit ISS operations.
- Evaluate hazard analyses and safety Noncompliance Reports (NCRs).
- Negotiate the resolution of safety issues involving design and operation to ensure compliance with all applicable safety requirements, including coordination with appropriate technical forum(s), e.g. Extravehicular Activity (EVA) Analysis and Integration Team (AIT), Dexterous Robotic Integration Team (DRIT), Mechanical Systems Working Group (MSWG).
- Assess <END ITEMS> design features that have been implemented for controlling identified hazards and the verification approach.

The safety review process provides the ISS Program with safety assessments of ISS design and operations. The ISS Program Manager is responsible for the acceptance of safety risk. This safety risk responsibility has been delegated to the ISS S&MA/PR manager and to the safety review panel chairperson where the level of risk is assessed to be in accordance to the applicable safety requirements as specified in Section 2.0.

3.2 <END ITEMS> PROVIDERS

<END ITEMS> providers are responsible for demonstrating compliance to applicable safety requirements, performing a safety assessment and presenting the documentation to the appropriate safety review panel and/or IP safety organization.

3.2.1 ISS SAFETY INTEGRATION

The ISS prime contractor performs an integrated hazard analysis in accordance with the current contract. This analysis ensures that interdependent systems (including United States (US) and IP systems) used for hazard control or failure tolerance are properly identified. If an item relies on a hazard control provided by other ISS equipment, this must be assessed and captured in the integrated hazard reports (HRs). Integrated HRs will be developed and presented by the ISS prime contractor at the safety review panel meeting to support the overall assessment of the flight <END ITEMS>.

For pressurized, soft-stowed cargo transportation, NASA provides an Integrated Bag Level Hazard Assessment (IBLHA) that is available to Commercial Resupply Service (CRS) and IP launch vehicle owners. An IBLHA identifies applicable NASA integrated hazards for packing, ground handling, transportation, launch, and return/disposal. IP bag level lists are communicated to NASA through the Hardware Accountability Matrix Report (HAMR).

For United States On-orbit Segment (USOS) <END ITEMS> ground operations and GSE, the ISS prime contractor will participate in phase safety reviews conducted by the appropriate processing or launch site.

3.3 INTERNATIONAL PARTNERS

3.3.1 SAFETY REVIEW PANEL

It is the responsibility of the IPs to support the ISS safety review process and to certify that all applicable safety requirements have been met with respect to their respective <END ITEMS>. The safety requirements for <END ITEMS> are contained in the applicable IP segment specification, SSP 50021, SSP 51700, and/or applicable bilateral agreements. IP segment specifications are derived from the safety requirements through bilateral negotiations with NASA. For <END ITEMS> operated within the Russian Segment, applicable requirements are captured within SSP 41163, Russian Segment Specification and P32958-106, Technical Requirements for Hardware to be Stored or Operated on the ISS Russian Segment. In order for the <END ITEMS> provider to demonstrate safety requirements compliance, the safety review panel assessments shall be conducted by NASA or IPs in accordance to appropriate ISS Program Charters, Memorandums of Arrangement or Agreement and/or other documented agreements, as applicable.

3.3.2 <END ITEMS> PROVIDER

Each IP is responsible to maintain an integrated hazard analysis of their element. If unique integrated hazards are found during this assessment or existing hazards require modification, the HRs will be submitted to the NASA safety review panel for review and

SSP 30599
Revision F

approval. If there are no new integrated hazards identified, the IP will provide this endorsement as part of the Certification of Flight Readiness (CoFR) for the IP segment. In support of these assessments, IPs are responsible for providing safety data to other IPs when their <END ITEMS> will be stowed or operated in or with another IP's <END ITEMS>.

3.4 TRANSPORT VEHICLES CARGO SAFETY AND GROUND SAFETY

3.4.1 INTERNATIONAL PARTNER TRANSPORT VEHICLES

IPs that provide transport vehicles are responsible for the establishment and maintenance of safety requirements and their processes for <END ITEMS> transported on their vehicle. Although IP safety review authorities generally utilize and accept the NASA safety review for <END ITEMS> launched by IP transport vehicles, additional data and coordination with the IP may be required. Table 3.4.1-1, IP Transport Vehicles Safety Documents lists the documents which contain the safety process and technical requirements for cargo that apply to each transport vehicle. Unless specified otherwise, the latest versions of the documents shall be applied.

TABLE 3.4.1-1 IP TRANSPORT VEHICLES SAFETY DOCUMENTS

Vehicle	Safety Requirements	Safety Process
Progress/ Soyuz	P32928-103	P32928-103 and SSP 50146, Attachment D
ATV	ESA-ATV-1700.7b	ESA-ATV-PR-13830
HTV	JMR-002B	JSX-2008041B (for launch) JSX-2009059A (for disposal)

3.4.2 COMMERCIAL RESUPPLY SERVICE (CRS) TRANSPORT VEHICLES

<END ITEMS> transported aboard CRS vehicles shall follow the standard safety review process for on-orbit operations as noted within this document. Additionally, per SSP 50021, Paragraph 3.3.6.1.8, and/or SSP 51700, Paragraph 3.1.3, <END ITEMS> shall be assessed to applicable environmental conditions as listed within the current revision of SSP 50835, ISS Pressurized Volume Hardware Common Interface Requirements Document and SSP 57012, ISS FRAM Based Payload Common Launch Interface Requirements Document. Upon receipt of safety data from the <END ITEMS> providers, NASA will facilitate the transmittal of this data to the CRS transport vehicle provider.

Launch site and transport phase safety reviews shall be conducted in accordance with the CRS provider's requirements.

3.4.3 TRANSPORT VEHICLE GROUND SAFETY

3.4.3.1 CENTRE SPATIAL GUYANAIS

For <END ITEMS> transported on an Automated Transfer Vehicle (ATV), an ATV/HTV/KSC Form 100, “Integrated Safety Checklist for ISS Cargo At Launch or Processing Sites” may be submitted in lieu of a full SDP in accordance with ESA-ATV-PR-13830, ATV Pressurized Payload/Cargo Safety Certification Process. If approved by CSG, this form will satisfy the requirements as defined in CSG-RS-10A-CN, Centre Spatial Guyanais (CSG) Safety Regulations. The form, with instructions, may be obtained from the GSRP website (see Appendix F, Safety Data Submittal and Scheduling Processes).

For <END ITEMS> not meeting the criteria of the ATV/HTV/KSC Form 100, a full SDP shall be provided in accordance with CSG-RS-10A-CN.

3.4.3.2 TANEGASHIMA SPACE CENTER

For <END ITEMS> transported on an HTV, the safety process contained in CSA-111001B, System Safety Review Panel Process for HTV Cargo, shall be followed.

For <END ITEMS> transported on an HTV that is of low risk to HTV and Tanegashima Space Center ground processing, an ATV/HTV/KSC Form 100, “Integrated Safety Checklist for ISS Cargo At Launch or Processing Sites” may be submitted in lieu of a full SDP in accordance with CSA-111001B. If approved by Japan Aerospace Exploration Agency (JAXA), this form will satisfy the requirements of JMR-002B, Launch Vehicle Payload Safety Standard.

The form, with instructions, may be obtained from the GSRP website (see Appendix F).

3.4.3.3 BAIKONUR COSMODROME

For <END ITEMS> transported on Progress or Soyuz, demonstrated compliance with P32928-103, Requirements For International Partner Cargoes Transported on Russian Progress and Soyuz Vehicles, for flight safety is sufficient for ground processing.

3.4.3.4 COMMERCIAL RESUPPLY SERVICE (CRS) LAUNCH SITES

For <END ITEMS> transported on a CRS transport vehicle, ground safety reviews are conducted between the CRS provider and the range in accordance with CRS requirements. <END ITEMS> ground safety input data will be captured via completion of ISS hardware data sets (cargo integration data) as documented in SSP 50835, SSP 57012, or the applicable unique <END ITEMS> to visiting vehicle ICD. Additional <END ITEMS> ground safety data may be requested to support CRS provider development of ground safety data packages and plans.

3.4.3.5 NASA WALLOPS FLIGHT FACILITY

For <END ITEMS> processing in NASA facilities at the Wallops Flight Facility (WFF), providers shall follow the procedures contained in KNPR 8715.3.

4.0 ISS SAFETY REVIEW PROCESS

SSP 30599
Revision F

The safety review process was developed to evaluate and assess the results of safety analyses conducted by developers, providers, and operators of ISS <END ITEMS>, software, and associated GSE. This includes all flight <END ITEMS>, Commercial-Off-The-Shelf (COTS) equipment, Factory Equipment (FE), Test Support Equipment (TSE) and Special Test Equipment (STE). Performance of Hazard Analyses (HAs) provides a means to systematically identify hazards and their causes and controls. SSP 30309, Safety Analysis and Risk Assessment Requirements Document, provides methodologies and examples to document traditional safety analysis techniques. See Paragraph 4.5 for additional details on HRs.

Traditional <END ITEMS> safety compliance assessment is accomplished using a phased safety review process (phases 0, I, II, III) that corresponds to the <END ITEMS> conceptual, preliminary, critical design, and final acceptance review phases (including verification/validation).

Safety data submittal for the ground safety review process (conducted by the GSRP) is required only at the phase III level; Phase 0, I, and II reviews are not required.

The safety assessments of all ISS systems and operations are provided to the safety review panel, including HRs and other applicable data. These deliverables are submitted in accordance with: the applicable Bilateral Data Exchange, Agreements, Lists, and Schedules (BDEALS) for IPs, contractual data requirements defined in the contract Statement of Work (SOW), Standard Payload Integration Agreement (SPIA), or other applicable integration agreements.

4.1 SAFETY REVIEW OBJECTIVES

The objective of the safety analysis is to identify all hazards and to assure that proper hazard controls have been developed and implemented for all hazard causes which have not been eliminated. Reference Appendix G, Summary of Safety Review Process. Safety review meetings are held for the safety review panel to assess the results of these safety assessments as performed by <END ITEMS> providers.

The safety review results are provided in support of ISS Program milestone and CoFR review activities.

The objectives of the phase 0 safety Technical Interchange Meeting (TIM) are to:

- Assist the <END ITEMS> providers in identifying hazards, hazard causes, and applicable safety requirements early in the development of the <END ITEMS>, Adequately describe the hazard potential, answer questions regarding the interpretation of the safety requirements or the implementation procedures of this document, and
- Provide guidance to the <END ITEMS> providers for preparing the safety data required for subsequent safety reviews.

The objectives of the phase I safety reviews are to:

SSP 30599
Revision F

- Obtain safety review panel approval of the initial/updated safety analysis, including all identified hazards, that reflects the preliminary design and concept of operations of the <END ITEMS> and their interfaces,
- Identify all hazard causes and controls
- Evaluate the means of eliminating, reducing, or controlling the risk,
- Identify integrated hazards,
- Identify potential safety requirement non-compliances, and
- Identify approach for safety verification.

The objectives of the phase II safety review are to:

- Obtain safety review panel approval of updated safety analysis that reflect the critical design and concept of operations of the <END ITEMS> and their interfaces,
- Update hazard causes defined at Phase I
- Assure all appropriate hazard controls have been implemented,
- Assure all verification methods are documented,
- Identify potential safety non-compliances in detail,
- Document newly identified hazards in existing or additional HRs.

The objectives of the phase III safety review are to:

- Obtain safety review panel final approval of the safety analysis that reflects the design and concept of operations of the <END ITEMS> and their interfaces.
- Present the final safety analysis that identifies all hazards and hazard causes, resolves any safety non-compliances, and identifies all safety verification methods, status of verification closures, and status of remaining open items transferred to Safety Verification Tracking Log (SVTL) and status.

If review phases are combined the <END ITEMS> provider shall provide all the data requirements that apply to the appropriate phases.

4.2 TYPES OF MEETINGS

The following may be conducted in person or remotely as deemed appropriate by the safety review panel chairperson.

- In-Board Safety Review Meeting: These formal meetings are conducted to address the hazards analyses for a particular <END ITEMS>. Participants include: the safety review panel, representatives of the <END ITEMS> provider, and the appropriate supporting technical staff.
 - Phased Review Meeting: These formal meetings are conducted to disposition HRs, NCRs, assigned actions and issues, and <END ITEMS> safety assessments. Delta phased reviews may be scheduled when the original phased reviews are not completed.

- Special Topics Meeting: These formal meetings are nominally conducted to finalize disposition on previously panel reviewed HRs, NCRs, assigned actions and issues, and/or <END ITEMS> safety assessments that require an additional formal safety review meeting (as determined by coordination with the safety panel engineer). These meetings can be composed of multiple <END ITEMS> technical safety subjects in one meeting. The review of new <END ITEMS> may be scheduled at a Special Topics meeting with the approval of the safety review panel chairperson and/or executive officer.
- Safety TIM: These formal meetings assist in the interpretation of safety requirements, clarification of safety analyses/issues, or discussion of specific technical subjects as requested by the <END ITEMS> provider.
- Outside-of-Board (OSB) Safety Review Meeting: These informal meetings are conducted to finalize disposition on previously panel-reviewed HRs, NCRs, assigned actions and issues, and <END ITEMS> safety assessments that either do not require an additional formal safety review meeting (as determined by coordination with the safety panel engineer) or has been previously dispositioned with minor changes. These meetings can also be conducted for common series/reflight <END ITEMS> at the discretion of the safety panel engineer, executive officer, and chairperson. Participants include the safety review panel chairperson and applicable safety panel engineer. Representatives of the <END ITEMS> provider and the appropriate supporting technical staff may also be requested to participate.
- Splinter/Working Group (WG) Meeting: These informal meetings may be held concurrently or prior to a safety review to discuss detailed technical concerns and/or coordinate on resolution of issues in support of the safety review process. Participants include representatives of the <END ITEMS> provider, safety panel engineer, and appropriate supporting technical staff.

4.3 SAFETY REVIEW MEETINGS AND AGENDA

In preparation for a phase safety review, the <END ITEMS> provider shall submit a Safety Data Package (SDP) and conduct safety reviews as indicated in Section 5.0. The depth and number of the planned reviews are dependent on the complexity, technical maturity, and hazard potential of the <END ITEMS>, and may be modified by the safety review panel chairperson in conjunction with the <END ITEMS> provider.

The <END ITEMS> provider shall provide sufficient technical support personnel to answer questions posed by the safety review panel in support of the agenda items.

Listed below are general agenda items for safety review meetings. These insure that the safety review meetings proceed smoothly and contain the necessary information to facilitate the review. The <END ITEMS> provider will develop an agenda and shall coordinate with the safety panel engineer. <END ITEMS> provider shall submit the final agenda 5 days before the meeting.

- A. Introduction of meeting and participants by the safety panel engineer.
- B. Opening remarks by the chairperson and <END ITEMS> provider.
- C. Status of pre-review activities, as applicable, by the safety panel engineer.

SSP 30599
Revision F

- D. Program milestone schedule: Provide the program milestone schedule, including, but not limited to:
 - 1. Design stages and reviews and corresponding safety review panel dates,
 - 2. Hardware/software build status,
 - 3. Testing and verification activities,
 - 4. Delivery, integration, and launch activities.
- E. A design overview/objective, including enough information to allow the safety review panel to gain a general technical understanding of the systems and safety critical subsystems involved. Identify any design changes since previous safety reviews.
- F. An operations overview, including a description of planned operations. Highlight any operations that impact safety or are hazard controls.
- G. A summary of all non-conformances, anomalies, and significant technical issues. Provide additional information on those with safety impacts.
- H. Detailed presentation of HRs (and safety NCRs if applicable) including phase-specific topics. Identify any updates since the previous submission of the HRs/NCRs.
- I. Verification tracking log status (phase III).
- J. Status of safety review meeting including Action Item (AI) dispositions, newly assigned AIs, HR dispositions, and NCR dispositions.
- K. Concluding remarks.

Official minutes are prepared by the safety review panel and are uploaded to the ISS Hazard System. Minutes capture agreements, actions, and HR/NCR dispositions. Although minutes do document the official panel disposition of submitted safety products, the <END ITEM> provider shall record/capture (within their own working notes), specific updates with respect to HRs and NCRs.

4.4 SAFETY REVIEW DATA LOGISTICS

Data submittals, as specified within Section 5.0, should identify the vehicle on which the <END ITEMS> is manifested (if known) and be formally submitted to the safety review panel per Appendix F. Safety data shall be submitted under the purview of the project manager or delegated authority. All data planned for review by the safety review panel shall be in English.

Early coordination between the safety review panel and <END ITEMS> providers to determine flight safety review schedules are strongly recommended. Appendix F provides specific details on safety data submittal.

Submitted safety data will be made available to the safety review panel members, IP representatives (as applicable), and other NASA/contractor (technical and administrative personnel) who support the safety review panel. The distribution of safety data provides for the technical review and collection of comments by panel

SSP 30599
Revision F

support. To aid in a successful safety review, the planning schedule should accommodate sufficient time for comment coordination/resolution between the panel support and <END ITEMS> providers prior to the formal meeting. NASA and any NASA contractors have obligations (e.g. Non-Disclosure Agreements) to honor the limited rights of any project information.

Required safety review data for the flight and ground phase safety reviews shall be submitted 45 calendar days <TBR-4-1> prior to the scheduled meeting and/or requested disposition date. Adjustments (earlier or later) are based on consideration of the <END ITEMS> flight heritage, complexity, and/or mission scenario as determined by the safety review panel chairperson. <END ITEMS> providers shall follow the phased safety review process as defined in Section 5.0 (phase 0, I, II, III).

Contributing factors in determining the appropriate data submittal timeframe include but are not limited to:

- Ability to complete cursory data review against general data submittal requirements,
- Quality, content, and completeness of submitted data (safety reviews may be postponed due to deficiencies in provided safety data),
- Safety review panel resources availability based on Safety Planning Forum (SPF) discussions. Safety Planning Forum is conducted weekly to understand upcoming safety review activities, scheduling, data delivery and resource impacts.
- Distribution of data, receipt of comments/responses, and
- Resolution of pre-meeting technical issues at splinter/working group meetings.

The <END ITEMS> providers are responsible for providing project approved safety data to the safety review panel (see Appendix F). Electronic copies of safety data shall also be provided prior to safety review meetings to facilitate distribution of the SDP. Once a chairperson has approved the safety assessment, the approved data shall be posted to the safety panel website in a timely manner to support CoFR milestone activities. The <END ITEMS> provider is responsible for maintaining copies of all submitted data.

4.4.1 SUBMITTAL OF PROPRIETARY OR LIMITED RIGHTS DATA

If the data package contains proprietary or limited rights information, then the <END ITEMS> provider shall insert the word “PROPRIETARY” or “LIMITED RIGHTS” on the cover and each page that contains proprietary or limited rights data.

The submitting organization should be aware of the following while attending safety review panel activities:

- A. Safety review panel meetings are not conducted in secure facilities. When not in session (e.g., lunch and breaks), the presenting organization shall be responsible for protecting any proprietary or limited rights data distributed during the meeting.
- B. If any proprietary data are to be presented or discussed during the meeting, prior to the meeting, the presenting organization will notify the safety panel engineer and

SSP 30599
Revision F

executive officer, who will make arrangements to implement appropriate access controls.

- C. The presenting organization will be responsible for retrieval and disposal of any proprietary or limited rights material distributed at the meeting.
- D. NASA employees are covered by the "Trade Secrets Act," which makes it a Federal crime to disclose a company's trade secrets. NASA contractors and foreign nationals are obligated by terms of their contracts to treat data which contain restrictive markings in accordance with such markings unless otherwise specifically authorized in writing by the Contracting Officer.

When the safety review panel receives proprietary or limited rights data, such data will be handled in a manner that will protect the interests of the submitting organization. In order to exercise reasonable care in protecting proprietary or limited rights data in connection with the safety review process, NASA will ensure that proprietary or limited rights data are distributed only to persons who have a need to review such data in support of safety review panel functions.

If the submitting organization discovers that some portion of the SDP marked "PROPRIETARY" or "LIMITED RIGHTS" is no longer considered such, the organization must inform the safety review panel.

4.4.2 SUBMITTAL OF COPYRIGHTED DATA

Safety data will be reproduced and distributed to the members of the safety review panel and associated technical support. Copyrighted data shall not be included in the submitted documentation unless the submitting organization: 1) identifies such copyrighted data, and 2) grants to the Government, or acquires on behalf of the Government, a license to reproduce and distribute the data to these necessary recipients.

4.4.3 SUBMITTAL OF TRANSLATED DATA

For all documents submitted to the safety review panel that have been translated into English, the English translation shall be the official document.

4.4.4 EXPORT CONTROL

The safety review panel conforms to the export control process/requirements as documented within SSP 50223, International Space Station Export Control Plan.

Distribution of safety data packages/supporting data to the IPs is a standard part of the safety review panel process. <END ITEMS> providers shall thoroughly review the degree of included technical content within their safety data in consideration of required data distribution, discussion, and review with the IPs. General block diagrams, high-level schematics/pictures, and descriptions with form, fit, and function are sufficient to fulfill data submittal requirements.

4.4.4.1 U.S. <END ITEMS> PROVIDERS

The submitter shall identify/document the export control classification of all safety data, per SSP 50223. The safety review panel will not distribute data with an unknown export control classification. Safety review panel meetings may be delayed or cancelled for <END ITEMS> with unresolved export control issues. Safety review presentation materials and/or other supporting material must have the same or less restrictive export control classification or be marked accordingly.

As defined within the U.S. Department of Commerce Export Administration Regulations, 15 CFR Part 774, ECCN 9A004.a (Note 6), and SSP 50223, (Paragraph 6.4.2), ISS safety data generally falls within the level of technical data necessary to confirm that an item “has been designed, manufactured, and tested in conformance with specified requirements” and is typically classified as EAR99/NLR. <END ITEMS> providers, however, shall confirm and document the results of their individual export control assessments within safety data submitted to the safety review panel.

4.4.4.2 IP <END ITEMS> PROVIDERS

Unless classified as noted within Paragraph 4.10, for an IP SDP requiring international review, the responsible IP shall distribute the safety data to the affected IP safety organizations in accordance with applicable requirements/process. Appendix E, ISS IP Safety Certification Data Exchange Flowchart, provides a data flow diagram depicting the cargo safety certification process and the data exchanges between IPs.

4.5 HAZARD REPORTS

The HR summarizes how the <END ITEMS> design and operations demonstrate compliance with the safety requirements.

The flight SDP submittal must contain all flight HRs; the ground SDP submittal must contain all ground hazard reports.

Nominally, <END ITEMS> providers should utilize the ISS Hazard System (see Appendix F) for HR submittal. The ISS Hazard System allows for <END ITEMS> providers to document hazard causes, controls, and verification methods based upon the ISS_OE_1298, “Standard Hazard Report” and/or ISS_OE_851, “Unique Hazard Report Form” templates. HRs shall be submitted with supporting data as required by Appendices H, I, and J.

The ISS_OE_1298 defines commonly accepted control and verification approaches as outlined in the form. ISS_OE_851 is recommended to document unique hazards that are not contained in ISS_OE_1298. Examples of unique hazards include high voltage, safety critical mechanism, toxicity levels or containment, append deployment, and unique operational controls. Alternatively, <END ITEMS> providers may document hazard causes, controls, and verification methods via other formats, provided they contain those applicable data fields as utilized within the ISS_OE_851.

SSP 30599
Revision F

A phase I HR shall be prepared for each hazard identified as a result of the safety analysis on the preliminary design and operations (Preliminary Design Review (PDR) level of detail). The focus shall be on hazard cause descriptions and controls.

The phase II HRs shall be prepared by updating the safety hazards analysis to reflect the Critical Design Review (CDR) level of detail and by providing new and updated HRs to reflect the completed equipment design and flight/ground operating procedures. If the equipment design is changed from phase I to phase II such that a phase I HR may be deleted, a brief statement of rationale for deleting the report shall be presented in the phase II assessment report. Phase II HRs shall document the <END ITEMS> design and operations, updated causes and controls, final verification approaches and status of verifications.

The phase III HRs shall document the final <END ITEMS> design and operations, causes and controls, verification methods and closure status of verifications. Closure of verification activities related to design and analysis should be documented in HRs. All open verifications shall be listed on a safety verification tracking log (Paragraph 5.7). This log allows the safety review panel chairperson to sign the HRs indicating completion of the safety analyses, but with the understanding that approval for flight or corresponding ground operations will be withheld until all applicable verification activity is complete.

Approval for flight will not be withheld for open verification activities that are part of nominal on-orbit activation activities, but failure to successfully accomplish these activities may constrain subsequent on-orbit operations. Open ground and flight verifications that have been identified as a constraint against ground processing must be closed before the applicable ground operation can be performed.

All changes to the HRs shall be tracked to understand the nature of the change. The <END ITEMS> project manager or delegated authority shall sign and date each HR prior to safety review panel chairperson signature.

4.5.1 HAZARD REPORTS AND NON-COMPLIANCE REPORT DISPOSITION

The safety review panel chairperson will provide a disposition for each HR (and/or HR cause)/NCR upon review of comment dispositions. HRs with open NCRs will not be approved until the associated NCRs are signed by the ISS Program. This disposition may take one of the following forms:

- **APPROVED:**
 - AS IS: Technically concurred with presented HR(and/or HR cause)/NCR
 - Chairperson signature can be obtained at the meeting or OSB.
 - **WITH MODIFICATIONS:** Technical discussion completed and modifications agreed to between safety review panel and <END ITEMS> provider
 - <END ITEMS> provider completes edits during or following the meeting and signs HR (and/or HR cause)/NCR

SSP 30599
Revision F

- Safety panel engineer reviews and coordinates w/technical support (as needed)
- Chairperson signs the HR (and/or HR cause)/NCR in-board or OSB following the meeting.
- **DEFERRED:**
 - Safety review panel did not reach a consensus for HR (and/or HR cause)/NCR approval.
 - Further technical discussion with <END ITEMS> provider still required. Chairperson provides direction on forward plan to resolve HR (and/or HR cause)/NCR approval
 - Following resolution of technical discussions, chairperson signs the HR (and/or HR cause)/NCR in-board or OSB.
- **WITHDRAWN:**
 - HR (and/or HR cause)/NCR is superseded or deleted.

4.6 SAFETY REVIEW COMPLETION

Successful completion of phase I and II reviews is accomplished by obtaining approval (project manager or delegated authority and safety review panel chairperson's signature) of HRs for critical and catastrophic hazards as defined by SSP 51700 and SSP 50021. Safety review panel chairperson's approval of marginal hazards is not required. Successful completion of phase I or II can also be endorsed in the minutes to proceed to the next phase level.

Safety data submittal for the ground safety review process (conducted by the GSRP) is required only at the phase III level; Phase 0, I, and II reviews are not required.

After submission of all required data, the criteria for successful completion of phase III HRs and/or series/reflow assessments are as follows:

- Final safety assessment approval by the safety review panel chairperson.
 - Safety review action items associated with HRs are formally closed, if applicable.
 - Safety review panel comments have been dispositioned. Tracking of comment disposition resides with the safety panel engineer and the <END ITEMS> provider. Prior to the review, as time allows, the safety panel engineer collects comments from the safety community. The collected comments are then transmitted to the <END ITEMS> providers for disposition. <END ITEMS> provider disposition of comments are either discussed at the review or during safety working group activities with the safety community. All NCRs are signed, if applicable.
 - All <END ITEMS> HRs are signed by the project manager or delegated authority and the safety review panel chairperson at the phase III level.

SSP 30599
Revision F

- All safety analysis efforts should be completed. If all activities associated with the safety review (other than the open verification) are completed, the safety review panel chairperson may sign the HR(s) indicating acceptance of the safety work, but with the understanding that final approval of the hazard is not complete until all verification activity is completed.
- Final signed ISS_OE_906, Flight Safety Certificate (as defined in Paragraph 4.11), shall be submitted by <END ITEMS> providers only after successful completion of the items as noted above.
- Final SVTL as defined in Paragraph 5.7

4.7 YELLOW TAG PROCESS

SSP 50863, Multilateral Yellow Tag Process, and SSP 50864, NASA Yellow Tag Process, defines the process for the application, removal and tracking of Yellow Tags.

Use of the Yellow Tag process shall only be considered when all other options have been exhausted. In cases where the <END ITEMS> have not completed the safety process but safety for launch and transport has been assessed, the Yellow Tag process shall be implemented to allow delivery of the <END ITEMS> to ISS.

4.8 CERTIFICATION FOR GROUND PROCESSING

Following successful completion of the ground and flight safety review(s) and submission of the Ground Certificate of Safety Compliance, the GSRP will certify the <END ITEMS> as safe to begin ground processing at KSC. The GSRP certification shall note if any open safety verifications exist which must be closed prior to the start of ground operations involving the open items.

4.9 CERTIFICATION OF FLIGHT READINESS

In preparation for launch, operations, disposal, and/or return of ISS <END ITEMS>, the safety review panel chairperson participates in the CoFR process in accordance with SSP 50231, ISS Safety and Mission Assurance/Program Risk Certification of Flight Readiness Implementation Plan.

Final approval and signature of the safety assessment by the safety review panel chairperson is the basis for the Manager, ISS S&MA/PR CoFR endorsement in accordance with SSP 50108, Certification of Flight Readiness Process Document.

4.10 <END ITEMS> CATEGORIES

The term “cargo” in the following paragraphs refers to <END ITEMS> transferred, stowed, operated on and/or removed from ISS. Cargo items include (but are not limited to) specific scientific equipment (experiments), Orbital Replacement Units (ORU) for ISS systems, logistical supplies, crew psychological support items, tools, spare instruments and assemblies, Commercial-Off-The-Shelf (COTS), and series/reflow <END ITEMS>. Waste is also classified as cargo, and a definition and categorization of waste items are contained in SSP 50481, Management Plan for Waste Collection and Disposal.

4.10.1 CARGO CLASSIFICATIONS

Category 1 cargo is defined as lower hazard potential cargo that meets all of the constraints as documented on the ISS_OE_907, "Multilateral Category 1 Constraints".

Category 2 cargo is defined as cargo that does not meet one or more of the Category 1 constraints and therefore has higher hazard potential.

A cargo item may have different categories for different mission phases. For example, a cargo item that is passively soft-stowed for launch may meet all of the Category 1 constraints. However, the same cargo item may have additional ISS operational/stowage hazards that violate the Category 1 constraints and would be considered Category 1 for transport but Category 2 for operations.

Cargo providers shall prepare supporting safety data for all of their cargo items documenting applicable hazards, controls and verifications.

If a cargo item category changes based on design modifications and/or newly identified hazards, safety data shall be updated to reflect the new category. Cargo item categories may be re-classified if, after review, the <END ITEMS> classification is deemed incorrect.

The ISS_OE_906 documents: Cargo item description, safety certification for transportation vehicles/on-orbit elements (stowage and operations) with corresponding applicable safety process/technical requirements, safe life limits (design and operational), and concurrence/approval signatures.

<END ITEMS> provider signature on the ISS_OE_906 certifies that all necessary safety analyses have been performed in accordance with applicable safety requirements, and that associated verifications have been completed or transferred to a verification tracking log. Signature by the safety review panel chairperson and/or authorized IP safety organization confirms that the safety assessment has been reviewed and approved.

4.10.1.1 CATEGORY 1, IP-TO-IP CARGO FLIGHT SAFETY PROCESS

The Category 1 IP-to-IP cargo safety process recognizes the ability and expertise of IP submitting safety organizations to perform flight safety reviews for their own Category 1 cargo without required additional review by receiving IPs.

For IP cargo items meeting the Category 1 constraints, the flight safety documentation required to be exchanged between the IP provider and receiving IP is the completed/signed ISS_OE_906.

The IP cargo provider's safety organization shall submit the ISS_OE_906 directly to the receiving IP safety organization with a copy to the NASA safety review panel. Additionally, the IP cargo provider shall include the cargo in their CoFR endorsement for the relevant flight or stage.

SSP 30599
Revision F

The receiving IP safety organization shall provide confirmation of receipt to the submitting IP. Appendix E provides a data flow diagram depicting the cargo safety certification process and the data exchanges between IPs.

SDPs generated from IP safety analyses shall be maintained by the IP cargo provider for potential audit by the ISS Program. The receiving IP may request a copy of the complete safety data package which shall be provided by the IP cargo provider.

4.10.1.2 CATEGORY 2, IP-TO-IP CARGO FLIGHT SAFETY PROCESS

For IP cargo items meeting the Category 2 constraints, additional safety products may be required to be exchanged between the IP provider and receiving IP. This may include safety data packages, hazard reports, and/or NCRs, as required by the receiving IP safety organization. Appendix E provides a data flow diagram depicting the cargo safety certification process and the data exchanges between IPs.

4.10.2 COMMERCIAL OFF THE SHELF (COTS)

The certification process for COTS hardware is defined in <TBR-4-2>, SSP 50986, Commercial-Off-The-Shelf (COTS) Interface Certification Requirements and Processes for Hardware, Software and Payloads.

4.10.3 SERIES/REFLOWN <END ITEMS>

All series and reflowed <END ITEMS> shall be assessed each time they are manifested for transportation to ensure that the data supporting the original approval are still valid. See Section 7.0 for additional details.

4.11 ISS_OE_906, FLIGHT SAFETY CERTIFICATE

Safety certificates shall be provided by <END ITEMS> providers for all applicable visiting vehicles and mission phases. For the purposes of commonality and ease of tracking the ISS_OE_906, Flight Safety Certificates, the certificate numbers shall conform to the following pattern:

Mission/Increment Number/IP/Mission Phase and category (1 or 2)/unique <END ITEMS> identifier and number.

For example:

“HTV-5/NASA/TR1OP2/HRP-1”

Explanation: This is represented as NASA cargo to be first delivered on HTV-5, classified as category 1 for transport, category 2 for ISS operation, and designated as the first certificate for Human Research Program (HRP) <END ITEMS> on that mission.

For items that do not have a specific launch vehicle assignment at the time of the Phase III review, “NFS” (non-flight specific) can be used in place of the Mission and Increment number. All vehicles for which the item was certified should be covered on the ISS_OE_906 form.

SSP 30599
Revision F

For example:

“NFS/NASA/TR10P2/HRP-1”

As required, safety certificates can be issued separately for the transportation or operation phases. The hazard category of <END ITEMS> is specific to the mission phase, so category assignment for transport may not be the same as for operations.

All <END ITEMS> must have a valid, approved flight safety certificate for launch, ISS operations/stowage, and applicable return/disposal phases as defined in Section 8, “Transport Vehicle Unique Process Requirements.”

4.12 SIMPLIFIED GROUND SAFETY REVIEW PROCESS

For flight <END ITEMS> that have no or low hazards (e.g. Category 1 hardware) and have minimal KSC ground processing, an ATV/HTV/KSC Form 100, “Integrated Safety Checklist for ISS Cargo At Launch or Processing Sites” may be submitted in lieu of a ground SDP. If the hardware provider has any questions concerning appropriateness of the form, contact with the GSRP is encouraged. Approval by the GSRP will satisfy the requirements of this document. Also, if approved, the form need not be completed for subsequent flights unless there is a change to the answer to any question. GSRP approval of the ATV/HTV/KSC Form 100 is valid for 6 months only. The form, with instructions, may be obtained from the GSRP website (see Appendix F).

5.0 PHASED SAFETY REVIEW PROCESS

5.1 SAFETY REVIEW PHASING AND SCHEDULES

Pre-coordination/consultation with the assigned safety panel engineer and/or executive officer prior to formal data submittal is highly encouraged.

Discussions typically include, but are not limited to, an overview of general applicability of requirements and/or processes, safety review milestones/schedule planning, and/or coordination on specific technical subjects.

Pre-coordination activities do not replace phased safety reviews but are intended to supplement and assist the <END ITEMS> provider for the successful completion of the safety review process.

The schedule for phase 0, I, and II safety milestones generally relates to the <END ITEMS> development schedule to allow integration of safety into the design process. The <END ITEMS> provider shall coordinate with the assigned safety panel engineer in order to set the review schedule to obtain maximum benefit to development based on the results of the safety reviews. Phase 0 is held during the concept phase or at the start of the <END ITEMS>/element design. Phase I is associated with the Preliminary Design Review (PDR); phase II is associated with the CDR.

Phase III is associated with completion of safety verifications and/or the start of ground processing. When establishing a timeline for phase III, the <END ITEMS> provider should allow enough time to close potential issues that may result from a phase III review. The timing and completion of the phase III review and safety certification are critical to the launch schedule.

Phased safety reviews may be combined as negotiated with the safety review panel chairperson and as coordinated with the assigned safety panel engineer and executive officer. This practice may result in additional risk to the project and ISS Program. Reference Appendix G, Summary of Safety Review Process.

Safety data submittal for the ground safety review process (conducted by the GSRP) is required only at the phase III level; Phase 0, I, and II reviews are not required.

Safety reviews shall be completed prior to delivery of the <END ITEMS> from the provider to the next level integrator (e.g. packing or launch site facility, including any unique GSE). Safety reviews for <END ITEMS> processed at KSC shall be completed 30 days prior to delivery of the <END ITEMS> for ground processing. Transport vehicle owners may impose additional process/timeline requirements as reflected in Paragraph 3.4.

Additional ISS Program timelines/requirements mandating the completion of the safety review process may also be imposed upon <END ITEMS> providers and should be incorporated into the <END ITEMS> provider's integration schedule.

5.2 GENERAL REQUIREMENTS FOR ALL PHASES

The following paragraphs address safety data submittals related to various technical disciplines. HRs shall be supported by the minimum set of data as outlined below. Each HR should be completely usable as a "stand alone" document. However, cross referencing of common causes and their respective controls between HRs is acceptable when the alternative is duplication without providing additional insight to requirements compliance. It is also acceptable for "shared" supporting data to be contained within appendices rather than attaching multiple copies throughout a SDP. Each such HR shall clearly identify the flight and ground supporting data as identified in Appendices H, I, and J.

The applicable technical data in support of the HRs shall be submitted in one of the following methods: a) attached to the HR, b) as part of the SDP, or c) submitted to the appropriate technical discipline as identified in Appendices H, I, and J. Changes to technical support data shall be annotated.

In the following paragraphs, applicable NASA requirements are annotated. When applicable, IP technical specifications may be used when determined to meet or exceed the identified NASA requirements.

The following paragraphs will delineate requirements for all <END ITEMS>.

5.3 PHASE 0 TECHNICAL INTERCHANGE MEETING DATA REQUIREMENTS

If a Phase 0 TIM is planned, then the following are to be included by the <END ITEMS> provider as part of the phase 0 TIM data and submitted as stated in Paragraph 4.4:

For <END ITEMS> design and flight operations:

1. Conceptual <END ITEMS> description (including subsystems) and mission scenario.
2. Description of safety-critical subsystems and their operations.
3. Preliminary identification of hazards.

The description of the <END ITEMS> and its operation must be of sufficient detail to permit identification of all subsystems that may create hazards. Emphasis should be given to those subsystems that store, transfer, or release energy. The descriptions of the safety-critical subsystems must be of sufficient detail to identify the hazards in terms consistent with the conceptual design. In addition, the <END ITEMS> provider should address tentative plans for any flight operation (e.g., extravehicular activity, reverification of hazard controls) or ground operation that would require personnel certification to perform hazardous procedures.

The phase 0 TIM is not a requirement, but provides an opportunity for the <END ITEMS> provider to interact with the safety review panel early within the design phase and to provide initial feedback on safety hazards, preliminary causes, controls and verification approaches.

5.4 PHASE I SAFETY REVIEW

5.4.1 PHASE I DATA REQUIREMENTS

The following data is required to be included by the <END ITEMS> provider for the phase I safety reviews.

Flight System Design and Operations:

1. An overview description of the design and flight operations of the <END ITEMS> including:
 - a. Flight and ground system interfaces,
 - b. Operational scenarios related to assembly, start-up sequences, and nominal operations,
 - c. <END ITEMS> part name(s) and number(s), if known.
 - d. Descriptions of safety-critical subsystems and their operations, including schematics and block diagrams with safety features, inhibits, hazard controls and monitoring provisions.
 - e. Identify any safety-critical subsystems that are computer controlled, and identify the functional architecture associated with that computer control. Coordination with the Computer Safety Panel (CSP) may be required to determine the applicability of Computer Based Control System (CBCS) requirements. **<TBR-5-1>**
 - f. Include figures or illustrations to show all major configurations and identify all hazardous systems and subsystems.
 - g. Provide a list of limited life items that could create a hazardous condition if they were to remain in service past their certification (design and/or operational) expiration date. Include a description of the failure mode and potential hazard created, and identify the safe operational life and safe design life for each item.
 - h. Provide an initial return and/or disposal plan, if applicable.
2. Flight HRs and appropriate support data (Appendix H, Phase I Technical Data Submittal) shall be submitted per Paragraph 4.4.
3. A summary listing, in the description section, of safety-critical services provided by other elements.
4. For ISS <END ITEMS>, a description is necessary to understand the Fire Detection and Suppression (FDS) implementation approach. Sub-rack <END ITEMS> providers shall address the integrated system approach (using sub-rack services and/or ISS services) to fully define the FDS implementation strategy.
5. A preliminary maintenance hazard assessment (if applicable) shall be performed on flight <END ITEMS> to address the control of hazards during planned maintenance activities.

5.5 PHASE II SAFETY REVIEW

5.5.1 PHASE II DATA REQUIREMENTS

The following data is required to be included by the <END ITEMS> provider for the phase II safety review.

Flight System Design and Operations:

1. Updated overview descriptions of <END ITEMS> and flight operations specified in Paragraph 4.3F; this includes descriptions of <END ITEMS> operations through all mission phases.
 - a. Flight and ground system interfaces,
 - b. Operational scenarios related to assembly, start-up sequences and nominal operations,
 - c. <END ITEMS> part name(s) and number(s).
 - d. Updated descriptions of safety-critical subsystems and their operations, including schematics and block diagrams with safety features, inhibits, hazard controls and monitoring provisions.
 - e. Identify any safety-critical subsystems that are computer controlled, and identify the functional architecture associated with that computer control in meeting either SSP 50038 or SSP 51700.
 - f. Include figures or illustrations to show all major configurations and identify all hazardous systems and subsystems.
 - g. Provide an updated list of limited life items that could create a hazardous condition if they were to remain in service past their certification (design and/or operational) expiration date. Include a description of the failure mode and potential hazard created, and identify the safe operational life and safe design life for each item along with sufficient supporting verification data.
 - h. Provide an updated return and/or disposal plan, if applicable.
 - i. Preliminary hazardous commands list, if applicable
2. Flight HRs and appropriate support data (Appendix I, Phase II Technical Data Submittal) shall be submitted per Paragraphs 4.4 and 4.5.
3. A summary listing in the description section, of safety-critical services provided by other elements.
4. Identification of flight safety non-compliances.
5. The <END ITEMS> provider shall include an update of the FDS implementation approach:
 - a. Information on use of forced air flow, wire derating, circuit protection, materials usage, parameter monitoring (fan speeds, temperatures, current, etc.) and

SSP 30599
Revision F

- b. Responses to an out-of-limit condition, and
 - c. Suppression approach.
 - d. Sub-rack <END ITEMS> providers shall define the integrated rack approach.
6. Identification of operational controls within each hazard cause.
- a. Each operations control will begin with “[Operational Control]”
 - b. Verification methods may include
 - 1. Formal acceptance via the NASA Operational Control Agreement Database (OCAD) process.
 - 2. Statements such as “Review of input to payload procedures”
 - 3. References to hardware owner databases (e.g. Operational Control Matrix (OCM) [JAXA], European OCAD (eOCAD) [ESA], etc.)

The operational control implementation plan for other hardware providers with operations organizations (not listed above) shall be assessed on a case by case basis.
7. An updated maintenance hazard assessment (if applicable) shall be performed on flight <END ITEMS> to address the control of hazards during planned maintenance activities.
8. Items that require on-orbit verification and/or re-verification should document their applicable approach and include rationale, constraints, and detailed methodology.
9. A record of test failures, anomalies, and accidents involving qualification or potential flight <END ITEMS>. Include a safety assessment for items which may affect safety.
10. Status of action items assigned during previous safety reviews.

5.6 PHASE III SAFETY REVIEW

5.6.1 PHASE III DATA REQUIREMENTS

The following data is required to be included by the <END ITEMS> provider for the phase III safety review.

A. Flight System Design and Operation:

- 1. Updated overview descriptions of the as-built <END ITEMS> and flight operations specified in Paragraph 4.3(E).
 - a. Flight and ground system interfaces,
 - b. Operational scenarios related to assembly, start-up sequences and nominal operations,
 - c. <END ITEMS> part name(s) and number(s).

SSP 30599
Revision F

- d. Updated descriptions of safety-critical subsystems and their operations, including schematics and block diagrams with safety features, inhibits, hazard controls and monitoring provisions.
 - e. Identify any safety-critical subsystems that are computer controlled, and identify the CBCS architecture, software description, and final CBCS system design associated with that computer control.
 - f. Include figures or illustrations to show all major configurations and identify all hazardous systems and subsystems.
 - g. Provide a list of limited life items that could create a hazardous condition if they were to remain in service past their certification (design and/or operational) expiration date. Include a description of the failure mode and potential hazard created, and identify the safe operational life and safe design life for each item along with sufficient supporting verification data.
 - h. Provide a final return and/or disposal plan, if applicable.
 - i. Final hazardous commands list, if applicable.
2. Flight HRs and appropriate support data (Appendix J, Phase III Technical Data Submittal) shall be submitted per Paragraph 4.4.
 3. A summary listing in the description section, of safety-critical services provided by other elements.
 4. Listing of NCRs to safety requirements. A signed copy of each approved NCR shall be included, see Section 6.0.
 5. The <END ITEMS> provider shall include the final FDS implementation.
 6. Final operational controls identified within each hazard cause. Operational control database entry numbers (i.e. OCAD numbers, etc.) shall be documented in the verification section, as applicable (see section 5.5.1 for additional guidance on verification methods).
 7. A final maintenance hazard assessment (if applicable) shall be performed on flight <END ITEMS> to address the control of hazards during planned maintenance activities.
 8. Final list of items that require on-orbit verification and/or re-verification with details of applicable approaches for hazard controls and verifications.
 9. An updated record of test failures, anomalies, and accidents involving qualification or potential flight <END ITEMS> or baselined flight software if the software is used for hazard control. Include a safety assessment for items which may affect safety.
 10. Closure of action items assigned during previous safety reviews.
 11. ISS SVTL that identifies open safety verification methods (if open verifications exist).
 12. ISS_OE_906 signed by the <END ITEMS> provider.

B. GSE and Flight <END ITEMS> Ground Operations at KSC:

1. Final as built <END ITEMS> description and brief mission scenario.
2. Updated descriptions and matrices defining the final configuration of the GSE, the <END ITEMS> subsystems that are potentially hazardous during ground processing, and their ground operations. Include updated schematics and block diagrams with the as built safety features and inhibits identified.
3. Updated and finalized ground operations scenario, including any post-flight ground operations at KSC.
4. Updated and additional ground HRs, including support data (see Appendix J) that reflect the final configuration of the as-built GSE and planned <END ITEMS> use.
5. Updated and finalized ordnance data required by KNPR 8715.3, CHAPTER 20.
6. Updated and finalized on-dock delivery date at KSC.
7. Engineering drawings and stress analyses of safety critical subsystems when specifically requested.
8. A summary of all safety related failures and accidents involving the flight <END ITEMS> or GSE.
9. Status of action items assigned during previous safety reviews.
10. Finalized list of technical operating procedures that will be used at KSC with the hazardous procedures clearly identified. The list shall also state the proposed first use date of the procedure at KSC.
11. Verification that each flight system pressure vessel has a pressure vessel logbook showing pressurization, history, fluid exposure, and other applicable data. This verification shall account for the planned testing at KSC.
12. SVTL (for ground operations only) for a specific mission.
13. Certificate of Safety Compliance (GSRP Form 1) and demonstration that the design is in compliance with design requirements of KNPR 8715.3, CHAPTER 20.
14. Procedural hazard control matrix that identifies hazard control criteria within the associated work-authorization documents for all procedural hazards. The matrix is available via the GSRP website (see Appendix F).
15. Identification of ground safety non-compliances. Ground safety non-compliances must be approved as NCRs before the phase III safety review can be completed. A signed copy of each approved NCR shall be included in the phase III SDP (see Section 6.0).

5.6.2 INTEGRATED HAZARD ASSESSMENTS

Integrated hazards identified during the phase safety review process shall be the responsibility of the top-level <END ITEMS> provider, unless otherwise negotiated

SSP 30599
Revision F

among <END ITEMS> providers (see SSP 50417, Integrated Experiment Hazard Assessment Generic Baseline). Configurations requiring integrated safety assessments may include (but are not limited to): scientific equipment (experiments), cargo, visiting vehicles, ISS systems and modules. Negotiations between <END ITEMS> providers and integrators should begin at the start of the life cycle. The integrated SDP shall be submitted for a separate review at phase III. Hazards associated with the interaction between two or more <END ITEMS> or ISS must be addressed in an integrated HR.

For details regarding the ISS integrated hazard assessments performed by the ISS prime contractor, refer to section 3.2.1.

5.7 SAFETY VERIFICATION TRACKING LOG

All completed verification work shall be documented on the appropriate HR(s). The SVTL is used to formally document and status ISS safety verification work that is not completed at the time the phase III HR(s) is (are) prepared. Typical content of the SVTL includes: HR number/title, hazard cause/control number, and verification method with status, any unique associated ground operation constraints, whether independent verification is required, scheduled and actual completion date. The SVTL can be used for both flight and ground. The ISS_OE_764, Safety Verification Tracking Log (SVTL), template is acceptable for use as the SVTL.

Following approval of the phase III HR(s) or a series/reflow assessment (with open verifications), the <END ITEMS> provider shall communicate the updated flight SVTL status. The <END ITEMS> providers shall submit an updated SVTL in support of ISS Program milestone activities. Final SVTL shall be provided prior to ground or launch processing (as required by the launch provider). Frequency of updates shall be negotiated on a case by case basis with the executive officers and safety panel engineers.

If any verification items remain open on the flight HRs and are determined to be a constraint to ground operations, the <END ITEMS> provider shall identify them as such on the SVTL, both flight and ground, and provide rationale to support the safety of starting ground processing. Closure rationale shall be submitted to the safety review panel and/or the launch provider.

The acceptability of verification items allowed to be transferred to the SVTL is at the discretion of the safety review panel chairperson.

5.8 POST PHASE III ACTIVITIES

If there are changes/anomalies post-phase III to the <END ITEMS> that may affect the safe design or operation, the provider shall assess those changes/anomalies for safety impacts and forward the assessment for safety review panel disposition. New or revised HRs and support data shall be prepared, where applicable. Significant changes may require a delta phase safety review, as determined by the safety review panel chairperson. The chairperson decision for a delta review may be coordinated with safety panel members.

SSP 30599
Revision F

If the change has ground safety implications, it shall be reviewed and approved by the ground safety panel prior to proceeding with ground processing.

5.8.1 GROUND SAFETY POST PHASE III CHANGES

Any changes meeting the following criteria require <END ITEMS> providers to provide an updated safety assessment to the GSRP:

- A. New hazardous operations;
- B. New GSE or GSE being used in a different manner;
- C. Return of control of the flight <END ITEMS> (from KSC back to the <END ITEMS> provider) after turnover to KSC;
- D. The operations involve different Programs or the International Partners.

Submission of the assessment shall be as soon as possible; however, the GSRP may take up to 14 calendar days to complete its review.

5.8.2 ON-ORBIT RECONFIGURATION

On-orbit reconfiguration is defined when <END ITEMS> either 1) will be physically reconfigured by modular substitution/addition, or 2) will experience a change in planned use or manifested location.

<END ITEMS> providers shall provide safety assessments as detailed in Section 7.0, unless otherwise directed by the flight control team as noted in Section 5.8.3.

5.8.3 NEAR REAL-TIME/REAL-TIME FLIGHT SAFETY REVIEW PROCESSES AND COORDINATION

Flight safety review authority for new safety issues that occur in near real-time (beginning at the Stage Operations Readiness Review (SORR)) resides with the ISS Mission Management Team (IMMT), per ISS PPD 507A. Flight safety review authority for real-time on-orbit safety issues resides with the Flight Director. Either the IMMT or the flight control team may request input from the safety review panel prior to approval of requested activity.

6.0 NONCOMPLIANCE WITH ISS SAFETY REQUIREMENTS

<END ITEMS> shall meet all applicable safety requirements. In the event that the <END ITEMS> design is unable to comply with an applicable safety requirement, the safety non-compliance process provides a mechanism for the ISS Program to review and accept the increased risk.

If the developer identifies a non-compliant condition, efforts shall be taken to bring the item into compliance. If a solution cannot be found, then notification of the noncompliance to the safety review panel shall be provided immediately.

Approval of an NCR for the design or operation of <END ITEMS> will not relieve the developer of the responsibility to meet the requirement in any other element, subsystem, or component of other <END ITEMS>.

For <END ITEMS> with a non-compliant condition, additional rigor and scrutiny may be required to validate hazard controls, risk mitigations, and acceptance rationale relied upon for the safe design and operation of the <END ITEMS>.

Phase III HR(s) approval is (are) contingent upon ISS Program approval of the associated NCR.

6.1 NONCOMPLIANCE DEVELOPMENT AND PROCESSING

The <END ITEMS> provider shall comply with the NCR process as established in SSP 50123, Configuration Management Handbook, Appendix F. The <END ITEMS> provider shall document the safety non-compliance via ISS_CM_031, ISS Safety Noncompliance Report (NCR).

The <END ITEMS> provider shall coordinate agreement/concurrence through the appropriate technical forum(s), The <END ITEMS> provider shall coordinate agreement/concurrence through the appropriate technical forum(s), e.g. EVA AIT, DRIT, MSWG, prior to presentation to the safety review panel. In addition, the <END ITEMS> provider shall sponsor/present the NCR through the appropriate ISS Program control board(s) and panels. It is the responsibility of the <END ITEMS> provider to execute the process as is identified in SSP 50123, Appendix F, including submission to NASA ISS Configuration Management for distribution to appropriate ISS Program control board(s) and panels.

“Equivalent Safety” may be granted for noncompliant conditions that do not meet specific requirements in the exact manner specified; however, the <END ITEMS> design, procedure, or configuration satisfies the intent of the requirement by achieving a comparable or higher degree of safety.

Approval authority for “Equivalent Safety” type NCRs to SSP 50021 has been delegated by the ISS Program Manager to the NASA safety review panel as documented in ISS Program Charters and per memorandum OE-97-044, “Approval Authority for Safety Noncompliance Reports (NCR) for International Space Station (ISS) “Equivalent Safety” Hardware” as referenced in Appendix K. NASA safety review panel considers OE-97-044 to encompass equivalent safety NCRs to SSP 51700. Safety review panel

SSP 30599
Revision F

will determine the applicability of the NCR cases as defined in this memorandum against <END ITEMS> design.

The GSRP has been granted the authority to approve NCRs that impact only GSE or ground processing and have no impact to the flight <END ITEMS> design, flight operations, or flight safety.

6.2 EFFECTIVITY OF SAFETY NCRS

For those NCRs with limited effectivity the <END ITEMS> provider has the responsibility to correct the noncompliant condition prior to reflight of the same item, or prior to the flight of subsequent items of the same series. An NCR may be approved for unlimited use. NCRs considered for this effectivity will be those where the design, procedure, configuration, etc., does not comply with the safety requirement in the exact manner specified, but the intent of the requirement has been satisfied and a comparable or higher degree of safety is achieved.

7.0 SERIES AND REFLOWN EQUIPMENT

Series <END ITEMS> are defined as those of the same design and operation which were previously reviewed/approved by the safety review panel and/or IP safety organization.

Reflown <END ITEMS> are the actual items which were previously approved, transported, utilized on-orbit and is re-manifested for flight/use.

<END ITEMS> with significant re-design, changes to baselined controls/verification approaches and/or new hazards may warrant reclassification of the hardware as a delta-phase III and may require additional safety review panel coordination and discussion.

The <END ITEMS> provider shall be responsible for the safety of the series/reflown items and associated interfaces by assessing the applicability of the previously approved safety data to the planned application. The number and depth of the phase safety reviews required should be discussed during a pre-coordination meeting with the safety panel engineer.

The timeline for submission shall follow Paragraph 5.1.

The <END ITEMS> provider shall provide the following:

- A. Identification of all series/reflown <END ITEMS> to be used and the baseline safety analyses by document number, title, and release date. If chemicals, biological materials, and/or ionizing radiation are used, provide a comprehensive listing, even if similar to those flown previously
- B. Identification and assessment of changes in hardware/software and operations, which have safety impact, including required on-orbit verification/re-verification of hazard controls
- C. New or revised HR(s) with additional supporting data, and identification of HR(s) deleted or no longer applicable. Approved, baselined phase III HR(s) shall also be referenced
- D. An assessment of the baseline safety verification methods to determine which verification(s) must be re-opened. This would include any maintenance, structural inspections and/or refurbishment. Open verification items shall be tracked via SVTL, see Paragraph 5.7 for further details
- E. Assessment of limited life items for series/reflown <END ITEMS>, including a list which describes the failure mode and potential resulting hazard if they were to remain in service past their safe design and/or operational life
- F. Assessment (including any corrective action taken) of all flight and ground failures and anomalies
- G. ISS_OE_906, or confirmation that the previously submitted certificate remains valid for the updated transportation/operations scenario, see Paragraph 4.11 for further details.

SSP 30599
Revision F

- H. Assessment of safety non-compliances including the acceptance rationale for each, see Paragraph 6.1 for further details.
- I. For ground review: Verification that each flight system pressure vessel has a pressure vessel logbook showing pressurization history, fluid exposure, and other applicable data. This verification shall account for the planned testing at KSC.
- J. For ground review: A final list of procedures for ground processing. All necessary GSRP forms, including compliance letter (which must be signed for submittal) are available on the GSRP website (see Appendix F).

The ISS_OE_622, Reflow and Series Payload Hardware Reflight Assessment Reporting Sheet, template is acceptable for use to document a flight series/reflow safety assessment. If not utilizing the ISS_OE_622 template, <END ITEMS> providers shall also include a signature section to document Safety Review Panel approval.

7.1 SIMPLIFIED SERIES/REFLIGHT CERTIFICATION (SSRC) PROCESS

The ISS Program has developed specialized agreements with <END ITEMS> providers to utilize standard quality assurance/build-to processes (with required in-line product assurance verified through CoFR endorsement reporting provided to the ISS program). Such agreements shall be determined to meet the intent of the series/reflight safety review process noted here within, only after documented agreement between the <END ITEMS> provider, ISS Program, and the safety review panel. Memorandum "OE-13-001" and <TBR-7-1> define the criteria and process for implementation of the SSRC process.

Delivery of specific series/reflight safety assessments shall not be required for applicable <END ITEMS> that utilize the SSRC process.

8.0 TRANSPORT VEHICLE UNIQUE PROCESS REQUIREMENTS

The return/disposal of <END ITEMS> from the ISS requires additional assurance that during the period of time present/operating aboard the ISS, the <END ITEMS> have experienced no safety anomalies, changes, reconfigurations, and/or new hazards which could affect the transport vehicle and create a hazardous condition.

Table 8.0-1 provides guidelines regarding the delivery of safety assessments and supporting data to the safety review panel and IP transport vehicle review authorities.

TABLE 8.0-1 RETURN/DISPOSAL SAFETY ASSESSMENTS APPLICABILITY

Vehicle	Return (Category 1, 2)	Disposal (Category 1)	Disposal (Category 2)
ATV	N/A	No ¹	No ¹
CRS (Return)	Yes	Yes	Yes
CRS (Disposal)	N/A	No ¹	No ¹
HTV	N/A	No ^{1,2}	No ^{1,2}
Progress	N/A	No ^{1,3}	Yes ³
Soyuz	Yes ³	Yes ³	Yes ³

¹ Disposal safety coordinated via ISS Mission Evaluation Room (MER) and documented via Waste Manifest Request (WMR) and mission action request (chit) processes

² Disposal safety for HTV in accordance with JSX-2009059A

³ Disposal safety for Progress/Soyuz in accordance with SSP 50146, Attachment D

8.1 <END ITEMS> PLANNED FOR RETURN

The series/reflown safety assessment process (Section 7.0) is required for all <END ITEMS> planned for return on Soyuz and CRS vehicles, per Paragraphs 3.4.1 and 3.4.2.

Safety data shall be provided no later than undock-3 months. Selection of this timeframe protects for the verification of the most current <END ITEMS> on-orbit status/configuration close to packing operations in addition to the expedited distribution of series/reflown safety data to all required stakeholders and CoFR input support to the ISS Program/SORR process.

8.2 <END ITEMS> PLANNED FOR DISPOSAL

The series/re-flown safety assessment process (Section 7.0) is required for all Category 2 <END ITEMS> planned for disposal on Progress, per Paragraph 3.4.1.

Safety approval for <END ITEMS> proposed for disposal on other ISS transport vehicles are coordinated via the ISS Mission Evaluation Room (MER) via the Waste Manifest Request (WMR) and mission action request (chit) processes. Additional supporting data may be required as noted within Paragraphs 3.4.1 and 3.4.2, or as determined by the chit review/approval process.

APPENDIX A - ACRONYMS AND ABBREVIATIONS

AIAA	American Institute of Aeronautics and Astronautics
AIT	Analysis and Integration Team
ASI	Agenzia Spaziale Italiana
ASME	American Society of Mechanical Engineers
ATV	Automated Transfer Vehicle
BDEALS	Bilateral Data Exchange, Agreements, Lists, and Schedules
CBCS	Computer Based Control System
CDR	Critical Design Review
CCP	Commercial Crew Program
CE	Conducted Emissions
CFE	Contractor-Furnished Equipment
CM	Configuration Management
CoFR	Certification of Flight Readiness
COPV	Composite Overwrapped Pressure Vessel
COTS	Commercial Off-the-Shelf
COTS	Commercial Orbital Transportation Services
CRS	Commercial Resupply Service
CSA	Canadian Space Agency
CSG	Centre Spatial Guyanais
CSP	Computer Safety Panel
CTS	Crew Transportation Service
CW	Continuous Wave
DCN	Document Change Notice
DCP	Damage Control Plan
DFMR	Design For Minimum Risk
DOT	Department of Transportation
DQA	Document Quality Assurance
DRIT	Dexterous Robotic Integration Team
DRM	Design Reference Mission
e.g.	Example
ECP	Engineering Change Proposal
EDMS	Electronic Document Management System
EED	Electro-Explosive Device
EMC	Electromagnetic Compatibility
EMEP	Electromagnetic Effects Panel
EMI	Electromagnetic Interference
eOCAD	European Operational Control Agreement Database
ESA	European Space Agency
etc.	Etcetera
EVA	Extravehicular Activity
FCP	Fracture Control Plan

SSP 30599
Revision F

FCSR	Fracture Control Summary Report
FDS	Fire Detection and Suppression
FE	Factory Equipment
FL	Florida
FRAM	Flight Releasable Attach Mechanism
GFE	Government Furnished Equipment
GN2	Gaseous Nitrogen
GSE	Ground Support Equipment
GSRP	Ground Safety Review Panel
HA	Hazard Analyses
HAMR	Hardware Accountability Matrix Report
HMST	Hazardous Materials Summary Table
HR	Hazard Report
HTV	H-II Transfer Vehicle
IBLHA	Integrate Bag Level Hazard Assessment
ICD	Interface Control Document
IMMT	ISS Mission Management Team
IP	International Partner
IRD	Interface Revision Document
ISS	International Space Station
ISSA	International Space Station Alpha
JAXA	Japan Aerospace Exploration Agency
JSC	Johnson Space Center
KOZ	Keep-Out Zone
KSC	Kennedy Space Center
L-	Launch minus
m	meter
MDP	Maximum Design Pressure
MER	Mission Evaluation Room
MIP	Mission Integration Plan
MSVP	Mechanical Systems Verification Plan
MSVR	Mechanical Systems Verification Report
MSWG	Mechanical Systems Working Group
NASA	National Aeronautics and Space Administration
NCR	Non-Compliance Report
NDE	Nondestructive Evaluation
NLR	No License Required
NOHD	Nominal Ocular Hazard Distance
NSTS	National Space Transportation System

SSP 30599
Revision F

OCM	Operational Control Matrix
ORG	Organization
ORU	Orbital Replacement Unit
OSB	Outside-of-Board
PDR	Preliminary Design Review
PPD	Partner Program Directive
PR	Program Risk
PSRP	Payload Safety Review Panel
Ref	Reference
RF	Radio Frequency
RPODU	Rendezvous, Proximity Operations, Docking and Undocking
RS	Russian Segment
RSA	Russian Space Agency
RSC-E	Rocket Space Corporation - Energia
S&M	Structure and Mechanism
S&MA	Safety and Mission Assurance
SA	Solar Array
sccs	Standard Cubic Centimeter per Second
SDP	Safety Data Package
SORR	Stage Operations Readiness Review
SOW	Statement of Work
SPF	Safety Planning Forum
SPIA	Standard Payload Integration Agreement
SRM	Solid Rocket Motor
SRP	Safety Review Panel
SRR	Systems Requirements Review
SSC	Station Support Computer
SSCBD	Space Station Control Board Directive
SSCD	Space Station Change Directive
SSDBD	Space Station Document Board Directive
SSP	Space Station Program
SSPCB	Space Station Program Control Board
SSRC	Simplified Series/Reflight Certification
STE	Special Test Equipment
SVTL	Safety Verification Tracking Log
TBD	To Be Determined
TBR	To Be Resolved
TIM	Technical Interchange Meeting
TNT	Trinitrotoluene
TSE	Test Support Equipment
UN	United Nations
US	United States

SSP 30599
Revision F

USOS	United States On-orbit Segment
vs.	versus
VTL	Verification Tracking Log
W	watt
WFF	Wallops Flight Facility
WG	Working Group
WMR	Waste Manifest Request

APPENDIX B - GLOSSARY OF TERMS

CBCS

A control system which utilizes computer hardware, software, and/or firmware which accepts input information, and processes that information to provide outputs to perform a defined task.

COMMERCIAL OFF-THE-SHELF

Commercially available <END ITEMS> procured directly from a vendor or authorized distributor with no modifications.

<END ITEMS>

Items transported, transferred, stowed, operated on and/or removed from the ISS. <END ITEMS> include, but are not limited to: modules, visiting vehicles, specific scientific equipment (experiments), logistics, crew psychological support items, tools, spare instruments and assemblies, including waste.

FLIGHT

As related to a specific ISS Program transportation vehicle mission phase.

GOVERNMENT FURNISHED EQUIPMENT

Equipment acquired by the Government and delivered or otherwise made available to a non-Government organization.

GROUND SUPPORT EQUIPMENT

Deliverable equipment, both hardware and associated software, that is used on the ground to provide some means of support to flight systems or equipment. GSE includes test and checkout equipment, handling and transporting equipment, access equipment, and servicing equipment.

HAZARD

The presence of a potential risk situation caused by an unsafe act or condition.

HAZARD REPORT

The output of a safety analysis for a specific hazard which documents the hazard title, description, causes, control, verification, and status.

HAZARDOUS COMMANDS

Those that can remove an inhibit to a hazardous function, activate an unpowered hazardous system, reduce safety critical redundancy, create a fail-critical or hazardous condition, and/or control actively safety systems

INCREMENT

A specific time period into which various assembly, research, testing, logistics, maintenance, and other ISS system operations and utilization activities are grouped. Increment boundaries are typically established to coincide with, and defined, by ISS Program crew rotations.

SSP 30599
Revision F

INTEGRATED HAZARD ANALYSIS

Integrated assessments (experiment and/or systems) are developed by identifying interfaces that exist between the elements, assessing those interfaces with hazard potential, and documented results in the in the integrated analysis/integrated HRs. Any new or undocumented interface hazards are documented on a new HR.

LIKELIHOOD

As defined in SSP 50175, "The chance or probability of a future risk event occurring." after taking controls into account

MISSION

The performance of a coherent set of investigations or operations in space to achieve ISS Program goals.

NONCOMPLIANCE REPORT

A report used to document technical noncompliances to specific safety requirements.

SAFE DESIGN LIFE

Time period in which an <END ITEMS> can be retained at or restored to the specified safe operational condition via prescribed resources and procedures. Safe design life is considered the end of useful life without extensive effort and/or expense and must include both ground and on-orbit time.

SAFE OPERATIONAL LIFE

Time period in which an <END ITEMS> will perform its intended function within specified performance limits under stated conditions without any corrective maintenance, recalibration or repair. Safe operational life must include both ground and on-orbit time.

SAFETY

As defined in NHB 5300.4 (1D-2), "Freedom from chance of injury or loss of personnel, equipment or property."

SAFETY ANALYSIS

A systematic and orderly process for the acquisition and evaluation of specific information pertaining to the safety of a system.

SAFETY ASSESSMENT

Documented evidence of a safety analysis performed for given <END ITEMS>. Safety assessments typically include the presence of (a) hazard report(s), flight safety certificate, safety data package/series/reflight assessment, and non-compliance report (if applicable).

SEVERITY

This index quantifies the worst case accident or undesired event resulting from this cause without taking controls into account. Severity levels are Catastrophic, Critical, and Marginal.

APPENDIX C - OPEN WORK

Table C-1 lists the specific To Be Determined (TBD) items in the document that are not yet known. The TBD is inserted as a placeholder wherever the required data is needed and is formatted in bold type within brackets. The TBD item is numbered based on the section where the first occurrence of the item is located as the first digit and a consecutive number as the second digit (i.e., <TBD 4-1> is the first undetermined item assigned in Section 4 of the document). As each TBD is solved, the updated text is inserted in each place that the TBD appears in the document and the item is removed from this table. As new TBD items are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBDs will not be renumbered.

TABLE C-1 TO BE DETERMINED ITEMS

TBD	Section	Description

Table C-2 lists the specific To Be Resolved (TBR) issues in the document that are not yet known. The TBR is inserted as a placeholder wherever the required data is needed and is formatted in bold type within brackets. The TBR issue is numbered based on the section where the first occurrence of the issue is located as the first digit and a consecutive number as the second digit (i.e., <TBR 4-1> is the first unresolved issue assigned in Section 4 of the document). As each TBR is resolved, the updated text is inserted in each place that the TBR appears in the document and the issue is removed from this table. As new TBR issues are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBRs will not be renumbered.

TABLE C-2 TO BE RESOLVED ISSUES

TBR	Section	Description
SIGN ATUR E-1	Signature	Roscosmos document approval/signature
4-1	4.4	Data submittal timeframe
4-2	4.10.2	Approval of ISSP COTS Certification Process, SSP 50986
5-1,H- 1, I-1, J-1	5.4.1.e H-14, I-14, J-14	Applicability of SSP 50038 for payload/experiment <END ITEMS>
7-1	7.1	ISSP Work Instruction for the SSRC process
H-2, I- 2, J-2	H-17, I-17, J-17	Data submittal requirements for capacitors used as energy stowage devices

APPENDIX D - LIST OF FORMS

This section contains a list of the forms a developer may use in the flight and ground safety review processes.

ISS FORMS

Current versions of the following forms are available via the ISS Program Electronic Data Management System (EDMS) and are searchable directly by the form number:

<https://iss-www.jsc.nasa.gov/nwo/apps/edms/web/>

Number	Title	Description
ISS_CM_031	ISS Safety Noncompliance Report (NCR)	Documents approval of safety non-compliances.
ISS_Biosafety_713	In-flight Biohazardous Materials Approval Form	Documents approval of material for biological safety.
ISS_EP_03	EP5 Battery Design Evaluation Form	Documents approval of cell/battery systems.
ISS_OE_1298	Standard Hazard Report	Template for documenting common hazards, controls, and verifications.
ISS_OE_622	Series and Reflown Equipment Safety Assessment Reporting Sheet	Documents compliance to series/reflight criteria contained in section 7, SSP 30599.
ISS_OE_764	Safety Verification Tracking Log (SVTL)	Documents verification closure activity (post-phase III hazard report approval).
ISS_OE_851	Unique Hazard Report Form	Template for documentation of hazards, based upon ISS Hazards System.
ISS_OE_906	Flight Safety Certificate	Documents flight safety readiness for visiting vehicles and ISS operations/stowage.
ISS_OE_907	Multilateral Category 1 Constraints	Criteria used to determined hardware category (category 1 vs. category 2) in support of ISS_OE-906.
ISS_ToX_Dusts	Recommended Data Format for Powders and Granular Solids	Documents approval of material for toxicological safety.
ISS_ToX_Gases	Recommended Data Format for Gases	Documents approval of material for toxicological safety.
ISS_ToX_Liquids	Recommended Data Format for Liquids, Solutions, and Gels	Documents approval of material for toxicological safety.
ISS_ToX_Metals	Recommended Data Format for Metals to be Processed in a Furnace	Documents approval of material for toxicological safety.
ISS_CM_048	ISS Jettison Form	Documents approval of <END ITEMS> planned for jettison/deployment.
JSC Form 44	Ionizing Radiation Source Data Sheet - Space Flight Hardware and Applications.	Documents approval of material for radiation health impacts.

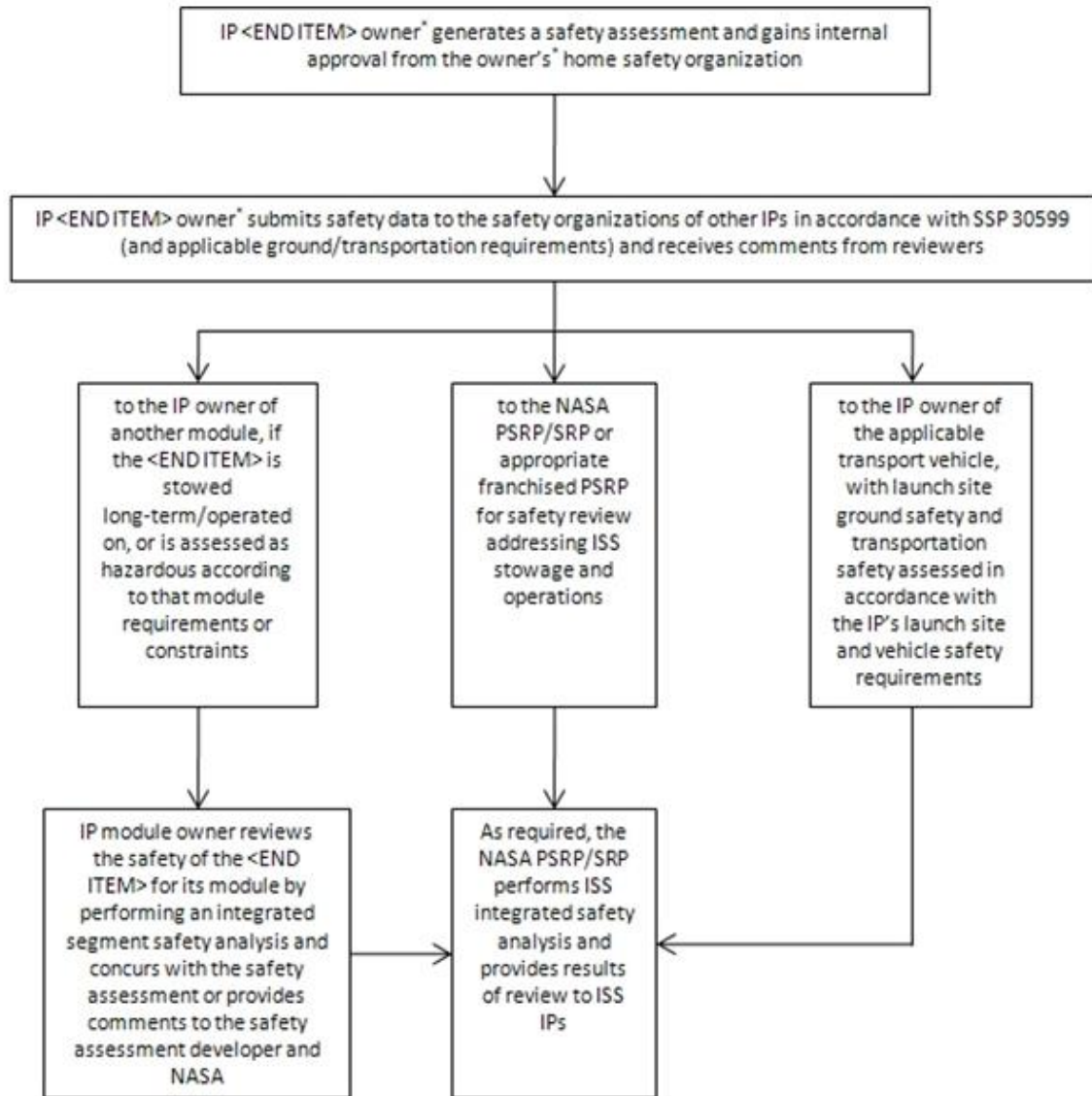
KSC FORMS

Current versions of the KSC/GSRP forms and matrices are available on the NASA/ISS GSRP home page (see Appendix F):

ATV/HTV/KSC Form 100	Integrated Safety Checklist for ISS Cargo At Launch or Processing Sites
GSRP Form 1	Certificate of Ground Safety Compliance
---	GSRP Battery Matrix
---	GSRP Ground Support Lifting/Handling Equipment Matrix
---	GSRP Ground Support Pressure System Components
---	GSRP GSE Materials List
---	GSRP Electro-Explosive Device (EED) Matrix
---	GSRP Hazard Controls Incorporated In Operational Procedures Matrix

APPENDIX E - ISS IP SAFETY CERTIFICATION DATA EXCHANGE FLOWCHART

NOTE: The term <END ITEMS> in the following refers to items transferred, stowed, operated on and/or removed from ISS. <END ITEMS> include specific scientific equipment (experiments), logistics, crew psychological support items, tools, spare instruments and assemblies, etc., including waste. Definition and categorization of waste items are contained in SSP 50481. Any issues identified will be worked through the item owner, the module or vehicle owner, and a safety panel. If consensus cannot be reached, the item may be rejected.



NOTE: * IP <END ITEMS> owner - ISS international partner who owns the <END ITEMS> or has a contract with any individual or legal entity for that <END ITEMS>. An IP that acquires an <END ITEMS> from another IP is responsible for its safety certification unless otherwise stipulated by a contract or other agreement.

APPENDIX f - SAFETY DATA SUBMITTAL

Questions regarding pre-coordination activities can be directed to the safety review panel executive officer via the following address:

jsc-dl-iss-srps-xos@mail.nasa.gov

<END ITEMS> providers shall submit flight safety data via the ISS Hazard System:

ISS Hazard System Website:

<https://hazard.iss.nasa.gov>

<END ITEMS> providers shall electronically submit a request for safety panel review via the following:

<https://oa.jsc.nasa.gov/OE/SRP/SitePages/Home.aspx>

The safety review panel executive officer and/or meeting services personnel can also provide additional information/instructions on acquiring access to NASA safety review panel databases (including detailed login instructions, and system procedures/processes), safety review panel scheduling, and requirements availability/access.

Ground safety data (KSC) shall be submitted to at the following address:

GSRP

**Mail Code SA-B
Kennedy Space Center, FL 32899**

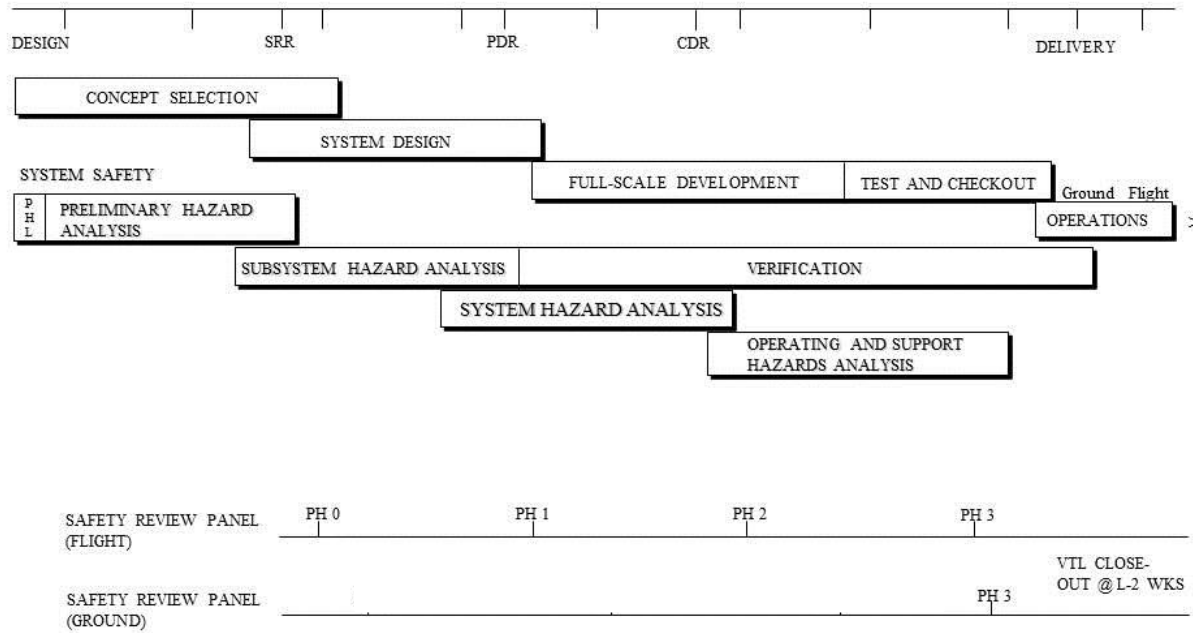
For electronic submittals, contact the GSRP.

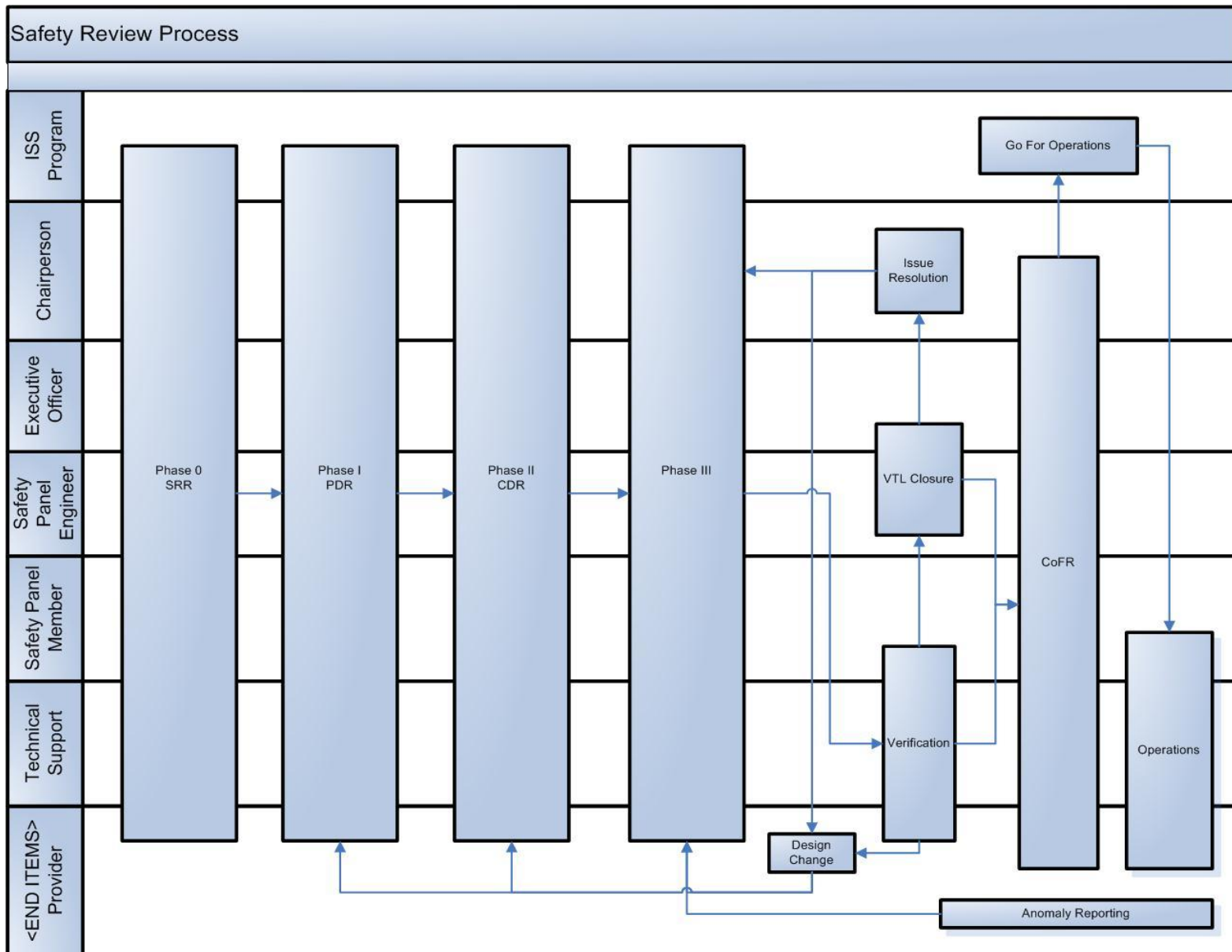
GSRP Website:

<http://kscsma.ksc.nasa.gov/GSRP/index.htm>

APPENDIX G - SUMMARY OF SAFETY REVIEW PROCESS

The Safety Review Process





Safety Review Process – Position Descriptions/Overview

Position	Position Description/Overview
ISS Program	Various positions/functions responsible for the integration, management, and implementation/operations of <END ITEMS> in support of the ISS Program.
Chairperson	Responsible for implementing and officiating Safety Panel activities with ISS Program Manager-delegated signature authority for approval of safety assessments, hazard reports, and Equivalent Safety Non-Compliance Reports.
Executive Officer	Assures consistent application and implementation of ISS Program technical/process requirements, including assistance in the interpretation of safety requirements, evaluation of safety analyses, and negotiation/resolution of safety issues.
Safety Panel Engineer	Provides technical liaison/support engineering functions between <END ITEMS> Provider and Safety Panel, facilitating safety review activities and technical evaluations of <END ITEMS> Provider-submitted safety products.
Safety Panel Member	Responsible for the coordination of review and comments from respective Technical Support disciplines to <END ITEMS Provider>, Safety Panel Engineer, and Safety Panel.
Technical Support	Responsible for the technical review/assessments of <END ITEMS> Provider-submitted safety data as subject matter/technical discipline experts.
<END ITEMS> Provider	Responsible for the development and presentation of safety products to the Safety Panel as designated representative of the provider.

SSP 30599
Revision F

Phase	Timing	General Safety Effort Required to Support Review	Purpose of Review
I	Preliminary Design Review	<ol style="list-style-type: none"> 1. Develop safety analysis/assessment report to reflect the preliminary design: <ol style="list-style-type: none"> a. Define hazards. b. Define hazard causes. c. Evaluate action for eliminating, reducing, or controlling hazards. d. Identify approach for safety verification. 2. Prepare a description of ground, assembly, maintenance, and nominal operations. 3. Determine compliance with SSP 50021 and SSP 51700 requirements. 	<ol style="list-style-type: none"> 1. Assess preliminary design against SSP 50021 and SSP 51700 requirements. 2. Evaluate preliminary hazard controls and safety verification methods. 3. Identify interface hazards and requirement inconsistencies.
II	Critical Design Review	<ol style="list-style-type: none"> 1. Refine and expand safety analysis/assessment report: <ol style="list-style-type: none"> a. Evaluate interfaces and mission (for ground) operations procedures, plans, and timeline. b. Update hazard descriptions, causes, and controls. c. Finalize test plans, analysis procedures, or inspections for safety verification. 2. Finalize description of ground, assembly, maintenance, and nominal scenarios. 3. Determine compliance with SSP 50021 and SSP 51700 requirements. 	<ol style="list-style-type: none"> 1. Assess final design against SSP 50021 and SSP 51700 requirements. 2. Identify potential non-compliances. 3. Concur on specific hazard controls and safety verification methods.
III	Prior to processing <END ITEMS> for launch	<ol style="list-style-type: none"> 1. Complete safety analysis. 2. For safety review panel, complete all significant safety verification test, analyses, and/or inspections. Open standard safety verification items are documented on the SVTL. 3. Submittal of flight safety certificate (ISS_OE_906) to the safety review panel. 4. For Ground – Submittal of GSRP Safety Certification Letter to KSC Operations 	<ol style="list-style-type: none"> 1. Approval of final safety assessment. 2. Resolve non-compliances 3. Identify and resolve open safety items. 4. Certificate of Ground Safety Compliance
Post phase III activities	Verification Complete	<ol style="list-style-type: none"> 1. Close open VTL items. 2. Assess real time changes 	<ol style="list-style-type: none"> 1. Support ISS Safety CoFR endorsement

APPENDIX H - PHASE I (FLIGHT) TECHNICAL DATA SUBMITTAL

1. Structures:

- a. Proposed Structural Verification Plan in accordance with SSP 30559, Structural Design and Verification Requirements, SSP 30560, Glass, Window, and Ceramic Structural Design and Verification Requirements, NASA-STD-5018, Strength Design and Verification Criteria for Glass, Ceramics, and Windows in Human Space Flight Applications, or SSP 52005, ISS Payload Flight Equipment Requirements and Guidelines for Safety Critical Structures.
- b. Verification plans for structural integrity of <END ITEMS> stowed or installed on ISS
- c. Fracture Control Plan (FCP) in accordance with applicable fracture control requirements (examples: SSP 30558, Fracture Control Requirements for Space Station, JSC 25863, Fracture Control Plan for JSC Flight Hardware, NASA-STD-5019, Fracture Control Requirements for Spaceflight Hardware, or IP-equivalent).
- d. Damage Control Plan (DCP) for structural composite/bonded structures and/or Composite Overwrapped Pressure Vessel (COPV), as applicable. Damage Control plan template is available upon request from the Fracture Control Group.
- e. Methodology for assurance of fastener integrity.
- f. Preliminary identification of structural materials, their intended use, configuration, and verification approach to assure that the material failure will not result in a hazardous condition.

2. Pressure Systems:

- a. Preliminary pressurized system schematic, operating parameters (e.g., temperature, pressure and other environmental conditions) and certification approach.
- b. Preliminary summary of the derivation of system Maximum Design Pressures (MDPs).
- c. Preliminary list of all system working fluids, their complete chemical composition, amounts, potential hazards (e.g., flammability, explosion, toxicity) and hazard category (e.g., catastrophic, critical, nonhazardous).
- d. Fracture Control Plan (FCP) in accordance with applicable fracture control requirements
- e. Damage Control Plan (DCP) for structural composite/bonded structures and/or Composite Overwrapped Pressure Vessel (COPV), as applicable. Damage Control plan template is available upon request from the Fracture Control Group.
- f. Preliminary table to show compliance with pressure systems safety requirements with columns for: 1) Item - (lines and fittings, components, or

pressure vessel), 2) Ultimate strength (design burst pressure), 3) system MDPs, 4) Factor of Safety (actual) as compared to Factor of Safety (required), 5) Proof Test Factor (Maximum Proof Test Pressure divided by MDP), 6) Leak rate method used for hazardous materials and 7) Containment integrity required (maximum allowed leak rate). If the Proof Test Factor will be less than 1.5 X MDP provide an explanation. See Appendix L.

- g. Preliminary identification of structural materials, their intended use, configuration, and verification approach to assure that the material failure will not result in a hazardous condition.
 - h. Proposed pressurized system(s) verification approach for controls to ensure pressure integrity.
 - i. For fluids whose leakage is hazardous also include: Proposed pressurized system(s) verification approach including controls to prevent leakage (e.g., levels of containment, Design for Minimum Risk (DFMR)).
 - j. For the DFMR approach to protect against leakage that may cause a catastrophic hazard include, but not limited to: 1) identification of mechanical fitting and leakage certification approach for wetted areas. Consider all environments where leakage is hazardous and 2) preliminary identification of fusion and bi-metallic joints within the system.
3. Pyrotechnic Devices:
- a. List of pyrotechnic devices and the functions performed.
4. Material Compatibility, Toxicity, Flammability, and Toxic Offgassing:
- a. Approach used to assure materials compatibility.
 - b. A tabulated list of tentative toxic materials and support data per JSC 27472, Requirements for Submission of Data Needed for Toxicological Assessment of Chemicals to be Flown on Manned Spacecraft.
 - c. Preliminary Hazardous Materials Summary Table (HMST) per JSC 27472
 - d. Preliminary materials assessment used in <END ITEMS> meet flammability requirements in operational configuration.
5. Ionizing Radiation:
- a. Ionizing Radiation Source Data Sheet (JSC Form 44), located at:
<http://srag.jsc.nasa.gov/form44/form44link.cfm>.
NOTE: A username and password are required to access this link.
Please contact the safety review panel for further assistance.
6. Non-Ionizing Radiation:
- a. List of equipment that generates non-ionizing radiation (Radio Frequency (RF) transmitters, light sources, etc.).
 - b. Submit preliminary Electromagnetic Interference (EMI)/Electromagnetic Compatibility (EMC) Test Plan to Electromagnetic Effects Panel (EMEP) or its

designated representative, for Conducted Emissions (CE), Radiated Emissions (RE), Conducted Susceptibility (CS), and Radiated Susceptibility (RS); applicable tests as determined by the <END ITEMS> intended application and criticality.

7. Permanent Magnets:

- a. Identify all permanent magnets, quantity, and magnetic field intensity/values.

NOTE: Applicable for all visiting vehicles/ISS modules with known magnetic field sensitivities/susceptibilities

8. Non-Ionizing Radiation – Lasers:

- a. Identify each laser, its operating location, and its complete beam path.
- b. Identify the laser hazard classification per ANSI Z136.1-2007, American National Standard for Safe Use of Lasers, or IEC-60825-1 Ed. 3, Safety of Laser Products.
- c. Identify each laser's operating characteristics (wavelength(s), (Continuous Wave) (CW)/pulsed).
- d. For CW lasers, provide average and peak powers.
- e. For pulsed lasers, provide pulse shape and energy characteristics and repetition frequency.
- f. Provide the laser manufacturer's specification sheet, if available.
- g. Identify each laser's transmission characteristics (beam diameter and beam divergence at accessible apertures, intensity profile) (class 1M, 2M, 3R, 3B and 4 only). Preliminary Nominal Ocular Hazard Distance (NOHD) and/or Nominal Hazard Zone (NHZ) analysis including a list of assumptions used in the analysis (window transmission factors, maximum exposure durations, atmospheric attenuation, reflections, etc.) (class 1M, 2M, 3R, 3B and 4 only) as defined by the ANSI Z136.1-2007.
- h. Preliminary description of controls and inhibits to contain laser beam or prevent inadvertent laser operation and/or crew exposure (interlocks, barriers, beam stops, etc.)
- i. Preliminary list of crew protective equipment (goggles, etc.), if required for hazard control.

9. Non-Ionizing Radiation - Radiofrequency Crew Exposure

- a. Identify each intentional radiofrequency emitter and scope of crewmember proximity operations to respective identified emitters.
- b. Identify proposed electromagnetic testing plan to meet the requirements of SSP 50005, International Space Station Flight Crew Integration Standard (NASA-STD-3000/T), 5.7.3.2.1 Radio-Frequency Electromagnetic Field Exposure. EMI/EMC or CE/RE testing protocol is acceptable.

SSP 30599
Revision F

- c. Determine whether scope of proximity operations necessitate near-field measurements and approximations to meet requirement SSP 50005 5.7.3.2.1 Radio-Frequency Electromagnetic Field Exposure.
- d. If scope of operations includes contact with active current carrying radiofrequency sources, requirement SSP 50021, 3.3.6.8.2 Crew Protection from Electrical Shock shall be applied.

10. Non-Ionizing Radiation - Broadband Light Exposure

- a. Identify each intentional broadband light source and scope of crewmember proximity operations to respective identified source.
- b. Identify proposed testing and/or verification plan to meet the requirements of SSP 50005 5.7.3.2.1 Limits on Exposure to Incoherent Electromagnetic Radiation.

11. Hazardous Commanding:

- a. Payloads:
 - 1. Provide functional schematic of ground command system including features that comply with interpretation letter TA-91-062, Payload Commanding, September 11, 1991.
 - 2. Provide preliminary compliance matrix based on interpretation letter TA-91-062. (Include placeholders for controls and verifications.)
 - 3. Preliminary hazardous command List
- b. ISS Systems
 - 1. Provide information to substantiate compliance to SSP 54500 "International Ground Systems Specification Document".
 - 2. Preliminary hazardous command list

12. Electrical Systems

- a. Preliminary power distribution schematic(s) showing wire sizing and circuit protection.
- b. Preliminary bonding and grounding diagram/plan.
- c. Preliminary diagrams for power distribution inhibits/controls for hazardous functions or controls.

13. Avionics Control:

- a. Preliminary diagram of safety-critical subsystems, that indicate inhibits, controls, and monitors.
- b. Preliminary verification approach for electrical safety-critical subsystems.
- c. Identify any usage of visiting vehicle and/or ISS electrical service to control a hazard.

14. Computer System:

SSP 30599
Revision F

a. Payloads

1. Provide a preliminary CBCS Matrix to the CSP assessing the safety compliance for items that utilize computers as more than 1 level of hazard control. Items in the CBCS matrix include (but not limited to):
 - a. Identify the specific features of the computer system used to control the hazard on the hazard report.
 - b. Describe the function(s) controlled by computer system that prevent a hazard from occurring or control a hazardous function.
 - c. Provide a block diagram of the CBCS with all inhibits to a hazard identified and describe how the inhibits independently control the hazard, including clear identification of control paths or other independent inhibit CBCS control methods.
2. Provide design features for CBCSs planned to control multiple inhibits to a hazard (i.e. designed to be greater than zero-fault tolerant).
3. Describe the development process (including verification) of software/hardware and computer based control.

<TBR-H-1>

b. Systems

1. Provide a preliminary CBCS Matrix to the CSP for items that utilize computers for hazard control. Items in the CBCS matrix include (but are not limited to):
 - a. Describe the independence of computer and non-computer methods of hazard control with block diagrams that detail the control of inhibits to a hazard.
 - b. Provide a description of computer system hazard controls, and the function(s) controlled by computer systems that prevent a hazard from occurring or control a hazardous function, including design features for CBCSs controlling multiple inhibits to a hazard and designed to be greater than zero-fault tolerant.
 - c. Describe the preliminary functional testing of the software/hardware and verification approach for the computer based hazard control system.

NOTE: This section applies only to computer systems (as defined in SSP 50038 Appendix C) used to control hazardous functions.

15. Mechanisms in Critical Applications:

- a. Provide a draft Mechanical Systems Verification Plan (MSVP) approach to the MSWG. The MSVP should include:
 1. A description of the system and each mechanism within it

SSP 30599
Revision F

2. Fault-tolerant approach for each safety-critical mechanism (summary of critical procedures and processes to meet safety requirements)
3. Whether Design For Minimum Risk (DFMR) approach that required compliance with JSC letter MA2-00-057, Mechanical Systems Safety, September 28, 2000, is requested to help meet fault tolerance requirements.
4. Any requests for a "Simple Mechanism" designation (must be granted prior to Phase I review)

NOTE: Supplying items i – iv at the TIM will help expedite the MSWG approval process

5. Fault-tolerance analysis explaining the hazard controls in place to meet fault-tolerance requirements for each safety-critical mechanism
6. A draft DFMR Matrix detailing how each of the 78 requirements in MA2-00-057 Mechanical Systems Safety Letter will be met for each mechanism relying on a DFMR designation

NOTE: A link to the MSWG website and the MA2-00-057 letter is available at: <http://mmptdpublic.jsc.nasa.gov/mswg/>

- b. Planned verification approach (test or analysis)
- c. d. Preliminary functional verification matrix
- e. Fracture Control Plan (FCP) in accordance with applicable fracture control requirements.

16. Solid Rocket Motors:

- a. Preliminary schematic showing electrical inhibits, controls and monitoring provisions to prevent premature firing.
- b. Preliminary characteristics of the Solid Rocket Motor (SRM).
- c. Preliminary SRM case Fracture Control Plan, preliminary SRM qualification plan with a history of the related, family of, rocket motors and propellants history.

17. Batteries:

- a. Preliminary list of type and number of cells and batteries, details of application and usage loads and environments, cell size (capacity), battery configuration (series/parallel), cell/battery chemistry, cell/battery manufacturer, model number(s), voltage, capacity, details of pre-flight test plan and on-orbit operations.
- b. Preliminary design approach to fault tolerance or design for minimum risk strategy to meet battery safety requirements of JSC 20793, Crewed Space Vehicle Battery Safety Requirements.
- c. State whether on-orbit cell/battery charging is intended.

SSP 30599
Revision F

- d. Provide a copy of ISS_EP_03, as submitted to JSC-EP5 Battery Office, for each cell/battery model and unique application or hardware.

NOTE: <TBR-H-2> for capacitors used as energy storage devices.

18. Fluid Propulsion Systems:

- a. Preliminary propulsion system schematic(s) and operating parameters (e.g., temperature, pressure, other environmental conditions, number of thrusters).
- b. Preliminary summary of the derivation of system MDP(s) per applicable technical safety requirements.
- c. Preliminary list of all system working fluids, their complete chemical composition, amounts, potential hazards (e.g., flammability, explosion, toxicity) and hazard category (e.g., catastrophic, critical, nonhazardous).
- d. Summary of pressure vessel(s) design and qualification approach.
- e. Fracture Control Plan in accordance with applicable fracture control requirements.
- f. Safe distance assessment and planned thrust level(s) used to determine it.
- g. Preliminary schematic(s) showing flow control devices, their electrical inhibits and monitoring provisions to prevent premature firing. Proposed verification approach for controls to prevent premature firing.
- h. Proposed propulsion system(s) verification approach for controls to ensure pressure integrity.
- i. For fluids whose leakage is hazardous also include: Proposed propulsion system(s) verification approach including controls to prevent leakage. To protect against leakage that may cause a catastrophic hazard include: 1) identification of mechanical fitting and leakage certification approach for wetted areas. Consider all environments where leakage is hazardous, 2) preliminary identification of fusion and bi-metallic joints within the system (See Appendix L).
- j. For fluids whose leakage is hazardous also include proposed propulsion system(s) containment integrity (including controls) to prevent hazardous fluid leakage, and verification (leak test) method.
- k. Since fluid propulsion systems are normally pressure systems, the data requirements for pressure systems are also applicable to fluid propulsion systems.
- l. Provide the standard, MIL, NASA, ANSI, or American Institute of Aeronautics and Astronautics (AIAA) or other sources that characterizes the propellant.
- m. If the propellant is new and the characteristics are not readily available from conventional sources then data shall be provided as detailed in Appendix M.

19. Sealed Containers:

- a. List the name of each sealed container.

SSP 30599
Revision F

- b. Provide preliminary identification of MDP, fluid(s), materials of construction for container enclosure, stored energy due to pressure, and environmental conditions.
- c. Confirm/show sealed container meets design requirements per SSP 30558, Fracture Control Requirements for Space Station, SSP 52005, or NASA-STD-5019, for sealed containers, respectively.

20. Extravehicular Activities:

- a. Identification of potential Extravehicular Activities (EVAs) including scheduled, unscheduled, and contingency including maintenance and retrieval. State which EVAs/EVA tasks are for mission success and which are intended as a hazard control.
- b. Preliminary safety assessment of hazards related to ISS environment.
- c. Description of <END ITEMS> affect on ISS floating potential.
- d. Description of EVA safety design features.

21. Biological Materials:

- a. ISS_Biosafety_713, "Inflight Biohazardous Materials Approval Form", per JSC 63828, Biosafety Review Board Operations and Requirements Document
- b. Preliminary Hazardous Materials Summary Table (HMST) per JSC 27472

22. Jettison and Deployment Operations:

- a. ISS Jettison Authorization Form, ISS_CM_048
- b. Preliminary data in compliance with ISS PPD 1011, Multilateral International Space Station (ISS) Jettison Policy

APPENDIX I - PHASE II (FLIGHT) TECHNICAL DATA SUBMITTAL

1. Structures:

- a. Final structural verification plan, including: 1) summary of design loads derivation leading to critical load cases, and 2) math model verification plan.
- b. Fracture Control status and parts categorization, which shall include but not limited to the list of fracture critical and low-risk fracture parts.
- c. Any unique or alternate approaches used in Fracture Control that require the approval of the Fracture Control authority.
- d. Updated identification of structural materials, their intended use, configuration, and verification approach to assure that the material failure will not result in a hazardous condition.
- e. For <END ITEMS> stowed or installed on ISS, provide summary of verification approach to meet ISS on-orbit load requirements including crew-induced loads for the on-orbit stowed or installed configurations.
- f. Summary of design loads derivation leading to critical load cases.
- g. Math model verification plan.

2. Pressurized Systems:

- a. Complete and updated pressurized system schematic(s) and operating parameters, addressing all pressurized hardware.
- b. Complete summary of the derivation of system MDP(s) per applicable technical safety requirements.
- c. Complete table of pressurized system hardware, MDP(s), proof pressure, ultimate pressure, resulting proof and ultimate safety factors and method of determining the safety factors (e.g., test, analysis, vendor data) should be fully disclosed except for information not yet available with respect to "Proof Factor (Maximum Test Pressure)" and "Leak rate method used for hazardous materials".
- d. Updated list of all system working fluids, their complete chemical composition, amounts, identified hazards and hazard category. Status on pressure vessel(s) design and qualification.
- e. Fracture Control status and parts categorization, which shall include but not limited to the list of fracture critical and low-risk fracture parts.
- f. Any unique or alternate approaches used in Fracture Control that require the approval of the Fracture Control authority.
- g. Updated identification of structural materials, their intended use, configuration, and verification approach to assure that the material failure will not result in a hazardous condition.

SSP 30599
Revision F

- h. Final pressurized system(s) verification approach for controls to ensure pressure integrity including a summary of qualification and acceptance test plans and analyses.
 - i. For fluids whose leakage is hazardous include: Final pressurized system(s) verification approach including controls to prevent leakage (e.g., levels of containment, DFMR). Include a summary of qualification and acceptance test plans and analyses.
 - j. For the DFMR approach to protect against leakage that may cause a catastrophic hazard include: 1) summary of certification test plans and analyses to prevent leakage of wetted mechanical fittings, 2) identification of system fusion joints and their method of Nondestructive Evaluation (NDE). Identification of system bi-metallic joint(s), manufacturer and certification data, and 3) complete list of wetted materials and their compatibility rating with system and cleaning fluids. Define credible single barrier failures which may release fluid into a volume that is not normally wetted and provide a summary of maximum worst case temperatures which were considered.
 - k. Qualification and acceptance test plan.
3. Pyrotechnic Devices:
- a. Detailed drawings of devices.
 - b. Chemical composition of any booster charge(s).
 - c. Inspection plan(s) for critical components.
 - d. Plan for evaluation of aging degradation.
 - e. Verification plan summary, including acceptance and qualification approach(s) (including margin demonstration), in accordance SSP 51700 or SSP 50021.
 - f. For pyrotechnic devices which must operate reliably in order to meet safety requirements, an acceptance and qualification plan shall be cleared and accepted by the NASA\JSC Pyrotechnic Office
4. Material Compatibility, Toxicity, Flammability, and Toxic Offgassing:
- a. Updated verification that <END ITEMS> meets toxic offgassing requirements
 - b. Updated HMST in accordance with JSC 27472
 - c. Updated verification that materials used in<END ITEMS> meet flammability requirements in operational configuration
 - d. Status on evaluation of materials compatibility with fluids
5. Ionizing Radiation:
- a. New/updated Ionizing Radiation Source Data Sheet (JSC Form 44), located at: <http://srag.jsc.nasa.gov/form44/form44link.cfm>.
NOTE: A username and password are required to access this link. Please contact the safety review panel for further assistance.

SSP 30599
Revision F

6. Non-ionizing Radiation:

- a. Updated list of equipment that generates non-ionizing radiation, including expected nominal operational characteristics of all non-ionizing radiation sources.
- b. Submit final EMI/EMC Test Plan to EMEP or its designated representative, for CE, RE, CS, and RS: applicable tests as determined by the <END ITEMS>'s intended application and criticality.

7. Permanent Magnets:

- a. Updated listing of all permanent magnets, quantity, and magnetic field intensity/values.

NOTE: Applicable for all visiting vehicles/ISS modules with known magnetic field sensitivities/susceptibilities

8. Non-ionizing Radiation (Lasers):

- a. Final NOHD/NHZ analysis (class 1M, 2M, 3R, 3B and 4 only) as defined by the ANSI Z136.1-2007.
- b. Final description of controls and inhibits to contain laser beam or prevent inadvertent laser operation and/or crew exposure.
- c. Final list of crew protective equipment (goggles, etc.), if required hazard control.
- d. Test plan for verifying operating and transmission characteristics of laser (class 1M, 2M, 3R, 3B and 4 only)

9. Non-Ionizing Radiation - Radiofrequency Crew Exposure

- a. If applicable, identify each intentional radiofrequency emitter Keep-Out Zones (KOZs) based on requirement SSP 50005, section 5.7.3.2., "Radio-Frequency Electromagnetic Field Exposure."
- b. If scope of operations includes contact or proximity operations indicate verification data of SSP 50021, section 3.3.6.8.2, "Crew Protection from Electrical Shock" and/or SSP 50005, section 5.7.3.2.1, "Radio-Frequency Electromagnetic Field Exposure."

10. Non-Ionizing Radiation - Broadband Light Exposure

- a. Identify Keep-out Zones (KOZs) or controls if applicable to meet requirement SSP 50005, 5.7.3.2.1

11. Hazardous Commanding:

- a. Updated list of hazardous commands and detailed implementation plan.
- b. Ground Commanding:
 - 1) Training plan for command controllers
 - 2) List of hazardous commands including procedures used to preclude inadvertent commanding

3) Description of command hardware

12. Electrical Systems:

- a. Updated power distribution schematic(s) showing wire sizing and circuit protection.
- b. Updated bonding and grounding diagram.
- c. Updated diagrams for power distribution inhibits/controls for hazardous functions or controls.

13. Avionics Control:

- a. Updated schematics of safety-critical subsystems that indicate inhibits, controls, monitors, and visiting vehicle/ISS interfaces.
- b. Verification approach (test pass/fail criteria) for each avionics leg of the hazard control/monitor subsystem, including test location procedures, and test apparatus used in substantiating end function.

14. Computer System:

- a. Payloads
 1. Provide an updated CBCS Matrix to the CSP assessing the safety compliance for items that utilize computers as more than 1 level of hazard control. Items in the CBCS matrix include (but not limited to):
 - a. Provide computer based hazard control verification approach for CBCS used for hazard controls.
 - b. Updated CBCS hazard control diagrams to show independence of inhibits, and provide verification details for CBCS that controls multiple inhibits to a hazardous function that confirms fault tolerance of CBCS and independence of inhibits.

<TBR-I-1>

- b. Systems
 1. Provide an updated CBCS Matrix to the CSP for items that utilize computers for hazard control. Items in the CBCS matrix include (but are not limited to):
 - a. Updated description of the independence of computer and non-computer methods of hazard control with block diagrams that detail the control of inhibits to a hazard.
 - b. Updated description of computer system hazard controls, and the function(s) controlled by computer systems that prevent a hazard from occurring or control a hazardous function, including design features for CBCSs controlling multiple inhibits to a hazard and designed to be greater than zero-fault tolerant.
 - c. Describe the functional testing of the software/hardware and verification approach for the computer based hazard control system.

SSP 30599
Revision F

NOTE: This section applies only to computer systems (as defined in SSP 50038 Appendix C) used to control hazardous functions.

15. Mechanisms in Critical Applications:

- a. Provide a final MSVP to MSWG. The final MSVP includes:
 1. Updates of critical procedures and processes to meet safety requirements
 2. Fault-tolerance analysis for the safety-critical mechanisms explaining the independent success legs in place to meet fault-tolerance requirements
 3. Completed DFMR Matrix detailing how each requirement in the MA2-00-057, Mechanical Systems Safety letter is or will be met for each mechanism relying upon a DFMR designation as a success leg.
 4. A complete discussion of the verification approach for each critical mechanism operation or feature
 5. Complete Dimensional Tolerance Analysis (including thermal effects) for all features affecting safety-critical mechanisms
 6. List of Mandatory Inspection Points (MIPs)
 7. All force/torque margin analyses
 8. Fracture control status and parts categorization, which shall include but not limited to the list of fracture critical and low-risk fracture parts.

16. Solid Rocket Motors:

- a. Updated schematic showing electrical inhibits, controls, and monitoring provisions to prevent premature firing, including power sources, inhibit control command sources and static control devices. Independence of inhibits shall be clearly depicted.
- b. Updated characteristics of SRM, including motor manufacturer, total mass and type of propellant, propellant formulation/ingredients, motor/propellant explosive classification, and case description.
- c. Cutaway diagram of the initiator.
- d. Diagram of the safe-and-arm device, indicating design and operation.
- e. SRM case Fracture Control Status.
- f. SRM qualification plan showing qualification analysis, qualification testing, and qualification of SRMs inspection to be used for acceptance of the SRMs with a history of the related, family of, rocket motors and propellants history.

17. Batteries:

- a. Confirmed list of type and number of cells and batteries, cell/battery size (capacity), cell/battery voltage, battery configuration, cell/battery chemistry, cell/battery manufacturer, and model number(s) and charging circuit (if applicable), usage load and environment (including launch and return/landing vehicles).

SSP 30599
Revision F

- b. Electrical power diagram detailing cell/battery safety circuit diagram including charging circuit showing compliance with applicable technical requirements. Diagram of charging devices, characteristics, and implementation procedures. Confirmed design approach to fault tolerance or design for minimum risk strategy to meet battery safety requirements of JSC 20793, "Crewed Space Vehicle Battery Safety Requirements." See requirements in JSC 20793, "Crewed Space Vehicle Battery Safety Requirements" and JWI 8705.3, "Battery Processing".
- c. Charging characteristics and procedures, e.g., pulse charging, charge rate, trickle charge rate, and method of charge termination.
- d. Describe on-orbit operations including charging, discharging, conditioning, battery replacement, stowage, and disposal procedures. Provide design details and a diagram for battery boxes that indicates materials of construction, absorbent material, venting provisions and other unique safety controls.
- e. Verification plan, including qualification, flight acceptance and lot sample testing (where applicable).
- f. Fracture control approach for battery cells where leakage causes a catastrophic hazard and for nickel-hydrogen batteries. (Refer to Paragraph 7.2 for data submittal on fracture critical pressurized components or pressure vessels).
- g. Updated ISS_EP_03 for each cell/battery model (as submitted to JSC\EP5).
NOTE: <TBR-I-2> for capacitors used as energy storage devices.

18. Fluid Propulsion Systems:

- a. Complete and updated propulsion system schematic(s) and operating parameters, addressing all pressurized hardware.
- b. Complete summary of the derivation of system MDP(s) per applicable technical safety requirements. Complete table of propulsion system hardware, MDP(s), proof pressure, ultimate pressure, resulting proof and ultimate safety factors, and method of determining the safety factors (e.g., test, analysis, vendor data).
- c. Updated list of all system working fluids, their complete chemical composition, amounts, identified hazards, and hazard category.
- d. Status on pressure vessel(s) design and qualification.
- e. Fracture control status and parts categorization, which shall include but not limited to the list of fracture critical and low-risk fracture parts.
- f. Updated safe distance assessment and planned thrust level(s) used to determine it.
- g. Updated schematic(s) showing flow control devices, and their electrical inhibits and monitoring provisions to prevent premature firing. Independence of inhibits shall be clearly depicted. Provide cut-away diagrams of the flow control devices. Final verification approach for controls to prevent premature firing.

SSP 30599
Revision F

- h. Final propulsion system(s) verification approach for controls to ensure pressure integrity, including a summary of qualification and acceptance test plans and analyses (See Appendix L).
- i. For fluids whose leakage is hazardous also include: Final propulsion system(s) verification approach, including controls to prevent leakage. Include a summary of qualification and acceptance test plans and analyses.
- j. To protect against leakage that may cause a catastrophic hazard, include:
 - 1) summary of certification test plans and analyses to prevent leakage of wetted mechanical fittings, 2) identification of system fusion joints and their method of NDE. Identification of system bi-metallic joint(s), manufacturer, and certification data, 3) complete list of wetted materials and their compatibility rating with system and cleaning fluids. Define credible single barrier failures which may release fluid into a volume that is not normally wetted and provide a summary of maximum worst case temperatures considered.
- k. Since fluid propulsion systems are pressure systems, the data requirements for pressure systems are also applicable to fluid propulsion systems.
- l. Provide the standard, MIL, NASA, ANSI, or AIAA or other sources that characterizes the propellant.

If the propellant is new and the characteristics are not readily available from conventional sources then data shall be provided as detailed in Appendix M.

19. Sealed Containers:

- a. List the name of each sealed container and verify that information furnished at Phase I is still valid. If not, identify and explain changes.
- b. Provide preliminary summary of analyses and tests for each sealed container as required by pressure ratings and verification methods.

20. Extravehicular Activities:

- a. Clarification of EVAs including scheduled, unscheduled, and contingency, identifying all EVA operational controls.
- b. Updated description and verification approach (including qualification and acceptance test/analysis/inspections) used to address hazards related to EVA hardware and ISS environments.
- c. Updated description of EVA <END ITEMS> design features' affect on ISS floating potential; if the <END ITEMS> impacts the ISS floating potential, evidence of coordination with the space environments group must be provided.
- d. Supporting verification data to demonstrate compliance with applicable Interface Control Documents (ICDs).
- e. Updated description of EVA design features.

21. Biological Materials:

SSP 30599

Revision F

- a. Updated ISS_Biosafety_713, "Inflight Biohazardous Materials Approval Form", per JSC 63828.
- b. Updated HMST in accordance with JSC 27472

22. Jettison and Deployment Operations:

- a. If applicable, updated ISS Jettison Authorization Form, ISS_CM_048.
- b. Updated data in compliance with ISS PPD 1011.

APPENDIX J - PHASE III (FLIGHT/GROUND) TECHNICAL DATA SUBMITTAL

1. Structures:

- a. Structural Verification Report that provides a summary of verification tests/analyses/inspections results.
- b. Fracture Control Summary Report (FCSR) or certification of compliance from a center or agency with whom an inter-center agreement has been established.
- c. Final identification of structural materials, their intended use, configuration, and verification status to assure that the material failure will not result in a hazardous condition.
- d. Documentation of compliance with fastener integrity program.
- e. For <END ITEMS> that will be stowed or installed on ISS, provide summary of verification tests/analyses/inspection results to meet ISS on-orbit load requirements including crew-induced loads for the on-orbit stowed or installed configurations.
- f. Final Loads Analysis Summary.

2. Pressurized Systems:

- a. Final pressurized system schematic(s) and operating parameters, addressing all pressurized hardware.
- b. Final MDP derivation summary and table of pressurized system hardware, including the "Proof Factor (Maximum Test Pressure)" and "Leak rate method for hazardous materials".
- c. Final list of all system working fluids, their complete chemical composition, amounts, hazards and categories.
- d. Certification of pressure vessel(s) design, including qualification and acceptance test results.
- e. Fracture Control Summary Report (FCSR) or certification of compliance from a center or agency with whom an inter-center agreement has been established.
- f. Final identification of structural materials, their intended use, configuration, and verification status to assure that the material failure will not result in a hazardous condition.
- g. For safe life and limited life pressure vessels, document existence of a Pressure Log, including log number.
- h. Summary of results from verification tests/analyses/inspections for controls to ensure pressure integrity.
- i. For fluids whose leakage is hazardous also include: Summary of results from verification tests/analyses/inspections for controls to prevent leakage.
- j. For the DFMR approach to protect against leakage that may cause a catastrophic hazard include: 1) summary of results from certification tests and

SSP 30599
Revision F

analyses on wetted mechanical fittings, 2) final list of system fusion joints and results from NDE. Final list of system bi-metallic joint(s), manufacturer(s) and certification data, 3) final list of wetted materials and their compatibility rating with system and cleaning fluids.

3. Pyrotechnic Devices:

- a. Summary of verification tests/analyses/inspections results.

4. Material Compatibility, Toxicity, Flammability, and Toxic Offgassing:

- a. Final verification that <END ITEMS> meets toxic offgassing requirements. Results of offgas tests (if performed) in accordance with NASA-STD-6001B or IP equivalent.
- b. Updated HMST in accordance with JSC 27472.
- c. Final verification that materials used in <END ITEMS> meet flammability requirements in operational configuration
- e. Final evaluation of materials compatibility with fluids.

5. Ionizing Radiation:

- a. Approved JSC Form 44.

6. Non-ionizing Radiation:

- a. Final list of equipment that generates non-ionizing radiation (for all powered <END ITEMS>), including actual nominal operational characteristics of all non-ionizing radiation sources.
- b. Submit final report of the EMEP, or designated representative, approval of relevant EMI/EMC test results, including any Tailoring Agreements (TIAs) approved by the EMEP.

7. Permanent Magnets:

- a. Final listing of all permanent magnets, quantity, and magnetic field intensity/values.

NOTE: Applicable for all visiting vehicles/ISS modules with known magnetic field sensitivities/susceptibilities

8. Non-ionizing Radiation (Lasers):

- a. Summary of verifications and test results.

9. Non-Ionizing Radiation – Radiofrequency Crew Exposure:

- a. Summary of verifications and test results.

10. Non-Ionizing Radiation – Broadband Light Exposure:

- a. Summary of verifications and test results.

11. Hazardous Commanding:

- a. A final hazardous commands list

SSP 30599
Revision F

- b. Verification of <END ITEMS> implementation plan.
- c. Ground Commanding:
 - 1) Training plan for command controllers
 - 2) List of hazardous commands including procedures used to preclude inadvertent commanding
 - 3) Description of command hardware

12. Electrical Systems:

- a. As-built power distribution schematic(s) that show wire sizing, circuit protection and bonding and grounding.
- b. Summary of verification tests/analyses/inspection results for bonding and grounding.
- c. Final diagrams for power distribution inhibits/controls for hazardous functions or controls.

13. Avionics Control:

- a. As-built schematics of safety-critical subsystems that indicate inhibits, controls, and monitors.
- b. Summary of test results and summary of test procedures, including hardware testing and/or fully integrated testing.

14. Computer System:

- a. Payloads
 - 1. Provide a final CBCS Matrix to the CSP assessing the safety compliance for items that utilize computers as more than 1 level of hazard control. Items in the CBCS matrix include (but not limited to):
 - a. Provide a summary of results of computer based hazard control verification activity, including summaries of any failures/errors of the baselined flight software used for hazard control.
 - b. Final CBCS hazard control diagrams to show independence of inhibits, and provide verification details for CBCS that controls multiple inhibits to a hazardous function that confirms fault tolerance of CBCS and independence of inhibits.

<TBR-J-1>

- b. Systems
 - 1. Provide a final CBCS Matrix to the CSP for items that utilize computers for hazard control. Items in the CBCS matrix include (but are not limited to):
 - a. Final description of the independence of computer and non-computer methods of hazard control with block diagrams that detail the control of inhibits to a hazard.

- b. Final description of computer system hazard controls, and the function(s) controlled by computer systems that prevent a hazard from occurring or control a hazardous function, including design features for CBCSs controlling multiple inhibits to a hazard and designed to be greater than zero-fault tolerant.
- c. Describe the functional testing results of the software/hardware and verification status for the computer based hazard control system.

NOTE: This section applies only to computer systems (as defined in SSP 50038 Appendix C) used to control hazardous functions.

15. Mechanisms in Critical Applications:

- a. Provide an up-to-date copy of MSVP
- b. Provide a Mechanical Systems Verification Report (MSVR). The MSVR includes:
 - 1. Final description of the as-built system and identification of the safety-critical mechanisms.
 - 2. Results of all verification testing, analyses, and inspections.
 - 3. Trade/special studies supporting HRs
 - 4. Flight HRs and appropriate support data (see paragraph 5.5.1)
 - 5. A summary listing in the SDP description section, of safety-critical services, and an explanation in the appropriate HRs of the ISS services used to control and/or monitor hazards
- c. Completed functional verification matrix
- d. Fracture Control Summary Report, (FCSR) or certification/paper of compliance from a center or agency with whom an inter-center agreement has been established.

16. Solid Rocket Motors:

- a. Final schematic showing electrical inhibits, controls, and monitoring provisions to prevent premature firing, including power sources, inhibit control command sources, and static control devices. Independence of inhibits shall be clearly depicted.
- b. Final characteristics of SRM, including motor manufacturer, total mass and type of propellant, propellant formulation/ingredients, motor/propellant explosive classification and case description.
- c. A table listing the inhibits, when last cycled (actuated), and the final pre-launch state.
- d. Final cutaway diagram of the initiator.
- e. Updated diagram of the safe-and-arm device, indicating design and operation.
- f. SRM case fracture control summary.

SSP 30599
Revision F

- g. SRM qualification analysis summary, qualification testing summary (number of motor hot firings and family of motors operational performance), SRM NDE acceptance inspection summary with a history of the related, family of, rocket motors and propellants history.

17. Batteries:

- a. Final list of type and number of cells and batteries, cell size/battery size (capacity), battery configuration (series/parallel), cell/battery chemistry, cell manufacturer, and model number(s), usage loads and environment, details of application and launch and landing vehicles.
- b. Final circuit diagrams, including safety circuitry, fracture control summary report (where applicable), and charging circuit showing compliance with applicable technical safety requirements. Final design for fault tolerance controls or design for minimum risk strategy to meet battery safety requirements. See requirements in JSC 20793, "Crewed Space Vehicle Battery Safety Requirements" and JW1 8705.3 "Battery Processing."
- c. Final on-orbit operations including charging, discharging, conditioning, battery replacement, stowage and disposal procedures.
- d. Final design details and a diagram for battery boxes that indicates materials of construction, absorbent material, venting provisions and other unique safety controls.
- e. Results of verification tests for the safety controls and fault tolerance mitigations, results of qualification and flight acceptance tests, results of lot acceptance tests where applicable, as well as final analyses and inspection closures.
- f. Approved and signed ISS_EP_03 by JSC\EP5.

NOTE: <TBR-J-2> for capacitors used as energy storage devices.

18. Fluid Propulsion Systems:

- a. Final propulsion system schematic(s) and operating parameters, addressing all pressurized hardware.
- b. Final MDP derivation summary and table of propulsion system hardware.
- c. Final list of all system working fluids, their complete chemical composition, amounts, hazards, and categories.
- d. Certification of pressure vessel(s) design, including qualification and acceptance test results.
- e. Fracture Control Summary Report,(FCSR) or certification/paper of compliance from a center or agency with whom an inter-center agreement has been established.
- f. For safe life and limited life pressure vessels, document existence of a Pressure Log, including log number.

SSP 30599
Revision F

- g. Final safe distance assessment.
- h. Final schematic(s) showing flow control devices, and their electrical inhibits and monitoring provisions to prevent premature firing. Summary of results from verification tests/analyses/inspections for controls to prevent premature firing.
- i. Summary of results from verification tests/analyses/inspections for controls to ensure pressure integrity.
- j. For fluids whose leakage is hazardous also include: Summary of results from verification tests/analyses/inspections for controls to prevent leakage. To protect against leakage that may cause a catastrophic hazard, include:
 - 1) summary of results from certification tests and analyses on wetted mechanical fittings,
 - 2) final list of system fusion joints and results from NDE.Final list of system bi-metallic joint(s), manufacturer(s), and certification data,
 - 3) final list of wetted materials and their compatibility rating with system and cleaning fluids.
- k. Since fluid propulsion systems are pressure systems, the data requirements for pressure systems are also applicable to fluid propulsion systems.
- l. Provide the standard, MIL, NASA, ANSI, or AIAA or other sources that characterizes the propellant.
- m. If the propellant is new and the characteristics are not readily available from conventional sources then data shall be provided as detailed in Appendix M.

19. Sealed Containers:

- a. List the name of each sealed container and verify that information furnished at Phase II is still valid. If not, identify and explain changes.
- b. Provide final identification of MDP, fluid(s), materials of construction for container enclosure, stored energy due to pressure, and environmental conditions.
- c. Provide final acceptance rationale for each sealed container including a summary of any required analyses and tests.

20. Extravehicular Activities:

- a. Results of verification test, analyses, fit checks, and inspections.
- b. Final design information of any design features which may affect ISS floating potential or create electrical shocks.
- c. Final verification data to demonstrate compliance to applicable ICDs.
- d. All safety non-compliance reports for external <END ITEMS> shall have a concurrence signature from the EVA Analysis Integration Team.

21. Biological Materials:

- a. Final ISS_Biosafety_713, "Inflight Biohazardous Materials Approval Form", per JSC-63828.

SSP 30599
Revision F

- b. Final HMST in accordance with JSC 27472.

22. Jettison and Deployment Operations:

- a. If applicable, updated ISS Jettison Authorization Form, ISS_CM_048.
- b. Updated data in compliance with ISS PPD 1011.

APPENDIX K - EQUIVALENT SAFETY POLICY LETTER

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Road 1
Houston, Texas 77058-3696



October 10, 1997

Reply to Attn of: OE-97-044

TO: OE/Manager, Safety and Mission Assurance/Program Risk
FROM: OA/Manager, International Space Station Program
SUBJECT: Approval Authority for Safety Noncompliance Reports (NCR's) for International Space Station (ISS) "Equivalent Safety" Hardware

The purpose of this memorandum is to authorize the ISS Safety Review Panel (SRP) to approve safety NCR's where "equivalent safety" has been achieved. The ISS SRP safety assessments already include considerations of factors whereby the intent of SSP 50021 has been achieved by some means other than strict compliance with a requirement in the exact manner specified. Achieving the intent of SSP 50021 is defined as a condition whereby flight equipment will provide comparable (equivalent) or a higher degree of safety than would a literally compliant design. "Equivalent safety" NCR's are those NCR's whose rationale for acceptance includes consideration of factors which will indicate that a comparable or higher degree of safety has been attained.

This authorization to approve equivalent safety-type NCR's has previously been granted by the Space Shuttle Program (SSP) to the SSP Payload Safety Review Panel (PSRP). Since the SRP is a joint ISS Program and SSP panel and is actually performing the function of the PSRP for ISS elements utilizing the Shuttle, there is a need to have a consistent policy of delegation of authority to assess these NCR's between the ISS Program and SSP. This authorization applies specifically to the following NCR cases:

- 1. Single Failure Tolerance to a Catastrophic Hazard with a Limited Time of Exposure.** Reduced time of exposure to hazard causes may be considered the equivalent of additional failure tolerance in some specific flight safety situations. This consideration applies to designs where it has been determined that preexisting failures will have been detected and all failures causing the hazard must occur within a very limited time window. Equivalent safety is possible only if it can be established that the design will be single failure tolerant during the limited time of exposure.

2. **Single Failure Tolerance to a Catastrophic Event where the Probability of the Catastrophic Affects, after Two Failures, are 1×10^{-4} or Less.** If the probability of occurrence, after two failures, approached the probability of failure of an inhibit, the safety equivalent of a compliant design would be achieved. Consideration of this type of uncertainty will be included in the ISS SRP deliberations, and when the probability of hazard occurrence after two failures reaches 1×10^{-4} or less, equivalent safety has been achieved.
3. **Single Failure Tolerance to a Hazardous Event where there is Significant Uncertainty as to whether or not the Event is Actually Catastrophic.** It is extremely difficult to place some hazards in the proper hazard severity category (critical or catastrophic). In order to avoid unnecessary impacts to ISS hardware due to an overly conservative safety policy, the SRP will consider this uncertainty in its evaluation of hazard reports and NCR's. The hazard reports will be assessed against the two failure tolerant criteria necessary for the control of catastrophic hazards; however, if the design is at least single failure tolerant to the hazardous event, and if in the engineering judgment of the SRP the hazard severity is sufficiently uncertain, equivalent safety will have been achieved and may be used as acceptance rationale for an equivalent safety-type NCR.
4. **Designs that Exceed Intravehicular Activity (IVA) and Extravehicular Activity (EVA) Human Factors Safety Requirements.** SSP 50021, ISS Safety Requirements, contains many requirements related to IVA and EVA human factors-type design criteria for sharp edges, pinch points, protrusions into translation paths, and touch temperatures. These criteria are very conservative and provide adequate margin to protect the crew from hazards. However, due to the conservative nature of these requirements, there are many designs that have a noncompliance with these specific requirements, but still provide equivalent safety by alternate means. These alternate means include caution or warning in crew procedures, protective devices, swatch testing with EVA suit material, keep-out zones, hardware inspections and assessments by the flight crews, etc. With SRP approval of these alternate means, equivalent safety will be achieved.
5. **Other Factors Affecting Failure Tolerance and Design to Minimum Risk Areas.** Other factors than those addressed above may be considered for determining whether or not equivalent safety has been achieved. The consideration of equivalent safety will only be used when it is determined that the hazard control or safety verification method being utilized meets the intent of the safety requirement without increase of safety risk. If the hazard control is required to meet failure tolerance criteria, the design must be at least single failure tolerant to prevent the hazardous consequences. If "design for minimum risk" criteria apply to the control of the hazard, then the "other factors" considerations must establish that the intent of the requirement being addressed in the NCR has been met.

APPENDIX L - EXAMPLE PRESSURE SYSTEM COMPLIANCE TABLE

	Ultimate Strength - (Design Burst Pressure) ¹ (psig)	Proof Pressure, (psig)	System MDP ²	Ultimate Factor of Safety (Design Burst Pressure divided by MDP)	Required Ultimate Factor of Safety	Actual Factor of Safety (maximum Proof Test Pressure divided by MDP) ³	Leak Rate Method Used ⁴	Containment integrity Pass/Fail criteria
Components:					2.5			
i.e. GN2 isolation valve (list all the components)	1000	150	100	1000/100=10	2.5	150/100=1.5	Bubble soap	No bubbles detected
Lines and fittings:					4	1.5		
Lines (list all the lines and fittings)	5000	150	100	50	4		Bubble soap	bubbles detected
Fittings, (list all the different fittings)	4000	150	100	40	4		Bubble soap	bubbles detected
Pressure Vessels:					See note 5			
Pressure Vessel (show each pressure vessel)	4000	3000	2000	2	2	1.5	Helium mass spectrometer	<10 ⁻⁷ sccs

¹ Ultimate Strength (Design Burst Pressure) may be determined by analyses, test or manufacturing rating

² Within the system there may be more than one MDP

³ If Actual Factor of Safety is not equal or greater than 1.5 x MDP, provide explanation

⁴ Describe the leak rate method used (Immersion, Foam/Liquid Application, Pressure Change, etc. consistent with those documented in SSP 41172 Methods I, XII, or III or SSP 57000 "Pressurized Payloads Interface Requirements Document"

⁵ Small pressure vessel may comply with ASME code FS of 4 or greater, or spaceflight rated may be as low as FS of 2 (FS 1.5 is no longer allowed)

APPENDIX M – NEW PROPELLANT DATA SUBMITTAL REQUIREMENTS

PHASE I (FLIGHT)

The following additional data shall be provided, including but not limited to:

1. Complete chemical composition, of reactants and combustion products, including all additives and/or mixtures, proportions and tolerances on the proportions.
 - a. Energy, energy density, propellant mass, total explosive energy expressed in the equivalency of pounds of Trinitrotoluene (TNT).
 - b. Thermodynamic characterization, Phase Diagrams showing the triple point and critical temperature and critical pressure, vapor pressure, density vs. temperature, enthalpies, thermophysical and transport properties.
 - c. Sensitivity to shock initiation and propagation (e.g., Critical diameter) and method determined.
 - d. Sensitivity to mechanical impact and method determined.
 - e. Compatibility with all wetted propulsion system materials to propellant and propellant to all propulsion system materials. Provide long-term (>1 year) storability data to demonstrate propellant and material stability.
 - f. Cleanliness, purity, and contamination control requirements.
 - g. Thermal stability and method determined.
 - h. Minimum Ignition Energy (MIE) and susceptibility to Electrostatic Discharge and methods used to determine.
 - i. Auto-ignition/auto-decomposition temperature and method used to determine.
 - j. Susceptibility to adiabatic bubble compression ignition and method used to determine.
 - k. Susceptibility to EMI/RF environments and method used to determine.
 - l. Combustion temperature, products, and combustion stability.
 - m. Status of obtaining an United Nations (UN)/Department of Transportation (DOT) classification, slow cook-off, fast-cook-off, impact test results.
 - n. Provide propellant characterization testing summary.
 - o. Basic rocket performance characterization, including: specific impulse, density specific impulse, characteristic exhaust velocity, etc.
 - p. Toxicity.

If not currently available, develop and submit for review a detail test plan for generating the following data prior to Phase II.

PHASE II (FLIGHT)

The following additional data shall be provided, including but not limited to:

Complete all necessary testing and analyses, as needed in order to generate the following data - Provide final results as applicable to the flight configuration:

1. Complete chemical composition, of reactants and combustion products, including all additives and/or mixtures, proportions and tolerances on the proportions.
2. Final energy, energy density, propellant mass, total explosive energy expressed in the equivalency of pounds of Trinitrotoluene (TNT).
3. Thermodynamic characterization, including Final Phase Diagrams showing the triple point and critical temperature and critical pressure, vapor pressure, density vs. temperature, enthalpies, thermophysical and transport properties.
4. Sensitivity to shock initiation and propagation (e.g., Critical diameter) and method determined.
5. Sensitivity to mechanical impact and method determined.
6. Compatibility with all wetted propulsion system materials to propellant and propellant to all propulsion system materials. Provide long-term (>1 year) storability data to demonstrate propellant and material stability.
7. Cleanliness, purity, and contamination control requirements.
8. Thermal stability and method determined.
9. Minimum Ignition Energy (MIE) and susceptibility to Electrostatic Discharge and methods used to determine.
10. Auto-ignition/auto-decomposition temperature and method used to determine.
11. Susceptibility to adiabatic bubble compression ignition and method used to determine.
12. Susceptibility to EMI/RF environments and method used to determine.
13. Combustion temperature, products, and combustion stability.
14. Status of obtaining an UN/DOT classification, slow cook-off, fast-cook-off, impact test results.
15. Provide system level verification test Plan.
16. Basic rocket performance characterization, including: specific impulse, density specific impulse, characteristic exhaust velocity, etc.
17. Toxicity

PHASE III (FLIGHT/GROUND)

The following additional data shall be provided, including but not limited to:

1. Complete chemical composition of reactants and combustion products, including all additives and/or mixtures, proportions and tolerances on the proportions.
2. Final energy, energy density, propellant mass, total explosive energy expressed in the equivalency of pounds of Trinitrotoluene (TNT).
3. Thermodynamic characterization, including Final Phase Diagrams showing the triple point and critical temperature and critical pressure, vapor pressure, density vs. temperature, enthalpies, thermophysical and transport properties.
4. Sensitivity to shock initiation and propagation (e.g., Critical diameter) and method determined.
5. Sensitivity to mechanical impact and method determined.
6. Compatibility with all wetted propulsion system materials to propellant and propellant to all propulsion system materials. Provide long-term (>1 year) storability data to demonstrate propellant and material stability.
7. Cleanliness, purity, and contamination control requirements.
8. Thermal stability and method determined.
9. Minimum Ignition Energy (MIE) and susceptibility to Electrostatic Discharge and methods used to determine.
10. Auto-ignition/auto-decomposition temperature and method used to determine.
11. Susceptibility to adiabatic bubble compression ignition and method used to determine.
12. Susceptibility to EMI/RF environments and method used to determine.
13. Combustion stability test summary.
14. Provide UN/DOT classification.
15. Provide system level verification test summary.
16. Basic rocket performance characterization, including: specific impulse, density specific impulse, characteristic exhaust velocity, etc.
17. Toxicity.

APPENDIX N - COMMERCIAL CREW PROGRAM APPLICABILITY

The National Aeronautics and Space Administration (NASA) Commercial Crew Program (CCP) has been chartered to facilitate the certification of a commercial crew space transportation capability to and from ISS. Once the capability is certified, NASA expects to purchase commercial services to meet its ISS crew rotation and emergency return objectives.

The CCP and ISS Program will collaborate to assure the safety of the ISS, CCP Crew Transportation System (CTS), and ISS crew. The CCP and ISS Program will engage in a joint safety process with the commercial partner pursuing a NASA certification. Both the CCP and ISS Program will be “stakeholders” for all hazards associated with Rendezvous, Proximity Operations, Docking and Undocking (RPODU). SSP 30599 is applicable for RPODU hazards for the CCP Design Reference Mission (DRM). Both Programs will together engage the commercial partner on RPODU hazards to assure the safety of the ISS consistent with this document and the other NASA requirements as stated in the contract. The CCP will be the stakeholder for all other hazards for the CTS to assure the safety of the crew utilizing the service in the other phases of the mission. Additional details regarding this collaboration and requirements for the commercial partner are provided in CCT-PLN-1120.

The specific method of delivery of data to NASA in support of CCP should be specified by the contract/agreement between NASA and the commercial provider. In the absence of direction from CCP (which would be coordinated with ISS Program), the commercial provider should follow Appendix F for safety data submittal.