Safety Review Process

International Space Station Program

Revision E

Incorporates DCN 002
June 2009

esa
european space agency

CSA ASC

JAXA
Japan Aerospace
Exploration Agency

agenzia spaziale
italiana

National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
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PREFACE

SAFETY REVIEW DOCUMENT

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.

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7/20/09
Date

INTERNATIONAL SPACE STATION PROGRAM

SAFETY REVIEW PROCESS

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INTERNATIONAL SPACE STATION PROGRAM

SAFETY REVIEW PROCESS

CONCURRENCE

JUNE 2009

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INTERNATIONAL SPACE STATION PROGRAM

SAFETY REVIEW PROCESS

CONCURRENCE

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INTERNATIONAL SPACE STATION PROGRAM

SAFETY REVIEW PROCESS

LIST OF CHANGES

JUNE 2009

All changes to paragraphs, tables, and figures in this document are shown below:

Board Name	**Entry Date**	**Change**	**Paragraph(s)**
SSPCB	October 1993	Baseline	All
SSPCB	June 15, 1995	Revision A	All
SSPCB	February 2000	Revision B	All
SSPCB	May 2004	Revision C	All
SSPCB	September 2006	Revision D	All
SSPCB	June 2009	Revision E	All
SSPCB	November 2009	DCN 001	
SSPCB	July 2011	DCN 002	

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FIGURE

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 element hardware and its ground support equipment to the safety requirements established in SSP 50021, Safety Requirements Document (flight) and KHB 1700.7, Space Shuttle Payload Ground Safety Handbook (ground).

The safety review process is defined for: ISS elements (flight and ground), visiting vehicles and ISS support equipment. This process includes an in-line safety review process and a phased safety review process. The in-line safety review process assures that ISS safety requirements are incorporated into the ongoing design activities. The requirements for conducting the phased safety reviews are applicable to Launch Package/Stage (LP/S) safety assessments and for International Partner (IP) elements, and cover all mission phases of ISS equipment. The phased safety review process contained in this document is intended to be consistent with the tasks and products agreed to by the National Aeronautics and Space Administration (NASA) and IPs as specified in the appropriate Bilateral NASA/IP Safety and Mission Assurance (S&MA) Requirements documents. SSP 30309, Safety Analysis and Risk Assessment Requirements Document or its IP equivalent, provides the methodology for performing safety analysis. SSP 30599, Safety Review Process addresses preparation, maintenance, and reporting requirements of the safety analyses in support of the safety reviews.

1.1 PURPOSE

The purpose of SSP 30599 is to define the safety review process for ISS elements (flight and ground), support equipment, Government Furnished Equipment (GFE), and ISS visiting vehicles. The Safety Review Panel (SRP) at Johnson Space Center (JSC) will execute this process for flight design and operations and the Ground Safety Review Panel (GSRP) at Kennedy Space Center (KSC) for Ground Support Equipment (GSE) design and operations and flight hardware ground operations for ISS elements processed at KSC and launched in Orbiter. These flight and ground panels will address both ISS Program and Space Shuttle Program safety review responsibilities as part of a single integrated process that covers all mission phases of the hardware. Integration of ISS and Space Shuttle review requirements into a single process ensures effective identification and assessment of safety compliance involving ISS equipment, and minimizes any overlap that could exist if there were different review processes for the various mission phases of ISS hardware elements. The safety review process defined in this document is not applicable to ISS experiment payloads.

1.2 SCOPE

This document defines the process to assess compliance with the ISS safety requirements in SSP 50021 and KHB 1700.7. The ISS safety reviews are conducted for all mission phases to review and assess the safety hazards related to the design, operations, and functional capabilities of ISS elements, GFE, ISS visiting vehicles, ISS crew return vehicles, support equipment, and the integration of all ISS elements. The safety requirements for IP elements are contained in the applicable IP segment specification. IP segment specifications are derived from the SSP 50021 (Flight) and KHB 1700.7 (Ground Operations at KSC) safety requirements through bilateral negotiations with NASA. This document does not address the safety process for assuring ground and launch phase hazards for cargo or ISS elements launched on ISS visiting vehicles other than the United States (U.S.) Orbiter. Hardware providers shall meet the safety requirements and follow the safety processes of the launch vehicle safety authority.

The safety reviews of ISS experiment payloads are not included within the scope of the process defined by this document. ISS experiment payloads and the on-orbit increment payload complement will be reviewed by the Payload Safety Review Panel (PSRP) in accordance with the process and procedures defined in NSTS/ISS 13830, Payload Safety Review and Data Submittal Requirements for Payloads using the Space Shuttle/ISS for assessing compliance with NSTS 1700.7B, Safety Policy and Requirements for Payloads Using the International Space Station (ISS Addendum), and by the GSRP for assessing compliance with KHB 1700.7.

1.3 DELEGATION OF AUTHORITY

The ISS 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).

1.4 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.

2.0 DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents include specifications, models, standards, guidelines, handbooks, and other special publications. The documents listed in this paragraph are applicable to the extent specified herein. Inclusion of applicable documents herein does not in any way supersede the order of precedence identified in Paragraph 1.3 of this document.

CSG-RS-10A-CN	Centre Spatial Guyanais (CSG) Safety Regulations
ESA-ATV-1700.7b	Safety Requirements for Payloads/Cargo on-board Automated Transfer Vehicle (ATV)
ESA-ATV-PR-13830	ATV Pressurised Payload/Cargo Safety Certification Process
JPD 5150.2H	Industry Presentations and Related Nondisclosure Agreements
JSC 27472, Revision A	Requirements for Submission of Data Needed for Toxicological Assessment of Chemicals and Biologicals to be Flown on Manned Spacecraft
JSX-2001015	H-II Transfer Vehicle (HTV) Cargo Safety Requirements
KHB 1700.7	Space Shuttle Payload Ground Safety Handbook
NSTS 1700.7B	Safety Policy and Requirements for Payloads Using the Space Transportation System
NSTS 1700.7B Addendum	Safety Policy and Requirements for Payloads Using the International Space Station
NSTS/ISS 13830	Payload Safety Review and Data Submittal Requirements for Payloads using the Space Shuttle/ISS
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 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 41170	Configuration Management Requirements
SSP 50005	International Space Station Flight Crew Integration Standard (NASA-STD-3000/T)
SSP 50021	Safety Requirements Document
SSP 50094	NASA/RSA Joint Specifications Standards Document for the ISS Russian Segment
SSP 50108	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 50481	Management Plan for Waste Collection and Disposal
SSP XXXXX **<TBD 2-1>**	HTV Safety Certification Process

2.2 REFERENCE DOCUMENTS

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

N/A

3.0 SAFETY RESPONSIBILITIES

3.1 NASA

NASA by Memorandum Of Understanding (MOU) agreements with each International Partner, is responsible for the overall integrated safety of the ISS and is required to provide the overall certification that the U.S. elements, IP Elements, support equipment, GFE, ISS visiting vehicles, ISS crew return vehicles, and payloads are safe. It is also the responsibility of NASA to establish the overall safety requirements of the Program. To successfully implement NASA's overall safety responsibility, the safety requirements of SSP 50021 and KHB 1700.7 have been developed. NASA assures compliance with these overall safety requirements within the ISS Program by a structured safety review process. The Flight SRP is responsible for assessing the applicable design and operations for compliance with the requirements in SSP 50021. The GSRP is responsible for assessing the integrated operations of ISS GSE and flight hardware processed at KSC as well as KSC launch and landing site operations for compliance with the requirements of KHB 1700.7. ISS equipment that returns on the Orbiter is reviewed by the Flight SRP for on-orbit operations and by the GSRP for post-landing operations. These reviews may be part of the LP/S or IP Orbiter pre-launch phase safety review if the return cargo has been adequately defined.

United States On-orbit Segment (USOS) contractors will participate in formal phase safety reviews with the SRP that will address LP/S safety assessments. For ISS ground operations and GSE used at KSC and KSC launch and landing sites, the USOS contractor will participate in formal phase safety reviews conducted by the GSRP. There is also an in-line safety review process to assure ISS safety requirements are incorporated into the ongoing design activities of flight hardware. This in-line process is provided by ISS S&MA/Program Risk (PR) support of ISS design teams, by SRP special topic meetings, by the Safety Working Group (SWG) and by the safety reviews conducted by the Flight Equipment Safety and Reliability Review Panel (FESRRP) for GFE.

The formal phased safety review process with the SRP and GSRP is defined in section 5.0.

The USOS contractor assesses all USOS hardware provided by the USOS contractors, all IP segment interfaces with the USOS, and GFE items designated for USOS contractor integration as defined in Statement of Work (SOW) Annex J2 GFE listing.

The ISS contractor performs the Integrated Hazard Analysis (IHA). This analysis ensures that systems that are interdependent for hazard control or failure tolerance are properly identified and interactions assessed. The ISS contractor performs this assessment for all USOS and IP elements/systems and for J2 listed GFE. If a GFE item relies on a hazard control provided by other ISS equipment, this must be assessed and captured in the integrated hazard analysis. Integrated hazard reports will be developed and presented by the ISS contractor at the appropriate Flight SRP meeting to support the overall assessment of the flight hardware.

A Maintenance Hazard Analysis (MHA) shall be performed on flight hardware to address the control of hazards during maintenance activities. The maintenance hazard analysis will be delivered with the systems hazards analysis unless otherwise negotiated with the SRP.

3.2 INTERNATIONAL PARTNERS

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 elements and hardware items. The safety requirements for IP elements are contained in the applicable IP segment specification. IP segment specifications are derived from the SSP 50021 (Flight) and KHB 1700.7 (Ground Operations at KSC) safety requirements through bilateral negotiations with NASA. For IP segments and elements, the IPs will present the results of their safety assessments to the SRP and GSRP in formal phase safety reviews.

For low hazard hardware qualifying as Category 1, see section 4.10. Hardware items must also meet safety and interface requirements for the segments in which the hardware will be stowed or operated (IP Segment Specifications and P32958-106 Technical Requirements for Hardware to be Stowed or Operated on the Russian Segment for the Russian Segment). For Category explanations see Table 4.10-2, Category 1 and 2 Explanations.

For each on-orbit stage, each IP is responsible to complete an integrated safety assessment of their module/segment. This module/segment level assessment is not deliverable to NASA. However, if unique integrated hazards are found during this assessment or existing hazards require modification, the hazard reports will be submitted to the Safety Review Panel (SRP) for review and approval. If there are no new integrated hazards identified, the IP will make this positive statement as part of the Certificate 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 hardware will be stowed or operated in the other IP’s segment. The data deliverables to the other IP shall be in accordance with the IP-sponsored cargo data deliverables described in paragraphs 4.10.1 and 4.10.2 of this document.

3.2.1 ROSCOSMOS

For Russian hardware and elements defined by the Russian Segment Specification, the safety processes and requirements of this document have been implemented through SSP 50146, NASA/ RSA Bilateral S&MA Process Requirements for International Space Station.

3.2.2 INTERNATIONAL PARTNER TRANSPORT VEHICLES AND GROUND SAFETY

3.2.2.1 TRANSPORT VEHICLES CARGO SAFETY

Each transport vehicle has its own unique safety requirements and approval process. The following are the documents which contain the safety processes and safety requirements for cargo that apply to each transport vehicle.

TABLE 3.2.2.1-1 TRANSPORT VEHICLES CARGO 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	JSX-2001015	<**TBD 3-2**>

3.2.2.2 GROUND SAFETY

Each IP has its own unique ground safety requirements and approval process. The detail is described in section 4.3.3.1.

4.0 ISS SAFETY REVIEW PROCESS

4.1 SAFETY ANALYSES AND DELIVERABLES

The safety review process was developed to evaluate and assess the results of the U.S. and IP safety analyses conducted by developers, providers, and operators of ISS element hardware and software. Performance of Hazard Analyses HAs provides a means to systematically identify hazards and their causes and controls. SSP 30309 defines methodologies for traditional safety analysis techniques (i.e., Preliminary Hazard Analyses (PHAs), System Hazard Analyses (SHAs), Operation and Support Hazard Analyses (OSHAs), Software Safety Analyses (SSAs), and Integrated Hazard Analyses (IHAs)). Safety analyses are typically performed on a flight-by-flight, stage-by-stage basis. Hazards identified through the safety analysis process are documented on a Hazard Report (HR) as specified in Appendix D and JSC Form 1366, as defined by Appendix F and hazard controls are implemented in accordance with SSP 30309 section on Hazard Reduction Precedence Sequence.

The safety assessments of all ISS systems and operations are provided to the SRP or FESRRP and the GSRP as safety deliverables, 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 or contractual data requirements defined in the contract Statement Of Work (SOW). Deliveries associated with the phase safety review process are depicted in Table 4.3.3-1.

4.2 SAFETY REVIEW OBJECTIVES

The objective of the ISS safety program is to achieve the maximum degree of safety consistent with ISS objectives and operational requirements. The goal 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. The safety review meetings are held for the SRP and GSRP to assess the results of these safety assessments performed by U.S. or IP hardware providers. The ISS Flight SRP (or FESRRP as delegated by the SRP) and GSRP will assess the results of these safety analyses for all mission phases of ISS hardware (i.e., from KSC ground processing and Shuttle launch, to on-orbit assembly and operation, and return of hardware from orbit using the Shuttle).

The SRP, FESRRP and GSRP will review the safety assessments performed by U.S. hardware/software providers and IP hardware/software providers. The results are reported to the Program after each safety review, Program milestone, and CoFR review. This is accomplished through presentations to the Safety and Mission Assurance Panel (SMAP), the Program Manager, and through participation in the CoFR process.

4.3 REVIEW PROCESS

The safety review process is an incremental process that will focus on: assuring that all hazards and hazard causes inherent in the design and operations have been identified; evaluating the means employed to control the hazard; and assessing the methods identified to verify all hazard controls. The process is implemented through safety reviews with the developers, providers, and operators of the ISS elements and end items. Paragraphs 4.3.1, 4.3.2, and 4.3.3 address the review process for flight design and operations. Paragraph 4.3.4 addresses the ground safety review process for transportation of ISS elements and hardware.

4.3.1 IN-LINE SAFETY (FLIGHT ONLY)

An in-line safety process has been developed in addition to those formal LP/S and IP safety reviews conducted by the SRP. The ISS S&MA/PR Office manages the in-line process. It is a concurrent engineering approach that facilitates the implementation of safety design changes to control and eliminate hazards in a timely manner. This in-line process is implemented by: the SRP through the conduct of special topic meetings to address U.S. and IP issues and hazards resolutions; the ISS SWG through support of ISS design teams (the SWG consists of NASA JSC and Boeing S&MA/PR personnel acting in a support role to the ISS Program); and by the JSC FESRRP through direct support to GFE providers. The SWG in-line process does not replace the phased safety reviews conducted by the SRP. However, the SRP has delegated HR review authority to the FESRRP for GFE. The FESRRP review process for each item of GFE and other ISS hardware, as defined in section 4.3.2.3, will culminate with the submittal of a Safety Data Package (SDP) and a GFE CoFR to the Chair, ISS SRP. The SRP is responsible for ISS safety requirement development and interpretation and will be available to assist the ISS design and operations teams, SWG, and FESRRP in resolving issues and in providing clarification and interpretation of safety requirements necessary for issue resolution.

4.3.1.1 SAFETY WORKING GROUP

The SWG is responsible for assuring the implementation of safety programmatic and technical requirements as defined in the safety plan. This activity is part of the in-line concurrent engineering process to address safety issues in a timely manner. The SWG supports the SRP by evaluating and providing recommendations on safety issues, noncompliance reports (NCRs), close calls and mishaps, and provides technical recommendations to the SRP on specific SRP Action Items (AIs) and issues.

4.3.1.2 FESRRP FOR GFE AND OTHER ISS HARDWARE

The FESRRP has both an in-line safety role for JSC GFE and a delegated review role for all GFE in general. For GFE and other ISS hardware (section 4.3.2.3), the FESRRP will assess, document, and approve the results of the safety analyses performed by the developer/operator and will submit a letter documenting GFE Safety Certification to the ISS Program. The scope of safety review delegation from the SRP to the FESRRP includes approval authority for all generic and unique GFE hazards and equivalent safety noncompliances after coordination with the SRP. The FESRRP approval authority does not include GFE hazards that contribute to integrated ISS hazards, control of ISS catastrophic hazardous functions, or where the GFE hazard control relies on ISS-based hardware or software. The FESRRP will forward all safety noncompliances and those HRs which do not meet the delegation criteria stated above to the SRP for review and disposition. GFE ground safety analysis will be presented to the GSRP for approval per 4.3.3.2.1. The FESRRP will assist the GSRP in assuring providers complete the Ground Safety Review Process described in 4.3.3.2.1.

4.3.1.2.1 GENERAL

The GFE provider is responsible for preparation of the safety analysis, documentation of compliance, and presentation to the FESRRP. In general, the data requirements and scheduling of reviews with the FESRRP shall be consistent with the requirements of this document. For specific details with respect to FESRRP procedures and data requirements, JSC GFE providers shall contact FESRRP Executive Officer, mail code NA2450, at the NASA/JSC, Houston, Texas 77058-3696, or via e-mail at JSC-FESRRP@mail.nasa.gov.

4.3.1.2.2 PRESENTATION TO THE FESRRP

The GFE provider shall be prepared to present information submitted in the data package to the FESRRP. For details on the data submittal and presentations, contact the FESRRP Executive Officer. Presentation charts shall be submitted to the FESRRP Executive Officer no less than 10 working days prior to the scheduled FESRRP meeting; otherwise, all transparencies, plus 15 copies of the additional charts must be provided by the presenter at the time of the FESRRP meeting. Data elements already incorporated into the data package need not be resubmitted with the previously submitted presentation charts.

4.3.2 FLIGHT SAFETY REVIEW PROCESS

Three phased safety reviews with the flight SRP are typically held for each element of the ISS. The procedures and data for the phased safety reviews are defined in section 5.0. For other equipment listed in section 4.3.2.3, the safety review process may be with the SRP or delegated to the FESRRP. Delegation will be based upon the hazard potential of the hardware and its effects on the overall ISS integrated safety assessment. For visiting and crew return vehicles, the hardware provider and operator shall provide data addressing ISS proximity and attached operations and phases as pre-coordinated with the SRP.

4.3.2.1 INTERNATIONAL PARTNER SEGMENTS/ELEMENTS

For IP segments and elements, the data for these reviews will be provided as defined in the NASA/IP BDEALS and will be scheduled to correspond to the Preliminary Design Review (PDR), Critical Design Review (CDR), and design certification review. The depth and number of reviews is dependent on the complexity, technical maturity, and hazard potential of the equipment, and may be modified by the SRP in conjunction with IPs prior to the reviews.

4.3.2.2 US ON-ORBIT SEGMENT/ELEMENTS

The phased safety reviews for USOS and elements formally address the safety data, which was developed and assessed during the in-line process, for approval by the ISS Program. The disposition of HRs by the SRPs will be in accordance with section 4.5. The schedule of safety reviews for the U.S. elements is based upon the launch schedule. Safety reviews are scheduled for each stage on the Engineering Master Schedule (EMS).

4.3.2.3 OTHER ISS HARDWARE

Other ISS hardware includes: flight crew equipment; Extravehicular Activity (EVA) tools and equipment; GFE from NASA Centers; IP GFE and crew personal equipment; medical support equipment; ISS system spares; ISS supplies (consumables). The safety review process for these items will typically be through the FESRRP acting for the SRP in accordance with a letter of delegation of authority from the ISS Manager, S&MA/PR and described in 4.3.1.2.

4.3.3 LAUNCH PACKAGE/STAGE SAFETY REVIEWS (FLIGHT)

The LP/S safety reviews for ISS segments and elements formally address the safety data, which was developed and assessed during the in-line process and during the USOS and IP safety reviews. It is compiled to form a complete safety analysis for an LP/S and formally reviewed and approved by the ISS. The disposition of LP/S HRs by the SRP will be in accordance with section 4.5. The LP/S phase III safety review shall be completed 9 +/- 2 months prior to launch, the phase II review, 19 +/- 2 months prior to launch, and the phase I review, 36 +/- 4 months before launch or as agreed to with the SRP chair. The phase I and II LP/S reviews for IP flights will be held concurrently with safety reviews for the first USOS flight following the IP flight. For phase III of an IP LP/S, the integrated assessment by NASA contractor will be completed and appropriate HRs submitted to the SRP to support the U.S. CoFR. Figure 4.3.2-1, ISS Program Safety Review Process, defines the general ISS safety review process flow. The safety review process begins with the delivery of acceptable data submittals for the LP/S safety review, which are due at least 45 days prior to the safety review.

4.3.3.1 GROUND SAFETY REVIEW PROCESS FOR TRANSPORTATION OF ISS ELEMENTS AND HARDWARE

Hardware providers are responsible for the ground safety analysis and compliance with the appropriate requirements for the launch location they are using. GSE used at IP facilities are subject to IP safety requirements and review by the host country.

4.3.3.2 KENNEDY SPACE CENTER

Hardware developers and operators are responsible for the preparation of ground safety analysis, documentation of compliance, and presentation to the GSRP for pre-launch and post-landing operations that occur at KSC and contingency landing sites.

4.3.3.2.1 GSRP PHASE REVIEW PROCESS

The GSRP will review and approve the design and operations of GSE (including Commercial Off-the-Shelf (COTS) equipment, Factory Equipment (FE), Test Support Equipment (TSE), and Special Test Equipment (STE)) and the ground operations of flight hardware through a phased review process. The GSRP reviews and approves the interfaces between flight hardware, GSE, non-GSE and KSC facilities. The phased review process is defined in Section 5.0, Procedures and Data for Phased Safety

Reviews and Section 7.0, Series and Reflown Equipment. The Ground and Flight Phase III Safety Reviews shall be completed and the Ground Certificate of Safety Compliance shall be submitted 30 days prior to hardware (flight and GSE) delivery to KSC or the start of mission processing, as appropriate. Phase 0/I/II reviews, if required, shall be completed in sufficient time to meet the Phase III completion requirement.

For flight hardware meeting the constraints in Table 4.10-1, Category 1 Constraints, a KSC Form 20-201, “Certification for Ground Safety Review of Category 1 Cargo/ Hardware or Government Furnished Equipment (GFE)” may be submitted in lieu of a full SDP at least 30 days prior to first use at KSC. If approved by the GSRP, this form will satisfy the requirements above and those of 4.7. The form, with instructions, may be obtained from the GSRP Web Site at http://kscsma.ksc.nasa.gov/GSRP/index.htm or through NASA e-forms.

4.3.3.3 CENTRE SPATIAL GUYANAIS

The ground safety requirements and process for Centre Spatial Guyanais (CSG) are contained in CSG-RS-10A-CN, CSG Safety Regulations.

4.3.3.4 TANEGASHIMA SPACE CENTER

The ground safety requirements and process for Tanegashima Space Center (TNSC) are **<TBD 4-1>**.

4.3.3.5 BAIKONUR COSMODROME

The ground safety requirements and process for Baikonur Cosmodrome are **<TBD 4-2>**.

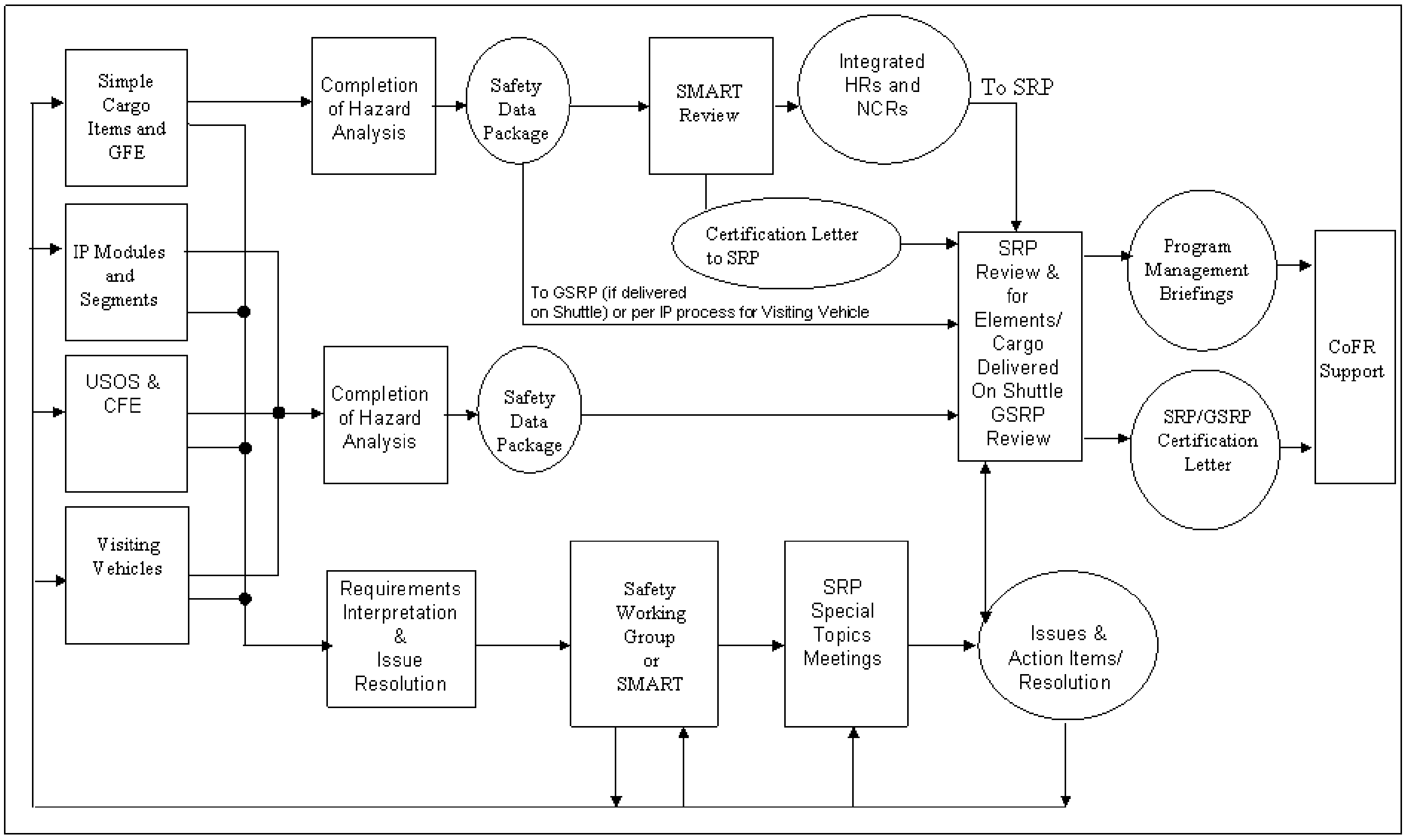


FIGURE 4.3.2-1 ISS PROGRAM SAFETY REVIEW PROCESS

TABLE 4.3.3-1 SUMMARY OF SAFETY REVIEW PROCESS (PAGE 1 OF 2)

Phase	Timing	General Safety Effort Required to Support Review	Purpose of Review
I	Preliminary Design Established L-3 yrs. (+- 4 mon.) *	1. Develop safety analysis/ assessment report to reflect the preliminary design: 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/contingency operations. 3. Determine compliance with SSP 50021, KHB 1700.7 requirements.	1. Assess preliminary design against SSP 50021 and KHB 1700.7 requirements. 2. Evaluate preliminary hazard controls and safety verification methods. 3. Identify interface hazards and requirement inconsistencies.
II	Final Design Established L-19 mon. (+- 2)*	1. Refine and expand safety analysis/assessment report. 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/contingency scenarios. 3. Determine compliance with SSP 50021, KHB 1700.7 requirements.	1. Assess final design against SSP 50021 and KHB 1700.7 requirements. 2. Identify potential non-compliances. 3. Concur on specific hazard controls and safety verification methods.

TABLE 4.3.3-1 SUMMARY OF SAFETY REVIEW PROCESS (PAGE 2 OF 2)

Phase	Timing	General Safety Effort Required to Support Review	Purpose of Review
III	Fabrication and Testing Complete L-9 mon. (+-2)*	Complete safety analysis. For SRP, Complete all significant safety verification test, analyses, and/or inspections. Open standard safety verification items are documented on the safety VTL. For GSRP, Complete all verifications or transfer to VTL. Prepare final SDP. For GSRP, Submittal of Certificate of Compliance to GSRP For Ground – Submittal of GSRP Safety Certification Letter to KSC/UB	1. Approval of final SDP. 2. Resolve non-compliances 3. Identify and resolve open safety items. 4. Certificate of Compliance for Ground Processing
Post III	Verification Complete L-30 days*	1. Close open VTL items. 2. Assess real time changes 3. For Flight - Submittal of SRP Safety Certification Letter to OE 4. For Ground – GSRP issue Review Completion Letter	1. Support ISS Safety CoFR endorsement
* Or as agreed to with Panel Chair			

4.4 SAFETY REVIEW MEETINGS AND AGENDA

More than one S/LP may be reviewed at a single review. All actions generated at the review will be logged and tracked. A single set of actions and minutes are generated and sent to attendees. A coordination teleconference will typically be held 1 to 2 weeks prior to the review to finalize the meeting agenda. The minimum agenda for the phase safety review is defined as follows:

A. Introduction by the Chair.

B. Management overview of areas of responsibility, the hardware/software status and schedule.

C. Status of pre-review activities, as applicable, by hardware provider.

D. A design overview, including enough information to allow the panels to gain a general technical understanding of the systems and safety critical subsystems involved. Highlight any design changes since previous safety reviews.

E. An operations overview, including a description of planned operations and known contingencies. Highlight any operations that impact safety or are hazard controls.

F. A summary of all safety-related problem reports, accidents, and significant technical issues.

G. Detailed presentation of HRs (and Noncompliance Report (NCRs) if applicable) including phase-specific topics.

H. Presentations of any proposed NCRs.

I. Status of safety review meeting Action Items (AIs) as assigned during the review.

J. Verification tracking log status (phase III).

K. Concluding remarks.

4.5 HAZARD REPORT DISPOSITION

After the technical discussion is held, the Chair provides a disposition of the HRs. The Chair assigns AIs and the list of AIs are documented. The disposition may take one of these forms:

A. Approval as written. Signature of these reports can occur outside of board meetings.

B. Approval with changes. Signature of these reports can occur outside of board meetings when the appropriate changes and have been met or complete.

C. Approval with an action to be performed by the responsible organization. Signature of these reports can occur outside of board meetings when the appropriate changes and actions have been met or complete.

D. Rejection with an action to be performed by the responsible organization or rejection pending resolution of a safety issue or requirements non compliance.

4.6 PROGRAM HAZARD REPORT ACCEPTANCE

Phased safety reviews provide the 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 chairs of the SRP and GSRP where the level of risk is in compliance with or equivalent to the requirements of SSP 50021 or KHB 1700.7.

Phase III HRs which meet acceptance criteria will be approved by the chairs of the SRP/GSRP. The signature of the phase III HRs by the Panel chairs is the basis for the Manager, ISS S&MA/PR CoFR 1 and 2 endorsements in accordance with SSP 50108, Certification of Flight Readiness Process Document. The criteria for chairs of the Panels signing HRs is adequate implementation and verification of hazard controls for each hazard cause in accordance with the safety requirements of SSP 50021 or KHB 1700.7. Where the requirements of SSP 50021/KHB 1700.7 are not met, the HRs will not be signed until the appropriate safety Noncompliance Report (NCR) has been endorsed by the SRP and submitted to ISS Program management for approval. ISS Approval authority for flight equivalent safety NCRs has been delegated to the ISS SRP Chairs. The GSRP chair has been delegated the authority to approve HRs and ground related NCRs by the ISS program manager.

4.7 READINESS FOR GROUND PROCESSING PRE/POST-FLIGHT CERTIFICATION

Following successful completion of the ground and flight safety review(s) and submission of the Ground Certificate of Safety Compliance (Note: Digitally signed Certificates are acceptable), the GSRP will certify the flight hardware/GFE as safe to begin ground processing at KSC. The GSRP certification shall note any open safety verifications that exist which must be closed prior to the start of ground operations involving the open items.

4.8 CERTIFICATION OF FLIGHT READINESS PROCESS

In preparation for launch of an ISS element, the safety review panels (SRP, GSRP, and FESRRP) participate in the CoFR process. The S&MA/PR Office shall coordinate with all S&MA participants to assure successful completion of the safety review process before certifying the ISS element as safe.

4.9 SAFETY REVIEW DATA SUBMITTALS

Although there will be some duplication of material contained in data submittals prepared for SRP/FESRRP and GSRP reviews, each package serves a different purpose and must stand alone.

Required safety review data for the flight and ground phase safety reviews shall be submitted 45 days prior to the scheduled meeting. The safety review data is to be submitted to the following individuals:

A. At JSC:

For SRP:
Coordination Office
ISS SRP
Mail Code NA2450
Johnson Space Center, Houston, TX 77058-3696
or via email at jsc-srpcooff@mail.nasa.gov

For FESRRP:
FESRRP Executive Secretary
Mail Code NA2450
Johnson Space Center, Houston, TX 77058-3696
or via email at JSC-FESRRP@mail.nasa.gov

B. At KSC:

For all submittals (3 Copies are required)
Executive Secretary, GSRP
Mail Code SA-C3
Kennedy Space Center, FL 32899
For electronic submittals, contact the Executive Secretary, GSRP.

A signed original of each completed HR must be available to the safety review panels for signature at the time of each review. (Note: Digitally signed HRs may be submitted in lieu of original signatures.) Only one copy of the safety deliverable must be sent to each addressee except as noted. Electronic copies of HRs shall also be provided prior to safety review meetings to facilitate distribution of the SDP, and post meeting to facilitate the update of the SRP web site. The ISS SRP web site Uniform Resource Locator (URL) is: http://srp-sma.jsc.nasa.gov/.

4.10 SIMPLIFIED CARGO SAFETY REVIEW PROCESS (FLIGHT ONLY) (NOTE: SEE SECTION 4.3.3.2.1 FOR GROUND SAFETY.)

To make more efficient use of safety panel time and to minimize safety documentation issues, a simplified safety review process has been developed. The principle that defines this modified process is that the level of detail in an SDP should be commensurate with the hardware's hazard potential; hardware whose design and operations are of recognized low hazard potential or whose hazards are controlled by standard hazard controls and verification methods can be adequately assessed for safety compliance without the use of complex SDPs.

The term "cargo" refers to all types of hardware stowed on a transport vehicle or module but not needed for the functionality of the transport vehicle or module, e.g. hardware transferred, stowed and operated on or removed from ISS. "Cargo" also relates to hardware items removed from service systems of the modules to be stowed, disposed of, or returned to the ground. Cargo items include specific scientific equipment (experiments), logistics, crew psychological support items, tools, spare instruments and assemblies, etc. 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.

Low hazard potential cargo (Category 1) is defined as a hardware item that meets all of the constraints listed in Table 4.10-1, which are also documented on JSC Form 907, Multilateral Category 1 Constraints. Essentially, this cargo has no associated hazards or the hazards are considered to be extremely low and controlled by standard ISS practices. Cargo items that do not meet one or more of the Category 1 constraints are considered to be Category 2 (hardware with higher hazard potential). Table 4.10-2 provides a summary of Category 1 and 2 definitions and data submittals between IPs.

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 some hazards associated with its operations on ISS that violate the Category 1 constraints. In this example, the cargo is considered Category 1 for transport and Category 2 for operations.

TABLE 4.10-1 CATEGORY 1 CONSTRAINTS (PAGE 1 OF 3)

Hardware having low hazard potential:

- Meets safety requirements of SSP 50021 or of the IP's segment specification. Any item violating any safety requirement shall not be considered Category 1.
- Meets constraints 1-27 for transportation and/or stowage phases and constraints 1-31 for operation phase.

Constraints for All Flight Phases:

1. The item will not create a critical or catastrophic hazard if it operates inadvertently.
2. The item is not structurally mounted during transportation.
3. The item does not weigh more than 23 kg (50 lbs) or its category is not being assessed for transportation on the Shuttle.
4. The item includes no containers/components pressurized above 1.5 atmosphere.
5. The item does not contain any substance that would cause a hazard if released (e.g. gases, liquids or particles).
6. The item will not create a hazard in the event of depressurization or re-pressurization of the surrounding volume.
7. The item does not contain any active ignition sources or self-igniting materials.
8. The item only contains materials that meet the NASA and/or applicable bilaterally agreed materials and processes requirements.
9. The item does not contain a source of ionizing radiation.
10. The item is not connected to a power source or meets the following criterion:
    - The item is a non-transmitter, connected to a power source, which produces non-ionizing radiation not exceeding the acceptable levels for the applicable ISS segment/vehicle.
11. The item is either not connected to a power source, does not contain any lasers or meets at least one of the following constraints:
    - The item contains laser beams that are totally contained over the complete power range.
    - The item contains lasers that meet ANSI Z136.1-2000 for Class 1, 2, or 3a lasers (power measured at source) or SSP 50094 (for Russian items).
12. The item does not contain any batteries or the item's batteries have been reviewed and approved by the respective IP Battery Technical Expert as meeting all the constraints listed below for the batteries' types:

    A) Alkaline-MnO2 :
    - The item does not contain any cell larger than size D.
    - The item does not contain any cells in a combination of series and parallel.
    - The item does not contain any battery assembly with a total voltage exceeding 12V.
    - The item does not contain any battery assembly with a total capacity exceeding 60 W•h (V x A•h)
    - The item does not contain a potential charging source.
    - The item does not contain any cells that are not in a gas-tight container.

    OR:

    B) Button cells and batteries:
    - The item does not contain any cells with a capacity of more than 300 mAh.
    - The item does not contain more than three (3) cells per common circuit.
    - The item is no Li-$COCl_2$, Li-SO_2, LiBCX or Li-SO_2Cl_2

TABLE 4.10-1 CATEGORY 1 CONSTRAINTS (PAGE 2 OF 3)

OR:

C) Unmodified COTS Rechargeable Ag-Zn, NiMH, NiCd:

- The item does not contain any battery assembly with a total voltage exceeding 20 V.
- The item does not contain any battery assembly with a total energy exceeding 60 Wh (V x Ah)
- The item is for IVA use only
- The item has proven at least one fault tolerance at the battery level.

OR:

D) Unmodified COTS Li-ion rechargeables (liquid only, not polymer):

- The item does not contain any battery assembly with a total voltage exceeding 10 V.
- The item does not contain any battery assembly with a total energy exceeding 60 Wh (V x Ah)
- The item is for IVA use only
- The item has proven at least one fault tolerance at the battery level.

13. The item does not contain shatterable materials or meets at least one of the following constraints:
    - The item contains shatterable materials that are provided with protection preventing fragments from entering the habitable environment.
    - The item contains glass components (e.g. photographic, optoelectric, TV lenses, filters, etc.) that are soft-stowed during transportation to ISS and have special covers to protect them when not in use on-orbit.

14: The item meets cleanliness/microbiological contamination requirements by at least one of the following:
- The item has been maintained clean since assembly/testing.
- The item's surface or its packaging has been or will be disinfected prior to launch.

15. The item does not contain any biological substances greater than Biosafety Level 1 (CDC/NIH).
16. The item does not contain any toxic substances greater than TOX Level 0 as defined in SSP 50260 (e.g. mercury, formaldehyde, ammonia) or alcohol (does not apply to batteries allowed per item 12.
17. The item does not contain any permanent magnets or meets at least one of the following constraints:
    - The item is not being assessed for transportation on a Progress or a Soyuz vehicle.
    - The permanent magnets have been approved for the receiving side's segment/vehicle.
18. The item does not contain any pyrotechnics.
19. The item does not contain any cryogenics.
20. The item does not have an active thermal exchange with the transport vehicle or segment.
21. The item does not contain any electrical power interface with a segment or vehicle or meets the following criterion:
    - The item is plugged into an interface that provides a maximum available 32 V (AC or DC), at 3 amperes or less, during connector mating/demating operations.
22. The item is not connected to vehicle power during transportation.

TABLE 4.10-1 CATEGORY 1 CONSTRAINTS (PAGE 3 OF 3)

23. The item is not connected to segment power or meets the following constraint:
    - The item has no voltage over 32 V (AC or DC).
24. The item does not require any monitoring or crew action to control any hazard with the exception of functional sharp edges and functional pinch points as documented in constraints 26 and 27.
25. The item does not contain any hardware that could create a potential appendage entrapment.
26. The item does not contain any sharp edges or meets the following constraint:
    - The item contains functional sharp edges (e.g. scissors) that are controlled through guards during transportation and stowage phases and handling procedures and crew training during operation.
27. The item does not contain any hardware that could create a pinch point or meets the following constraint:
    - The item contains functional pinch points (e.g. clamps) that are controlled through guards during transportation and stowage phases and handling procedures and crew training during operation.

Constraints for Operation Phase:

28. The item does not cause a critical or catastrophic hazard if it fails to function.
29. The item does not contain any rotating equipment or meets the following constraint:
    - The item contains only small fans or other low-energy rotating machinery (e.g. small electric motors) where release of debris is precluded by design.
30. The item does not contain any software or meets the following constraint:
    - The software does not interface with other systems and cannot create a hazard.
31. The item does not contain any hardware to be operated or mounted in an extravehicular environment.

4.10.1 CATEGORY 1 CARGO SAFETY PROCESS

All cargo developers shall prepare SDPs for all of their cargo items (both Category 1 and Category 2) that document the applicable hazards, controls and verifications. For those cargo items meeting the Category 1 constraints, the cargo owner’s IP safety organization reviews and approves the SDP, self-certifying the hardware.

The only safety documentation that needs to be exchanged between IPs for Category 1 cargo is the completed JSC Form 906, Flight Safety Certificate. This form documents the specifics of the cargo (part name, number, description, mass dimensions, materials, etc.); the transportation vehicle, on-orbit segment and mission phase (for example, launch and disposal) for the certificate; the safety process and technical safety requirements with which the hardware complies; and the approval signatures.

Note: For Category 1 transportation certification, the cargo provider’s safety organization shall submit the JF906 directly to the transport vehicle owner’s safety organization, with a copy to the NASA safety panel.

For Category 1 on-orbit certification, the cargo provider’s IP safety organization shall submit the JF906 directly to the IP safety organization of the segment where the hardware is to be stowed and/or operated, with a copy to the NASA safety panel. Appendix I provides a data flow diagram depicting the cargo safety certification process and the data exchanges between IPs. Note: In addition to submitting this data, the IP cargo provider shall include the cargo in their CoFR endorsement for the relevant flight or stage. Refer to Figure 4.10-1, Hardware Safety Approval Process, for a representation of the process.

SDPs generated from IP safety analyses shall be maintained by the IP cargo provider for potential audit by the ISS Program. Any partner may request a copy of the complete safety data package, and the IP cargo provider shall provide the package within two weeks of the request. The SRP/FESRRP has the authority to upgrade the category of any cargo they review at the panel's discretion. Additionally, if, after a cargo item category has been assigned, the developer identifies previously unidentified hazards or implements design changes that may create new hazards, the hardware provider shall submit a revised SDP commensurate with the new hazard potential of the worst-case mission phase.

Note: If a Category 1 cargo item must be reclassified as Category 2 after its initial designation, the entire safety data package shall be submitted to the SRP/FESRRP.

4.10.2 CATEGORY 2 CARGO SAFETY PROCESS

Category 2 cargo is defined as cargo that does not meet one or more of the Category 1 constraints. The hazards, controls and verifications are documented in hazard reports in the safety data package. Since Category 2 cargo may be hardware that is purchased off the shelf (for example a camcorder) or an item with few interfaces with the ISS systems (for example a vacuum cleaner), the cargo provider may propose to the safety review panel that the Category 2 cargo safety review be conducted as a single review, combining phase I/II/III objectives. With safety panel approval, the cargo provider shall submit the full safety data package covering the hazard and control identification and the verification evidence that the controls have been implemented.

The cargo provider's IP safety organization shall submit the safety data package to the appropriate safety review panel for review and approval. Additionally a JF906 shall be submitted documenting the transportation vehicle (if applicable), segment for operations and stowage, and mission phase for the safety certification.

Note: If the cargo is transported on a vehicle other than the Shuttle, the cargo provider's IP safety organization shall submit the JF 906 and safety data package for the transportation phase to the transportation vehicle owner's IP safety organization per IP requirements.

If the cargo is operated or stowed on another IP's segment, the cargo provider's IP safety organization shall submit the JF 906 and safety data package for on-orbit operations phase to the segment owner's IP safety organization. The segment owner(s) shall participate in the safety panel's review of the cargo and provide their approvals via the safety review by signing the appropriate signature block on the JF906. Appendix I provides a data flow diagram depicting the cargo safety certification process and the data exchanges between IPs.

Note: Additionally, the IP cargo provider shall include the cargo in their CoFR endorsement for the relevant flight or stage.

4.10.3 REFLIGHT HARDWARE

All series and reflown cargo hardware items shall be assessed each time they are manifested for transportation to the ISS to insure that the data supporting the original approval are still valid. The data deliverables and review process for IP-sponsored series and reflown hardware items are discussed in section 7.0 of this document.

4.10.4 SAFETY CERTIFICATE NUMBERING

For the purposes of commonality and ease of tracking JSC Form 906, Flight Safety Certificates, the certificate numbers will conform to the following pattern:

> Mission Number / IP / Mission Phase and category (1 or 2) / three-digit sequential number, where Mission Number is the first flight on which the hardware is delivered to ISS. For example, STS-124/NASA/OP1/001 would be NASA’s first Flight Safety Certificate for cargo delivered on STS-124 and it is being certified as Category 1 for operation on ISS [in the ISS Segment(s) designated in the appropriate check boxes on the JF906].
>
> TR will be used to designate certification for the transportation phase only. OP will be used to designate certification for the operation phase only.
>
> If the certificate applies to both transportation and operation on ISS, rather than identifying for example /TR-OP1/, the TR and OP will be omitted. Thus a number alone indicates certification for both phases. For example STS-124/NASA/1/002.

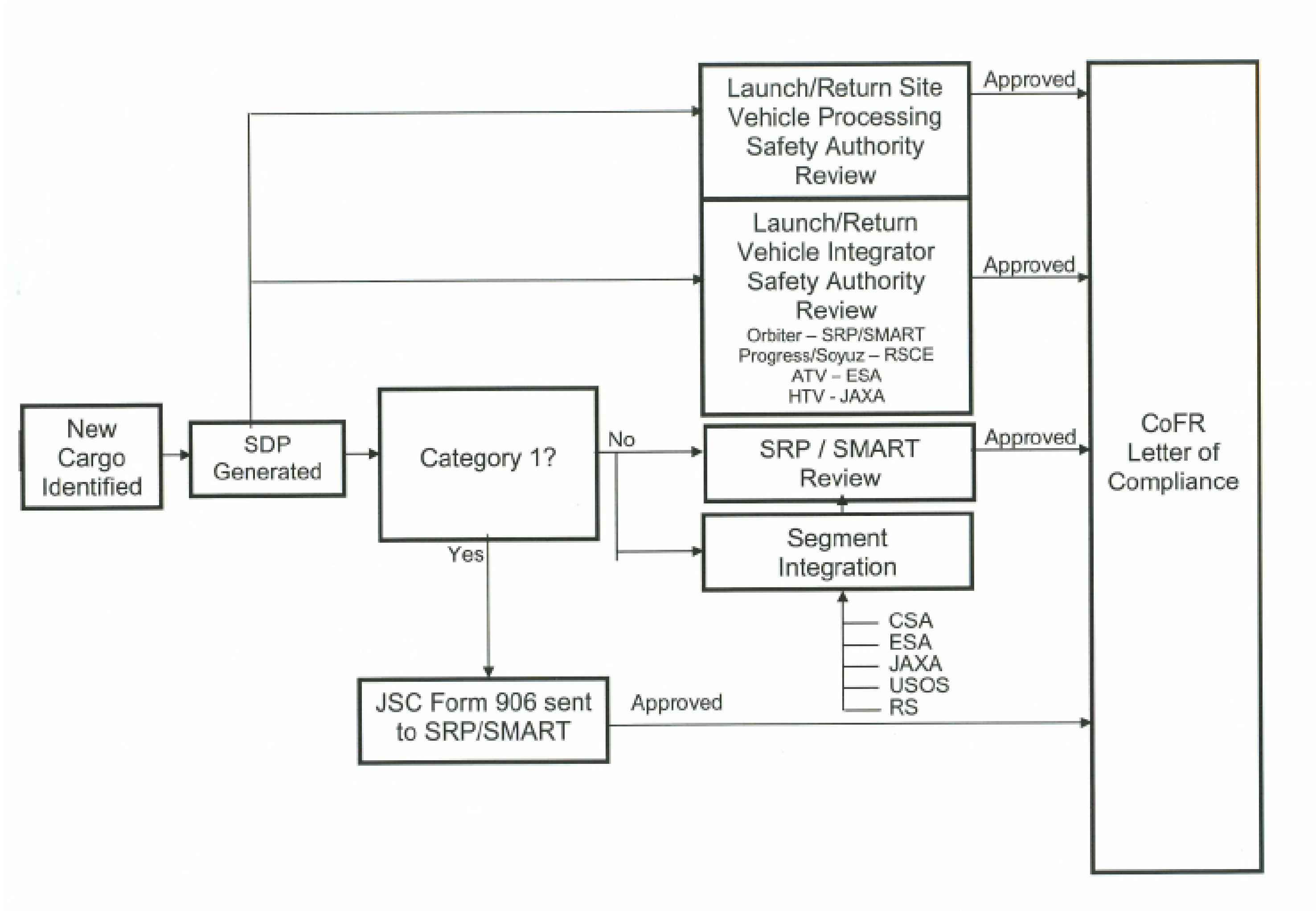


FIGURE 4.10-1 HARDWARE SAFETY APPROVAL PROCESS

TABLE 4.10-2 CATEGORY 1 AND 2 EXPLANATIONS*

Category	Explanation	Data submittal to SRP/FESRRP	Data submittal to other IPs
1	Hardware items with low hazard potential. See Table 4.10-1 for Category 1 Constraints. (JSC Form 907)	Each IP self-certifies category 1 hardware. The signed JSC Form 906 is submitted to the SRP/ FESRRP for records.	JSC Form 906 if the hardware is intended to be transported or stowed long-term or operated in another IP segment/ vehicle.
2	All hardware to be stowed or operated on ISS that does not meet at least one of the Category 1 Constraints. Meets safety requirements of SSP 50021 or of the IP's segment/ vehicle specification.	The JSC Form 906 along with the safety data package including hazard reports are submitted to the SRP/ FESRRP for approval.	JSC Form 906 along with the safety data package if the hardware is intended to be transported or stowed long-term or operated in another IP segment/ vehicle and/or if the hardware poses a hazard to another IP segment/ vehicle.

NOTE: *Items in any category require a complete safety/hazard analysis to be performed by the hardware provider and the safety/hazard analysis shall be reviewed and approved by the appropriate IP safety authority (e.g. safety review panel).

5.0 PROCEDURES AND DATA FOR PHASE SAFETY REVIEWS

The purpose of the safety review process is to assess the design and operations of the flight and ground elements for compliance with the safety requirements of SSP 50021 and KHB 1700.7, and to obtain panel approval of the completed safety compliance data. The responsible Safety and Engineering managers or a representative where applicable, and the Program Manager shall sign and date each Hazard Report before submittal.

5.1 PHASE I SAFETY REVIEW

The phase I safety review is the first safety meeting among the appropriate safety and engineering personnel representing NASA, IPs, contractors, and the ISS safety review panels in which safety of the ISS equipment and associated operations are addressed. The objective of the meeting is to identify all hazards and hazard causes inherent in the preliminary design, evaluate the means of eliminating, reducing, or controlling the risk, and establish a preliminary method for safety verification.

5.1.1 PHASE I DATA REQUIREMENTS

The following data is required for the phase I safety reviews:

A. GSE and Flight Hardware Ground Operations at KSC

1. Flight Element description based on subject mission.
2. Descriptions of GSE and flight hardware subsystems that present a potential hazard during ground processing, and the ground operations involving these items. Schematics and block diagrams with safety features and inhibits identified shall be included. Design data for hazardous systems (pressure, lifting, etc.) shall be summarized in a matrix. Contact the GSRP Chair for sample formats.
3. Ground operations scenarios including post-flight ground operations at the primary, alternate, and contingency landing sites. The scenarios shall highlight unique requirements, such as continuous power through a T-0 umbilical.
4. Ground HRs and appropriate support data.
5. Ordnance data required by KHB 1700.7
6. Demonstration that the preliminary design is in compliance with design requirements of KHB 1700.7. The following are basic hazard groups applicable to ground operations: structural failure of support structures and handling equipment; collision during handling; inadvertent release of corrosive, toxic, flammable, or cryogenic fluids; loss of habitable/breathable atmosphere; inadvertent activation of ordnance devices; ignition of flammable atmosphere/material; electrical shock/burns; personnel exposure to excessive levels of ionizing or nonionizing radiation; use of hazardous/incompatible GSE materials; inadvertent deployment of appendages; working under suspended loads; and rupture of composite epoxy overwrap pressure vessels.

7. Planned on-dock arrival date at KSC.

B. Flight System Design and Operations

1. An overview description of the design and flight operations of the hardware being addressed in the review. This includes descriptions of: hardware elements; flight and ground systems related to ISS on-orbit manned and unmanned operations; airborne support equipment; operational scenarios related to assembly, start-up sequences, and orbital operations; and LP, assembly, and stage configurations of the hardware. Briefly describe the hardware and operations in terms of significant characteristics and functions. Include figures or illustrations to show all major configurations and identify all hazardous systems and subsystems.

2. Detailed descriptions and schematics/block diagrams (at a PDR level of detail) for safety-critical systems and subsystems and their operations. In lieu of uniquely generated safety descriptive data, and with prior coordination with the SRP, references can be made to other ISS descriptive documentation made available to the SRP.

   a. The schematics and block diagrams should be prepared with safety features, inhibits, etc., identified. Describe the major elements of the end item or segment with the information organized by technical disciplines (See below).

   b. Describe the design, function, planned operation, and safety features of each system/subsystem.

   c. The following list of technical disciplines may be used to organize the data: structures, materials, mechanical systems, pyrotechnics and ordnance systems, pressure systems, propulsion and propellant systems, avionics systems (including electrical power distribution, computer-controlled systems), command and control systems, optical and laser systems, human factors, hazardous materials, thermal control systems, and interfaces and provided services.

3. Flight HRs and appropriate support data (see paragraph 5.1.2).

4. A summary listing in the description section, of safety-critical services provided by other ISS segments or the Orbiter.

5.1.2 PHASE I HAZARD REPORTS

A phase I HR shall be prepared for each hazard identified as a result of the safety analysis on the preliminary design and operations. The focus shall be on cause description and controls. Instructions for completion of phase I HR forms are contained in Appendix D.

5.1.3 SUPPORT DATA - PHASE I HAZARD REPORTS (FLIGHT ONLY)

Critical procedures/processes, which require special monitored verification, shall be identified in preliminary fashion. Also, for those hazards controlled by "design for minimum risk," rather than failure tolerance requirements, a minimum set of support data, defined herein for phase I are required. (Appendix D contains the complete list of data elements for design for minimum risk hazards.) For COTS and non-complex hardware, ISS subsystem manager and SRP with appropriate discipline expert (EEE, material, battery, etc) will provide guidance to the appropriate level of detail required for HR generation. (Note 1: Reference to submitted and approved document by number and title is sufficient unless given specific request.)

A. Unpressurized Structures:

1. Preliminary plan for structural verification in accordance with SSP 30559, Structural Design and Verification Requirements, (including beryllium, glass [in accordance with SSP 30560, Glass, Window, and Ceramic Structural Design and Verification Requirements], and composite/bonded structure) (Note 1)

2. Fracture Control Plan in accordance with SSP 30558, Fracture Control Requirements for Space Station (Note 1)

B. Pressurized Systems:

1. Fracture Control Plan (Note 1)

2. Summary of design conditions for each pressurized system and certification approach

C. Pyrotechnic Devices:

1. Identification of pyrotechnic devices and functions performed

D. Ionizing Radiation:

1. Ionizing radiation data sheet for each source (JSC Form 44 Ionizing Radiation Source Data Sheet - Space Flight Hardware and Applications, See Appendix G)

E. Electrical Systems:

1. Top level wiring diagrams illustrating the approach to wire sizing and circuit protection

F. Components and Elements of Mechanisms in Critical Applications:

1. Mechanical Systems Verification Plan (MSVP) – Preliminary Version (Note 1). Include in the MSVP a summary of critical procedures and processes to meet safety requirements using either a) failure tolerant approach or b) Design For Minimum Risk (DFMR) approach that required compliance with JSC letter MA2-00-057, Mechanical Systems Safety, September 28, 2000. A fault tolerant approach that combines a) and b) above will be accepted. A link to the MSWG website and the MA2-00-057 letter is available on the ISS SRP web page at http://srp-sma.jsc.nasa.gov/default.cfm.

5.2 PHASE II SAFETY REVIEW

The purpose of the phase II safety review is to present to the panels the updated Hazard Reports that reflect the completed design and operations of the ISS equipment to assure that all appropriate hazard controls have been implemented and that acceptable methods of verifying the controls have been identified in detail. The Phase II safety review is to correspond to the data maturity level of the CDR for the flight hardware and GSE. The Hazard Reports shall be completed such that: all hazards and hazard causes have been identified; a means for eliminating, reducing, or controlling the risk has been defined and implemented; and specific safety verification methods (i.e., test plans, analysis, inspection requirements, or demonstration plans) have been finalized. Interfaces to be assessed shall include those between the Orbiter and the LP, among the various elements and distributed systems in the cargo bay, and the integrated systems and elements that comprise the ISS stage configuration. Newly identified hazards shall be documented in additional Hazard Reports. If review phases are combined the hardware provider will need to provide all the data requirements that apply to the appropriate phases (i.e., phase I and phase II).

5.2.1 PHASE II DATA REQUIREMENTS

The following data is required for the phase II safety review:

A. GSE and Flight Hardware Ground Operations at KSC

1. Updated Flight Element description based on subject mission.
2. Updated descriptions and matrices of the GSE, the subsystems that present a potential hazard during ground processing, and their ground operations. Include updated schematics and block diagrams with safety features and inhibits identified. Electrical schematics must show all hardware/GSE grounding.
3. Updated ground operations scenarios, including post-flight ground operations at the primary, alternate, and contingency landing sites.
4. Updated and additional ground HRs and appropriate support data (see paragraph 5.2.2).
5. Updated ordnance data required by KHB 1700.7.
6. Updated on-dock delivery date at KSC.
7. Engineering drawings and stress analyses of safety critical subsystems when specifically requested.
8. A list of safety-related failures and mishaps that have occurred involving the flight hardware or GSE.
9. The status of action items assigned during phase I.
10. A list of technical operating procedures for ground processing with a preliminary designation showing which ones are hazardous.
11. Demonstration that design is in compliance with the design requirements of KHB 1700.7.

B. Flight System Design and Operations

1. Updated overview descriptions of hardware items and flight operations specified in paragraph 5.1.1b1. Individual stage descriptions as well as Assembly, Nominal, and Contingency Operation descriptions.

2. Updated detailed descriptions and schematics/block diagrams (at a CDR level of detail) for safety-critical systems and subsystems and their operations. The electrical schematics for safety critical circuits should depict the entire circuit from power source through the end function and to the power return. When shown in diagrams the inhibits and their controls should be clearly labeled. In lieu of uniquely generated safety descriptive data, and with prior coordination with the SRP, references can be made to other ISS descriptive documentation that will be made available to the SRP.
3. HRs and appropriate support data (see paragraphs 5.2.2 and 5.2.3).
4. Updated summary listing in the description section, of Orbiter or other ISS segment provided critical services. Critical services used to control and/or monitor hazards should be defined in appropriate HRs.
5. Engineering drawings and stress analyses of safety critical sub-systems when specifically requested.
6. A list of safety related failures and accidents.
7. Status of action items assigned during phase I safety reviews.

5.2.2 PHASE II HAZARD REPORTS

The phase II HRs shall be prepared by updating the safety hazards analysis to reflect the 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. Instructions for completion of phase II HR forms are contained in Appendix D. All current changes to the HRs are to be identified by a bar in the right-hand margin. The responsible safety and engineering managers or a representative where applicable, and the Program Manager shall sign and date each HR before submittal.

5.2.3 SUPPORT DATA - PHASE II HAZARD REPORTS (FLIGHT ONLY)

All critical procedures/processes must be addressed, including the plan for verification. For hazards controlled by "design for minimum risk," the following listed set of support data in addition to that provided for phase I, are required for phase II. For COTS and non-complex hardware, ISS subsystem manager and SRP with appropriate discipline expert (EEE, material, battery, etc) will provide guidance to the appropriate level of detail required for HR generation. (Note 2: Reference to submitted and approved document by number and title is sufficient unless given specific request.)

A. Unpressurized Structures: Structural verification plan (Note 2) in accordance with SSP 30559 including:

    1. Summary of design loads derivation leading to critical load cases (Note 2)

    2. Math model verification plan (Note 2)

B. Pressurized System:

    1. Qualification and acceptance test plan

C. Pyrotechnic Devices:

    1. For pyrotechnic devices which must operate reliably in order to meet safety requirements, an acceptance and qualification plan to verify fault tolerance, including margin demonstration, is required (Note 2)

D. Materials

    1. Fluids compatibility analysis (Note 2)

E. Flight Ionizing Radiation: JSC Form 44 for identified sources.

F. Ground Commanding:

    1. Training plan for command controllers (Note 2)

    2. List of hazardous commands including procedures used to preclude inadvertent commanding

    3. Description of command hardware

G. Components and Elements of Mechanisms in Critical Applications:

    1. MSVP – Final Version (Note 2). Include in the MSVP updates of critical procedures and processes to meet safety requirements using either a) failure tolerant approach or b) DFMR approach that required compliance with JSC letter MA2-00-057. Include fault-tolerance analysis for the safety-critical mechanisms explaining the independent success legs in place to meet fault-tolerance requirements and, if using DFMR approach, a completed 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. A complete discussion of the verification approach for each critical mechanism operation or feature is required for the MSVP.

5.3 PHASE III SAFETY REVIEW

The focus of the Phase III review will be the closure of significant safety verification test, analyses, inspections or demonstrations and review of the status of open standard verification items documented on the Verification Tracking Log (VTL). The phase III review provides the final safety assessment of equipment and operations.

5.3.1 PHASE III DATA REQUIREMENTS

The following data is required for the phase III safety review:

A. GSE and Flight Hardware Ground Operations at KSC

1. Final as-built hardware description and brief mission scenario.
2. Updated descriptions and matrices defining the final configuration of the GSE, the hardware 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 post-flight ground operations at the primary, alternate, and contingency landing sites.
4. Updated and additional ground hazard reports, including support data that reflect the final configuration of the as-built GSE and planned hardware/GSE use.
5. Updated and finalized ordnance data required by KHB 1700.7.
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 hardware or GSE.
9. Status of action items assigned during the phase II safety review.
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. ISS Safety VTL for ground operations only, in accordance with Appendix E (Figure E.1-1, Safety Verification Tracking Log) for a specific mission.
13. Certificate of Safety Compliance (JSC Form 1114A) signed by the responsible LP/mission manager for GSE design and ground operations. Demonstration that the design is in compliance with design requirements of KHB 1700.7.

14. Procedural hazard control matrix that identifies hazard control criteria within the associated work-authorization documents for all procedural hazards. Contact GSRP Executive Secretary for format.

15. Identification of ground safety noncompliances. Ground safety noncompliances must be approved as either a waiver or a deviation before the phase III safety review can be completed. A signed copy of each approved waiver/deviation shall be included in the phase III SDP (see paragraph 6.0).

B. Flight System Design and Operation

1. A final overview description of the design and operations of the hardware being addressed in the review. This includes descriptions of: elements; flight and ground systems related to ISS on-orbit manned and unmanned operations; airborne support equipment; operational scenarios related to assembly, start-up sequences, and orbital operations; and LP, assembly, and stage configurations of the hardware. Briefly describe the hardware and operations in terms of significant characteristics and functions. Include figures or illustrations to show all major configurations and identify all hazardous systems and subsystems.

2. Final detailed descriptions and schematics/block diagrams that reflect the as-built design for safety-critical systems and subsystems and their operations.

3. HRs and appropriate support data (see paragraphs 5.3.2 and 5.3.3).

4. A final summary listing of Orbiter or other ISS segment provided safety-critical services. Orbiter services or other ISS segment provided critical services used to control and/or monitor hazards should be defined in appropriate HRs.

5. Closure of action items assigned during the phase II safety review.

6. A summary of all safety related failures and accidents.

7. A list of all pyrotechnic initiators installed or to be installed. For each initiator the list identifies the function to be performed, the part, lot and serial numbers.

8. Engineering drawings and stress analyses of safety critical subsystems when specifically requested.

9. Listing of NCRs to safety requirements. A signed copy of each approved NCR shall be included, see section 6.0.

10. ISS Safety Verification Tracking Log (for flight hardware only) in accordance with Appendix E, Figure E.1-1 for a specific mission.

5.3.2 PHASE III HAZARD REPORTS

The phase III HRs shall reflect the as-built design and operations of the equipment. Ideally all safety analysis efforts are completed by phase III. The phase II HRs shall be updated to reflect this final equipment design and operations, and document the status and results of all completed verification work. All open verifications must be listed on a safety verification tracking log. This log allows the panel chairs 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 on orbit 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.

Instructions for completion of phase III HR forms are contained in Appendix D. All changes to the HRs since phase II shall be indicated by a bar in the right-hand margin. The HRs providers safety manager and Program manager shall sign and date each HR before submittal to the panels.

5.3.3 SUPPORT DATA - PHASE III HAZARD REPORTS (FLIGHT ONLY)

For hazards controlled by "design for minimum risk," the following listed set of support data in addition to that provided for phases I and II, are required for phase III. Note 3: Reference to submitted and approved document by number and title is sufficient unless given specific request.

A. Unpressurized Structures:
    1. Fracture summary report (Note 3)

B. Pressurized Systems: Fracture summary report (Note 3)
    1. Summary of results of verification tests/analyses

C. Pyrotechnic devices:
    1. Summary of results of verification test/analyses

D. Materials:
    1. Flammability assessment per SSP 30233 (Note 3)
    2. Fluids compatibility analysis (Note 3)

E. Flight Ionizing Radiation
    1. JSC Form 44 for identified sources

F. Components and Elements of Mechanisms in Critical Applications:

1. An up-to-date copy of MSVP (Note 3)
2. Mechanical Systems Verification Report (MSVR) (Note 3)
    a. Summary of the results of all verification testing, analyses, and inspections.
    b. Trade/special studies supporting HRs
    c. Flight HRs and appropriate support data (see paragraph 5.3.2)
    d. A summary listing in the SDP description section, of safety-critical services, and an explanation in the appropriate HRs of the ISS/Orbiter services used to control and/or monitor hazards

5.4 SAFETY VERIFICATION TRACKING LOG

The safety VTL is used to formally document and status ISS safety verification work that is not completed at the time the final safety assessment report is prepared. (All completed verification work is documented on the appropriate HRs.) The flight safety verification requirements will be acted on in accordance with the process described in the Program Master Verification Plan. If all activities associated with the safety analyses (other than the open verification) are completed, the panel chairs may sign the HRs indicating panel acceptance of the safety work, but with the understanding that final approval of the hazard is not complete until all applicable verification activity is completed. Items requiring on-orbit verification will be incorporated in approved assembly and checkout procedures. The procedure numbers will be referenced in the log. The status of VTL closure may be presented at the SWG, final closure or verification closure issues shall be coordinated with the SRP/GSRP. Flight verifications which are a constraint to ground operations shall be reported to the GSRP and tracked on the Ground Safety VTL.

5.5 POST PHASE III CHANGES

When changes to the design or operation of flight or ground hardware are required subsequent to the phase III safety review, the ISS participants shall assess those changes for possible safety implications, including their effect on all interfaces. The assessment shall be forwarded to the panels for approval. New or revised HRs and support data shall be prepared, where applicable, and submitted for review. Significant changes, as determined by the appropriate Panel Chair, may require a delta safety review.

5.5.1 GROUND POST PHASE III CHANGES

Any changes meeting the following criteria require the ISS hardware 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 hardware after turnover to KSC from KSC to the provider;

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.

5.6 SUBMITTAL OF PROPRIETARY DATA

The SRP/GSRP safety review process does not easily accommodate proprietary data, but reasonable efforts can be made, if necessary, to properly handle proprietary data. Non-disclosure requirements for JSC programs including the SRP are defined in JPD 5150.2H, Industry Presentations and Related Nondisclosure Agreements. Contact the SRP Coordination Office for assistance in these procedures.

In addition to the proper submittal of proprietary information, the submitting organization should be aware of the following while attending SRP/GSRP safety reviews, Technical Interchange Meetings (TIMs), and AI closure meetings:

A. SRP/GSRP meetings are not conducted in secure facilities. Thus, when it is necessary to recess meetings (e.g., lunch and breaks), the presenting organization will be responsible for protecting any proprietary data distributed during the meeting (other than that logged and distributed by NASA as part of the SDP).

B. If any proprietary data are to be presented or discussed during the meeting, prior to the meeting the presenting organization will notify the SRP Coordination Office/GSRP Executive Officer/Executive Secretary who will then make arrangements to monitor attendance, close the doors, and post a sign noting that access to the meeting is controlled. Panel members/alternates and support staffs have non-disclosure agreements and will not be restricted from panel meetings.

C. The presenting organization will be responsible for retrieval and disposition of any proprietary material distributed at the meeting (other than that logged and distributed by NASA as part of the SDP), with the exception that two copies of proprietary material distributed by the presenting organization at the meeting that will be retained by the SRP/GSRP in a protected file.

When the SRP/GSRP receives proprietary data included in the SDPs, such data will be handled in a manner that will protect the interests of the submitting organization. These procedures include tracking distributed materials, protecting files, and restricting reproduction. In order to exercise reasonable care in protecting proprietary data in connection with the flight hardware safety review process, NASA will ensure that proprietary data are distributed only to persons who have a need to review such data in support of panel functions. Furthermore, distributed data that is returned to the SRP Coordination Office/GSRP Executive Officer/Executive Secretary after use will be destroyed via the NASA secure disposal process.

The protection of material marked “PROPRIETARY” creates an added burden on the SRP/GSRP review support system, so the submitting organization shall mark only those items that are proprietary. The submitting organization shall coordinate with the SRP Coordination Office/GSRP Executive Officer/Executive Secretary to explore such alternatives as providing the proprietary material in a separate package when it is a very small portion of the overall SDP. If a separate, proprietary briefing package (not contained in the SDP) is to be presented to the SRP/GSRP during the review, the submitting organization shall provide at least 20 copies of such material for distribution at the review and will retrieve it after the review as stated above.

If the submitting organization discovers that some portion of the SDP marked “PROPRIETARY” is no longer considered such, the organization must inform the SRP Executive Officer and/or the GSRP Executive Secretary in writing.

5.7 SUBMITTAL OF COPYRIGHTED DATA

Organizations submitting SDPs are hereby informed that documentation submitted to NASA must be reproduced and distributed to the members of the SRP/GSRP and to associated technical support personnel. Accordingly, 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.

5.8 SUBMITTAL OF TRANSLATED DATA

For all documents submitted to the SRP/GSRP that have been translated into English, the English translation shall be the official document.

5.9 SUBMITTAL OF TOXICOLOGICAL DATA FOR ISS (FLIGHT ONLY)

The Shuttle/ISS safety review process requires biomedical safety assessments of potentially hazardous materials, such as chemicals, microorganisms, and radioisotopes. See JSC 27472 Requirements for Submission of Data Needed for Toxicological Assessments of Chemicals and Biologicals to be Flown on Manned Spacecraft, for the toxicological data requirements. In order for these assessments to be available for the safety reviews, the JSC Toxicology Group requires submittal of test sample data substantially in advance of the phase safety reviews, see JSC 27472, Appendix B for data submission timelines. The developer must attach both the data submitted to JSC Toxicology Group and the JSC response (when available) to the applicable HR that is a part of the SDP as requested by the SRP. Should toxicology submittals involve proprietary data, see section 5.6.

6.0 NONCOMPLIANCE WITH ISS SAFETY REQUIREMENTS

Elements of the ISS shall meet all the applicable safety requirements or obtain specific approval for each case of noncompliance. A compilation of the ISS safety requirements is in SSP 50021 and KHB 1700.7. The applicable safety requirements for an element of the ISS are those requirements of SSP 50021 and KHB 1700.7 which have been allocated to the item via the applicable system, segment, prime item development, or end item specification.

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 SRP/GSRP about the noncompliant condition should be made as soon as possible.

When the design of the ISS hardware or its operations do not comply with an applicable safety requirement, a safety NCR form shall be processed by the developer to obtain approval of the noncompliant condition. Prior to the submittal of the NCR, appropriate rationale must be developed that defines the design features and/or procedures used to conclude that the noncompliant condition is safe. This rationale with supporting data shall be documented on the NCR. Approval of an NCR for the design or operation of one element, subsystem, or component of the design will not relieve the developer of the responsibility to meet the requirement in any other element, subsystem, or component of the design.

Flight NCRs must be approved before the associated hazard report will be approved by the SRP.

Ground NCRs must be approved before the associated hazard report will be approved by the GSRP or, if Post-Phase III, prior to the start of associated KSC ground operations.

6.1 NONCOMPLIANCE DEVELOPMENT AND PROCESSING

All NCRs shall be coordinated with the SRP or the GSRP, as appropriate, prior to submittal and should be submitted as soon as it is determined that the safety requirement cannot be met. The hardware manager prior to submittal must sign all NCRs. The developer must ensure that the NCRs are processed through the appropriate technical panel or working group prior to submittal. The developer must also ensure that the NCRs are processed through the appropriate control board(s).

The NCR will contain the following information: title, applicable segment, system or subsystem, applicable safety requirements, description of the noncompliance, description of the hazard or hazard cause affected by the noncompliance condition, reason the requirement cannot be met or fulfilled, and rationale for acceptance. The form ISS_CM_031, ISS Safety Noncompliance Report (NCR), will be used for NCR submittal. The form is under the control of ISS Configuration Management and is available in the Electronic Document Management System (EDMS).

The NCR shall be provided by the developer for an initial review by the responsible technical panel or working group (EVA, Crew, Operations, Materials, etc.). Once concurrence of the technical community has been documented, the NCR will be submitted to the Flight SRP or GSRP for disposition. The developer will present the NCR and supporting data to the applicable panel. To obtain Space Station Program manager approval, the NCRs will be presented to the Space Station Program Control Board (SSPCB) and, if required the Joint Program Requirements Control Board (JPRCB) in accordance with SSP 50123, Configuration Management Handbook. The NCR shall be prepared and approved by the safety representative (e.g., contractor Safety manager for Contractor-Furnished Equipment (CFE), and IP Safety manager for IP segments) and Program/Project Manager of the responsible submitting organization. The developer will technically sponsor the NCR through the appropriate boards.

Approval authority for flight "equivalent safety" type NCRs has been delegated by the ISS Program Manager to the Chairs of the ISS SRP. This delegation is documented in memorandum OE-97-44, Approval Authority for Safety Noncompliance Reports (NCR) for International Space Station (ISS) "Equivalent Safety" Hardware.

"Equivalent safety" may be granted for noncompliance conditions that do not meet specific requirements in the exact manner specified; however, the hardware/system design, procedure, or configuration satisfies the intent of the requirement by achieving a comparable or higher degree of safety. Criteria for establishing an "equivalent safety" is based on:

A. Use of alternative methods/controls;

B. Utilization of procedures, protective devices, preflight verification activities, and crew experience base;

C. Reduced time of exposure;

D. Likelihood/probability of additional failures after loss of first control/inhibit;

E. Reduction of hazard category, and/or other factors such as minimum of single fault tolerance (1FT) with a robust design.

Specific requirements and details with respect to this delegated authority and the scope of noncompliant conditions to which it applies will be addressed during the conduct of flight safety review meetings when an applicable noncompliant condition is identified. Under these circumstances, the NCR condition shall be documented on the HR, and the SRP chairs will disposition the NCR.

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

6.2 EFFECTIVITY OF SAFETY NCRS

When a safety NCR is granted, it is applicable for only the period specified on the approved NCR. For those NCRs with limited effectivity the developer 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

This section applies only to hardware that has completed the SRP and GSRP Processes. Reflown Equipment is ISS flight equipment that was previously launched and utilized on orbit and is manifested for reflight and reuse, or GSE equipment that has been previously utilized. Series Equipment is hardware/software of the same or similar design to hardware/software, which has been previously certified safe by the appropriate safety review panel.

For IP-sponsored Category 1 and 2 series and reflown equipment, the flight approval request process is documented in paragraph 8.0. Variances to the basic procedures of paragraph 5.0 have been developed for similar and reflown equipment to eliminate unnecessary duplication of effort from previously accomplished safety activity.

The user of the reflown/series equipment (i.e., NASA, the ISS Contractor, or an IP) is responsible for the safety of the series/reflown equipment and associated interfaces. To fulfill this responsibility, the user shall assess the previously approved safety data of the series/reflown equipment for applicability to the new application and make all appropriate changes. The number and depth of the phase safety reviews to be conducted to assess series/reflown equipment shall be discussed at an early safety review meeting.

Ground safety data shall be submitted to the GSRP in time to meet the requirements in paragraghs 4.3.3.2.1 and 4.7.

The following unique data for the series/reflown equipment shall be submitted:

A. Identification of all series/reflown equipment to be used and the baseline safety analyses.

B. Assessment of each piece of series/reflown equipment to indicate that the proposed use is the same as that analyzed and documented.

C. New or revised HRs, additional data, and identification of deleted HRs. Identification and assessment of changes in hardware/software and operations, which have safety impact. A copy of the approved baseline Phase III Hazard Reports (attachments not required) shall also be submitted.

D. An assessment of the safety verification methods contained in the baseline safety analysis to determine which verification must be re-accomplished. Open verification items are to be tracked on a VTL (see Appendix E).

E. A list and description of safety noncompliances including the acceptance rationale for each.

F. Assessment of limited life items for reflown hardware.

G. Description of maintenance, structural inspections, and refurbishment of reflown hardware and assessment of safety impact.

H. Assessment of all failures and anomalies during previous usage of the series/reflown element with corrective action taken and rationale for extended use.

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 flight reviews: A list of all pyrotechnic initiators installed or to be installed. The list will identify for each initiator the function to be performed, the part number, and the lot number and the serial number.

K. Ionizing radiation data sheet for each source, see Appendix G, JSC Form 44, KSC Forms, as applicable.

L. Non-ionizing radiation data sheet for each source, see Appendix G, JSC Form 44, KSC Forms, as applicable.

M. A final list of procedures for ground processing (ground only).

N. On-dock date at KSC.

O. Certificate of Safety Compliance signed by the appropriate Program Manager.

P. Re-verification of operational controls for implementation in procedures and flight rules.

Q. Assessment of on-orbit operations restrictions.

8.0 CATEGORY 1 AND 2 IP-SPONSORED SERIES AND REFLOWN EQUIPMENT FLIGHT APPROVAL REQUEST PROCESS

For IP-sponsored Category 1 and 2 hardware that has been approved by the SRP/FESRRP for a previous flight/increment, rather than submitting a new JSC Form 906 or Certification for Ground Safety Review of Category 1 Cargo/Hardware or Government Furnished Equipment (GFE) (KSC Form 20-201) for each flight, the IP shall submit a list of previously approved hardware items to the SRP/FESRRP/GSRP for concurrence in the form of a series/reflight letter. In order for a hardware item to use this process, it must not have changed form, fit or function since its previous approval. The following statement and data elements shall be included in the list:

A. The statement, “The series/reflown equipment listed herein has experienced no safety-related ground or in-flight anomalies since its previous ISS/Shuttle safety approval unless otherwise noted”.

B. Part Names and Part Numbers for each hardware item.

C. Category for each hardware item (Category 1 or Category 2).

D. Original Flight Safety Certificate numbers from SRP/FESRRP approved JSC Form 906 or KSC Form 20-201 approval date, as appropriate.

E. Comments regarding any safety-related ground or in flight anomalies and their resolutions/rationale for extended use.

The reflight letter must be endorsed by the IP’s recognized safety organization manager.

APPENDIX A - ACRONYMS AND ABBREVIATIONS

A	Amp
AI	Action Item
ATV	Automated Transfer Vehicle
BDEALS	Bilateral Data Exchange, Agreements, Lists, and Schedules
CDR	Critical Design Review
CFE	Contractor-Furnished Equipment
CoFR	Certification of Flight Readiness
COTS	Commercial Off-the-Shelf
CSA	Canadian Space Agency
DFMR	Design For Minimum Risk
DTO	Development Test Objectives
e.g.	Example
EDMS	Electronic Document Management System
EED	Electro-Explosive Device
EMS	Engineering Master Schedule
ESA	European Space Agency
etc.	Etcetera
EVA	Extravehicular Activity
FE	Factory Equipment
FESRRP	Flight Equipment Safety and Reliability Review Panel
GFE	Government-Furnished Equipment
GSE	Ground Support Equipment
GSRP	Ground Safety Review Panel
h	hour
HA	Hazard Analyses
HR	Hazard Report
HTV	H-II Transfer Vehicle
IHA	Integrated Hazard Analyses
IP	International Partner
ISS	International Space Station
JAXA	Japan Aerospace Exploration Agency
JPRCB	Joint Program Requirements Control Board
JSC	Johnson Space Center
kg	kilogram
KSC	Kennedy Space Center
L-2	Launch Minus 2 Day

lbs	pounds
LP	Launch Package
LP/S	Launch Package/Stage
mAh	milliampere-hour
MOU	Memorandum of Understanding
MSVP	Mechanical Systems Verification Plan
MSVR	Mechanical Verification Systems Report
NASA	National Aeronautics and Space Administration
NCR	Noncompliance Report
O&U	Operations & Utilization
OSHA	Operations & Support Hazard Analyses
PDR	Preliminary Design Review
PHA	Preliminary Hazard Analyses
PR	Program Risk
RS	Russian Segment
RSA	Russian Space Agency
RSCE	Rocket Space Corporation Energia
S&MA	Safety and Mission Assurance
SDP	Safety Data Package
SHA	System Hazard Analyses
SMAP	Safety and Mission Assurance Panel
SOW	Statement of Work
SRP	Safety Review Panel
SSA	Software Safety Analyses
SSPCB	Space Station Program Control Board
STE	Special Test Equipment
SWG	Safety Working Group
T-	Time minus
TBD	To Be Determined
TBR	To Bo Resolved
TIM	Technical Interchange Meetings
TSE	Test Support Equipment
TNSC	Tanegashima Space Center
TV	Television
URL	Uniform Resource Locator
U.S.	United States
USOS	United States On-orbit Segment
v	volt
VCB	Vehicle Control Board

VCN	Verification Completion Notice
VTL	Verification Tracking Log
w	watt

APPENDIX B - GLOSSARY OF TERMS

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. The term GSE includes COTS, FE, TSE and STE.

INCREMENT

A specific time period into which various assembly, research, testing, logistics, maintenance, and other ISS system Operations and Utilization (O&U) activities are grouped. Increment boundaries are established to coincide with, and are defined by, crew rotations.

LAUNCH VEHICLE

The vehicle that launches the transportation vehicle to orbit.

MISSION

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

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
2-1	2.1	Placeholder for document title for H-II Transfer Vehicle (HTV) Safety Document.
3-2	3.2.2.1	Placeholder for HTV document number.
4-1	4.3.4.3	Placeholder for the ground safety requirements and process for TNSC.
4-2	4.3.4.4	Placeholder for the ground safety requirements and process for Baikonur Cosmodrome.

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

APPENDIX D – INSTRUCTIONS FOR ISS HAZARD REPORT FORM

D.1 SCOPE

The information required to complete a ISS HR form is defined herein. The ISS HR Form (figure D.1-1) and HR legend will be used as the standard form for all ISS equipment. An equivalent form may be used as long as the form contains the same content fields as the ISS form and has been coordinated with the appropriate panel.

D.2 SUPPORT DATA

Each HR shall stand alone. Data required to understand the hazard, the hazard controls, and the safety verification methods shall be attached to the report. Examples of such data include block diagrams, descriptions of the applicable flight/support system and its operation, a listing of the sequence of events, a list of critical procedures/processes that require special verification, lists of mechanisms, lists of connects made or broken, lists of penetrations to space and associated seals and summaries of proposed tests or test results. When functional diagrams or schematics are supplied, the pertinent information shall be clearly identified (e.g., controls, inhibits, monitors, etc.). HRs that address identified safety requirements as "design for minimum risk" areas of design must be supported by a minimum set of supporting data as listed below

A. Unpressurized Structures:

1. Preliminary plan for structural verification in accordance with SSP 30559, (including beryllium, glass [in accordance with SSP 30560], and composite/ bonded structures).#
2. Fracture Control Plan in accordance with SSP 30558.#
3. Structural verification plan in accordance with SSP 30559 including:#
    a. Summary of design loads derivation leading to critical load cases.#
    b. Math model verification plan.#
4. Fracture summary report.#

B. Pressurized Systems:

1. Fracture control plan in accordance with SSP 30558.#
2. Summary of design conditions for each pressurized system and certification approach.
3. Qualification and acceptance test plan.
4. Fracture summary report.#
5. Summary of results of verification tests/analyses.

C. Pyrotechnic Devices:

1. For pyrotechnic devices, which must operate reliably in order to meet safety requirements, the following data is required:

   a. Identification of pyrotechnic devices and functions performed.

   b. Acceptance and qualification plans to include margin demonstration.#

   c. Summary of results of verification test/analyses.

D. Materials:

1. Flammability assessment in accordance with SSP 30233 or NHB 8060.1C.#

2. Fluids compatibility analysis.#

E. Ionizing Radiation:

1. Ionizing Radiation data sheet for each source (JSC Form 44).

F. Non-Ionizing Radiation:

1. List of equipment generating non-ionizing radiation.

G. Ground Commanding:

1. List of hazardous commands including procedures used to preclude inadvertent commanding.

2. Description of command hardware.

3. Training plan for command controllers.#

H. Electrical Systems:

1. Wire sizing and circuit protection diagram.

2. Connector mate and demate table showing compliance to the requirements of letter MA2-99-170, Crew Mating/Demating of powered connectors.

I. Components and Elements of Mechanisms in Critical Applications:

1. Identification of critical procedures and processes.

2. Mechanism verification plan demonstrating approach to compliance with Letter JSC, TA-94-041, Mechanical Systems Safety, June 9, 1994. #

3. Summary of verification results.

Data marked by # symbol will be referred to by document number, title, and reference data on the applicable HRs and shall be submitted for review as in section 5.0.

D.3 APPROVAL

The ISS HRs will be approved in accordance with paragraph 4.6. The appropriate management personnel must sign and date the HR to signify agreement with the content prior to its submittal to the safety panel. The panel chairs will provide a disposition for each HR.

TEAM NAME
International Space Station

Hazard Report Number

---

1. HAZARD TITLE:

a. Review Level:
b. Revision Date:
c. Scope:

2. HAZARD CONDITION DESCRIPTION:

3. CAUSE SUMMARY:

1. Title:
2. Title:
3. Title:

4. PROGRAM STAGE(S):

5. INTERFACES:

6. STATUS OF OPEN WORK: (PHASE III ONLY)

7. REMARKS:

FIGURE D.1-1 HAZARD REPORT LEGEND (PAGE 1 OF 6)

8. SUBMITTAL CONCURRENCE:

(a) NASA Contractor

Safety Manager	Date
Mission Integration Manager	Date
Program Manager	Date

(b) International Partners

Safety Manager	Date
Program Manager	Date

9. APPROVAL:

(a) Safety Review Panel

Panel Chair	Date
Panel Chair	Date

FIGURE D.1-1 HAZARD REPORT LEGEND (PAGE 2 OF 6)

Hazard Report Number

Cause 1

1. HAZARD CAUSE DESCRIPTION:

SEVERITY: **LIKELIHOOD:**

2. CONTROL(S):

Control 1
Control 2
.
.
Control n

3. METHOD FOR VERIFICATION OF CONTROLS:

Verification for Control 1
Verification for Control 2
.
.
Verification for Control n

4. SAFETY REQUIREMENT(S):

Document: Paragraph:

Title:

Document: Paragraph:

Title:

FIGURE D.1-1 HAZARD REPORT LEGEND (PAGE 3 OF 6)

5. MISSION PHASE(S):

_____ Launch Processing:
_____ Launch:
_____ Rendezvous/Docking:
_____ Deployment:
_____ Orbital Assembly and Checkout:
_____ On-orbit Operation:
_____ On-orbit Maintenance:
_____ Return/Decommissioning:
_____ Landing
_____ Post-landing

---

6. PROGRAM STAGE(S):

---

7. DETECTION AND WARNING METHOD(S) (Including verification):

---

8. CAUSE REMARKS:

---

9. CIL REFERENCE:

---

10. POINT OF CONTACT:

Name: **Telephone:**

FIGURE D.1-1 HAZARD REPORT LEGEND (PAGE 4 OF 6)

Hazard Report Number

Cause *n*

1. HAZARD CAUSE DESCRIPTION:

SEVERITY: **LIKELIHOOD:**

2. CONTROL(S):

Control 1
Control 2
.
.
.
Control n

3. METHOD FOR VERIFICATION OF CONTROLS:

Verification for Control 1
Verification for Control 2
.
.
Verification for Control n

4. SAFETY REQUIREMENT(S):

Document: Paragraph:

Title:

Document: Paragraph:

Title:

FIGURE D.1-1 HAZARD REPORT LEGEND (PAGE 5 OF 6)

5. MISSION PHASE(S):
____ Launch Processing:
____ Launch:
____ Rendezvous/Docking:
____ Deployment:
____ Orbital Assembly and Checkout:
____ On-orbit Operation:
____ On-orbit Maintenance :
____ Return/Decommissioning:
____ Landing
____ Post-landing

---

6. PROGRAM STAGE(S):

---

7. DETECTION AND WARNING METHOD(S) (Including Verification):

---

8. CAUSE REMARKS:

---

9. CIL REFERENCE:

---

10. POINT OF CONTACT:

Name: **Telephone:**

FIGURE D.1-1 HAZARD REPORT LEGEND (PAGE 6 OF 6)

HAZARD REPORT LEGEND

FOR EACH CAUSE PAGE

1. HAZARD CAUSE DESCRIPTION: Describe the identified causes for the risk situation and the unsafe act or condition listed under the hazard description. Hazard causes may be environmental, personnel error, design characteristics, procedural deficiencies, or subsystem malfunctions. Causes should be established at a level of detail necessary to explain the event path to the hazard.

SEVERITY: This index quantifies the worst-case accident or undesired event resulting from this cause. Severity levels are I (Catastrophic), II (Critical), and III (Marginal) as specified in Table D.1-1, Severity Category. Hazard potential classification should be established based on an uncontrolled or unmitigated worst-case hazardous event. The fact that a causal event must occur in conjunction with another causal event to result in a hazardous consequence does not lessen the severity, but will affect the controls required by ISS safety requirements to prevent the individual causal event. In such cases, the hazard cause and hazard control linkage should be stated on the HR.

LIKELIHOOD: The likelihood (probability of occurrence) of this hazard cause manifesting itself after controls have been implemented. Likelihood levels are A, B, C, and D, with A being the most probable as specified in Table D.1-2, Likelihood of Occurrence.

2. CONTROL (S): Provide a description of all the necessary design/operational controls needed to mitigate this hazard cause, including documentation references, if applicable. Identify the design features, safety devices, warning devices, and/or special procedures that will reduce, safe, or counter the hazards resulting from the hazard cause. If procedures or processes in manufacturing or assembly are critical elements in controlling hazards, the procedures and/or processes must be so identified and addressed individually. The order of precedence for reducing hazards is defined in SSP 50021. This section of the HR shall be initially completed for the phase I submittal and updated as required for each subsequent phase safety review. A direct correlation (indexing) between each hazard cause and the corresponding hazard control(s) and the corresponding method of verification of controls must be clearly shown on the HR. The hazard controls should be defined to a level of detail that clearly indicates compliance with the Safety Requirement.

3. METHOD FOR VERIFICATION OF CONTROL (S): Identify for each control method the method of verification (procedure/processes), including document number (if applicable), used to assure the effectiveness of the hazard controls. Each control verification method must link with its corresponding control, and when more than one method of verification is listed for a control; the verification methods will be listed separately (e.g., 1a, 1b, 2, 3a, 3b, 3c). Each verification method description shall include sufficient detail or explanation of the testing, inspection, or analysis, which mitigates the hazard to support hazard closure or risk acceptance. For phase II, this section should be updated to refer to specific test (or analysis) procedures and a summary of criteria to be used. For phase III, all safety verifications should be

completed and a definitive statement of verification status shall be provided (i.e., “Open with Estimated Completion Date of …,” “Closed (with reference to supporting data),” or “Transferred for Closure via VTL”). This section shall be updated to reflect any changes in the verification methods made after the phase II review.

4. SAFETY REQUIREMENT (S): Identify the design safety requirements applicable in this cause. The detailing of safety requirements on the HR indicates what requirements are to be satisfied within the hazard controls. These requirements should be specified by document and paragraph. It is the responsibility of the originator of the HR to indicate the requirements that are being applied to their design based upon their hazard analysis. For flight Reference should be made to requirements at the segment and system level or the requirements in SSP 50021. References shall be made to KHB 1700.7 for ground hazard reports.

5. MISSION PHASE (S): Identify the phase of the mission in which the hazard manifests itself. An (X) indicates that the identified phase is affected by the hazard. An (O) indicates that it has been considered but is not affected.

Launch Processing covers the time period where the hardware arrives at the launch site, is processed into the launch vehicle, and extends to T-0.

Launch covers the time period from T-0 through orbital insertion.

Rendezvous/Docking covers the time period from orbital insertion until launch vehicle is docked to the Stage.

Deployment covers the time period from launch vehicle docking through detachment of the segment or end item from the launch vehicle.

Orbital Assembly and Checkout covers the time period from detachment from the launch vehicle, mating to the pre-existing stage, checkout, and launch vehicle demate.

On-orbit Operations covers Stage operations from launch vehicle demate until the next launch vehicle mates to the on-orbit stage.

On-orbit Maintenance covers the maintenance tasks and the tests required for verification of maintenance action completion.

Return/Decommissioning, Return covers the time period from launch vehicle demate from the on-orbit stage through element removal from launch vehicle on the ground. Decommissioning covers the time period from element disassembly from the on-orbit stage through final disposal of the elements.

Landing covers the period of Shuttle landing until flight hardware is removed from the Shuttle and leaves the landing site.

Postlanding covers the period after the flight hardware is removed from the Shuttle until the flight hardware leaves KSC or the contingency/alternate-landing site.

6. PROGRAM STAGES: Using the ISS Assembly Sequence Manifest, identify the Stage(s) in which the hazard manifests itself.

7. DETECTION AND WARNING METHOD (S): When applicable, describe the technique(s) used to detect the hazardous condition. This section is especially critical when detection and warning is required to implement required controls, which might not be effective without such detection. Identify, for each, the method of verification (procedure/processes), including document number (if applicable) used to assure the effectiveness of the detection and warning method(s).

8. CAUSE REMARKS: Entries here should include any information relating to the hazard cause but not fully covered in any other item field.

9. CIL REFERENCE: Provide the CIL numbers used in this analysis broken out by cause.

10. POINT OF CONTACT: Provide the name and telephone number of the individual to be used as a point of contact for this cause.

TABLE D-1.1 SEVERITY CATEGORY

Description	Category	Mishap Definition
Catastrophic	I	Any condition which may cause a disabling or fatal personnel injury or cause loss of one of the following: the Orbiter, ISS or a major ground facility. For safety failure tolerance considerations loss of the ISS is to be limited to those conditions resulting from failures or damage to elements of the ISS that render the ISS unusable for further operations, even with contingency repair or replacement of hardware, or which render the ISS in a condition which prevents further rendezvous and docking operations with ISS launch elements.
Critical	II	Any condition, which may cause a non-disabling personnel injury, severe occupational illness, loss of an ISS element, or involves damage to the Orbiter or a major ground facility. For safety failure tolerance considerations, critical hazards include loss of ISS elements that are not in the critical path for Station survival or damage to an element in the critical path, which can be restored through contingency repair.
Marginal	III	Any condition which may cause major damage to an emergency system, damage to an element in a non-critical path, minor personnel injury, or minor occupational illness.

TABLE D.1-2 LIKELIHOOD OF OCCURRENCE

Description	Category	Mishap Definition
Probable	A	Expected to happen in the life of the Program.
Infrequent	B	Could happen in the life of the Program. Controls have significant limitations or uncertainties.
Remote	C	Could happen in the life of the Program, but not expected. Controls have minor limitations or uncertainties.
Improbable	D	Extremely remote possibility that it will happen in the life of the Program. Strong controls are in place.

APPENDIX E – INSTRUCTIONS FOR ISS SAFETY VERIFICATION TRACKING LOG

E.1 SCOPE

This appendix describes the usage of the ISS safety VTL (figure E.1-1), and provides instructions for its completion.

E.2 USAGE

The verification-tracking log is used to formally document and status ISS safety verification work that is not completed at the time the final safety assessment report is prepared. (All completed verification work is documented on the appropriate HRs.) See paragraph 5.4.

E.3 INSTRUCTIONS

Instructions for the completion of the ISS Safety VTL are as follow:

A. TITLE

The title is used to identify whether or not the tracking log is for a mission or specific equipment verification.

B. PAGE

The specific page number followed by the total number of pages.

C. ELEMENT/MISSION

The name of the element, end item, etc., or the mission number.

D. DATE

Date completed or updated.

E. LOG NO.

An alphanumeric designation used to identify and track each verification item. These designations will be assigned by the project organization when the log is first submitted.

F. HAZARD REPORT NUMBER

The number of the HR containing the verification item.

G. SAFETY VERIFICATION NUMBER

The number from the applicable HR (Safety Verification Method block) for the specific verification item.

H. DESCRIPTION

The specific verification remaining open. Procedures will be identified by number and title.

I. GROUND OPERATION (S) CONSTRAINED

For Flight VTLs:

Indicate “yes” or “no” as to whether this safety verification constrains any ground operations. If “yes”, provide an attachment that identifies which ground operation is constrained. Notification to the GSRP of the constraint shall be provided.

For Ground VTLs:

Indicate which ground operation is constrained by this verification. Indication may be specific (e.g. a step in a procedure) or general (e.g., arrival or first use).

J. INDEPENDENT VERIFICATION REQUIRED (YES/NO)

The need (Yes/No) for an independent verification of the specific item.

K. SCHEDULED DATE

The date planned for completion of the verification.

L. COMPLETION DATE

The date this verification was completed.

M. METHOD OF CLOSURE/COMMENTS/VERIFICATION COMPLETION NOTICE (VCN)

The method by which this open verification has been confirmed closed, including additional information or remarks.

Submission of closure documentation is required for closure.

Page______ of____________

International Space Station

Mission Element

Safety Verification Tracking Log

Mission/Element: Flight: Ground: Date:__________

Log Number	Hazard Report Number	Safety Verification Number	Description (Identify Procedures by: Number and Title)	Operation(s) Constrained	Independent Verification Required (Yes/No)	Scheduled Date	Completion Date	Method of Closure Comments/Verification Completion Notice (VCN)

FIGURE E.1-1 SAFETY VERIFICATION TRACKING LOG

APPENDIX F – INSTRUCTIONS FOR COMPLETION OF ISS FORM 1366 (FLIGHT ONLY)

		A. NUMBER		B. PHASE		C. DATE
ISS FLIGHT HARDWARE STANDARDIZED HAZARD CONTROL REPORT		STD-		**Phase**		
D. ISS BASIC AND INTERMEDIATE HARDWARE, DTO, or GFE *(Include Part Number(s), if applicable)*		**HAZARD TITLE**			**E. VEHICLE**	
		STANDARD HAZARDS				
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE AND STATUS:**			
1. Structural Failure *(Item must comply with the listed requirements for all phases of flight)*	a) SSP 30559 section 3.0 and SSP 50021, 3.2.10, or b) SSP 50094, 6.4; or c) Designed to meet the standard modular locker stowage requirements of NSTS 21000-IDD-MDK or equivalent IDD, or d) Stowed in SPACEHAB per MDC91W5023					
2. Structural Failure of Sealed or Vented Containers causes fragmentation hazard to crew or adjacent equipment	a) Sealed containers must meet the criteria of SSP 50559, 3.1.9.4, Secondary Volumes or SSP 50094, 7.1.1.8. b) For intentionally vented containers, vents are sized to maintain a 1.5 factor of safety for Station with respect to pressure loads.					
3. Sharp Edges causes injury to IVA or EVA crewmember	Meets the intent of one or more of the following: a) SSP 50021, 3.3.6.12.3, External corner and edge protection, b) SSP 50021, 3.3.6.12.4, Internal corner and edge protection, c) NASA-STD-3000 / SSP 50005, d) SSP 50094, 6.3.3.1, 6.3.3.2, 6.3.3.3, 6.3.3.1.1.					
4. Shatterable Material Release *[limited to contained and non-stressed (no delta pressure) optical glass]*	a) SSP 50021, 3.3.6.11.14 (New) All materials contained and/or b) Non-stressed (no delta pressure) lenses, filters, etc., which pass a vibration test at flight levels and a post- test visual inspection, or c) SSP 50094, 7.1.2.1.2					

		A. NUMBER	B. PHASE	C. DATE
ISS FLIGHT HARDWARE STANDARDIZED HAZARD CONTROL REPORT		STD-	**Phase**	
D. ISS BASIC AND INTERMEDIATE HARDWARE, DTO, or GFE *(Include Part Number(s), if applicable)*		**HAZARD TITLE**	**E. VEHICLE**	
		STANDARD HAZARDS		
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE AND STATUS:**	
5. Flammable Materials	a) SSP 50021 3.2.9, Materials; A-rated materials selected from MAPTIS, or b) Flammability assessment per SSP 30233, 4.1, 4.2 (NHB 8060.1C), or c) SSP 50094, 4.3.3.1.3	☐ ☐ ☐		
6. Materials Offgassing	a) SSP 50021, 3.2.9.1; SSP 30233; Offgassing tests of assembled article per NHB 8060.1C or NASA-STD-601	☐		
7. Nonionizing Radiation 7.1 Non-transmitters	a) SSP 50021, 3.2.7.9, Electromagnetic Radiation; 3.2.7.10, EMC; 3.2.7.11, EMI ; SSP 30237 EMI compatibility testing, or a) NSTS/MS2 approved analysis, or b) SSP 50094, 3.4	☐ ☐ ☐		
7.2 Lasers	a) SSP 50021, 3.3.6.7.1, Lasers b) Beams are totally contained at the maximum possible power and there is no crew access, or c) Meet ANSI Z136.1-1993 for class 1, 2, or 3a Lasers (as measured at the source). Lasers are designed such that light intensities and special wavelengths at the eyepiece of direct viewing optical systems are limited to levels below the maximum permissible exposure (MPE) limit.	☐ ☐ ☐		

	A. NUMBER		B. PHASE		C. DATE
ISS FLIGHT HARDWARE STANDARDIZED HAZARD CONTROL REPORT	STD-		**Phase**		
D. ISS BASIC AND INTERMEDIATE HARDWARE, DTO, or GFE *(Include Part Number(s), if applicable)*	**HAZARD TITLE**			**E. VEHICLE**	
	STANDARD HAZARDS				

F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE AND STATUS:**
a) Battery Failure *(use of this form is limited to small commercial batteries as listed below)* 8.1 Alkaline-MnO_2, Carbon- Zn, or Zn-Air in sizes D or smaller having 6 or fewer cells either all in parallel or all in series (series/parallel combinations require a unique hazard report), no potential charging source, and cells are in a vented compartment. 8.2 Li-CFx, Li-Iodine, Li-MnO_2, Ni-Cd, Ni-MH, or Ag-Zn which have a capacity of 200 mAh or less, and no more than 2 cells per common circuit.	a) Pass acceptance tests which include open circuit & loaded voltage measurements, visual examination, and leakage check under vacuum (e.g., 6 hours at 0.1 psia). *Note: Above acceptance testing for button cells in Section 8.2 which are soldered to a circuit board in commercial equipment (not applicable to those button cells in a spring-loaded clip) is limited to a functional check of the equipment utilizing the subject battery., or* b) SSP 50094, 5.6 Note: SSP 50021, 3.3.6.8.4, Batteries must be met for batteries that do not meet the criteria of 8.1 and 8.2.	☐ ☐	*Note: Application and schematic reviewed and approved by JSC/EP5.*
9. Touch Temperature causes IVA or EVA injury	a) SSP 50021, 3.3.6.12. Internal/External touch temperature SSP 50094,	☐	
10. Electrical Power Distribution as cause for ignition source (Circuit loading, ignition sources, grounding, connnector design)	a) SSP 50021, 3.3.6.8.1, Electrical Power Circuit Overload (Meets all circuit protection requirements of Letter TA-92-038), or b) SSP 50094, 6.5.1.10, 4.3.4.6.3, 4.3.4.6.7, 3.4.8, 4.3.4.5.5, 4.3.4.6.3	☐ ☐	
11. Cargo flown in the Orbiter payload bay causes ignition of flammable atmosphere in Payload Bay	c) Cargo launched in the payload bay is unpowered or normal operating condition does not cause ignition sources for potential flammable atmosphere in payload bay. d) MLI grounded per ICD 2-19001.	☐ ☐	

	A. NUMBER		B. PHASE		C. DATE
ISS FLIGHT HARDWARE STANDARDIZED HAZARD CONTROL REPORT	STD-		**Phase**		
D. ISS BASIC AND INTERMEDIATE HARDWARE, DTO, or GFE *(Include Part Number(s), if applicable)*	**HAZARD TITLE**			**E. VEHICLE**	
	STANDARD HAZARDS				

F. DESCRIPTION OF HAZARD:	G. HAZARD CONTROLS: *(complies with)*	H. APP.	I. VERIFICATION METHOD, REFERENCE AND STATUS:
12. Rotating Equipment injures crewmember (Low energy machinery/ propelled debris)	Low energy rotating machinery (shrouded/enclosed air circulating fans, conventional electric motors, shafts, gearboxes, pumps) meet criteria of: a) SSP 50021, 3.3.6.14, or b) SSP 50021, 3.3.6.12.18, EVA , or c) SSP 50094, 7.1.2.4	☐ ☐ ☐	
13. Mating/demating power connectors injures IVA or EVA crew	Meets all requirements of Letter MA2-99-170 and a) SSP 500021, 3.3.6.8.2 crew protection from electrical shock b) SSP 50021, 3.3.6.11.6, Component hazardous energy provision. c) SSP 50021, 3.2.7.12 d) SSP 50094, 3.4.8.1, 3.4.8.2	☐ ☐ ☐ ☐	
14. Contingency Return and Rapid Safing	a) SSP 50021, 3.3.6.13.5 Contingency Return and Rapid Safing (Shuttle payload - meets all rapid safing requirements of Letter MA2-96-190). b) Station payload - Meets rapid safing requirements of Letter MA2-96-190, and design shall not impede emergency IVA egress to the remaining adjacent pressurized volumes.	☐ ☐	
15. Noise Exposure	For continuous noise exposure: a) SSP 50021, 3.2.6.1, and SSP 5005, 5.4, or b) SSP 50094, 6.5.2.4.1 For intermittent noise sources: a) SSP 5005, 5.4, or b) SSP 50094, 6.5.2.4.2	☐ ☐ ☐ ☐	

		A. NUMBER	**B. PHASE**	**C. DATE**
ISS FLIGHT HARDWARE STANDARDIZED HAZARD CONTROL REPORT		STD-	**Phase**	
D. ISS BASIC AND INTERMEDIATE HARDWARE, DTO, or GFE *(Include Part Number(s), if applicable)*		**HAZARD TITLE**	**E. VEHICLE**	
		STANDARD HAZARDS		
F. DESCRIPTION OF HAZARD:	**G. HAZARD CONTROLS:** *(complies with)*	**H. APP.**	**I. VERIFICATION METHOD, REFERENCE AND STATUS:**	
16. Interference with Translation Paths	Hardware designed to comply with traffic flow and translation paths: a) SSP 5005, 8.7, 8.8 b) SSP 50021, 3.3.6.12.17.1, 3.3.6.12.17.2	☐ ☐		
17. Pinch Points, Snags, and Burrs	Levers, cranks, hooks, controls, exposed surfaces, threaded ends of screws and bolts, screws, bolts, protrusions, and equipment requiring EVA handling are designed in accordance with: a) SSP 50021, 3.3.6.12.9 (SSP 5005, 6.3.3.8) Levers, etc. b) SSP 50021, 3.3.6.12.10 (SSP 5005, 6.3.3.9) Burrs c) SSP 5005, 6.3.3.6 Threaded ends d) SSP 50021, 3.3.6.12.7 Screws and bolts e) SSP 50021, 3.3.6.12.12 Protrusions f) SSP 50021, 3.3.6.12.13, EVA equipment handling	☐ ☐ ☐ ☐ ☐ ☐		
18. Appendage Entrapment in holes or latches	g) Holes are rounded or slotted in the range of 0.4 to 1.0 inches in diameter are covered, in accordance with SSP 50021, 3.3.6.12.11.1 (SSP 5005, 6.3.3.4) h) Latches that pivot, retract, or flex so that a gap of less than 1.4 inches exists are designed to prevent entrapment of a crewmembars appendage,in accordance with SSP 5005, 6.3.3.5 i) Equipment requiring EVA handling is designed in accordance with SSP 50021, 3.3.6.12.11.2	☐ ☐ ☐		
19. Ionizing Radiation	The system is design in accordance with: a) SSP 50021, 3.2.7.15 and SSP 5005, 5.7.2.2 b) SSP 50021, 3.2.7.1 for the USL habital volume limitations, or c) SSP 50094, 3.6, 13.4	☐ ☐ ☐		
APPROVAL	**HARDWARE ORGANIZATION**		**ISS**	
PHASE I				

<table>
<tr><td colspan="3"></td><td colspan="2">A. NUMBER</td><td colspan="2">B. PHASE</td><td colspan="2">C. DATE</td></tr>
<tr><td colspan="3">ISS FLIGHT HARDWARE STANDARDIZED HAZARD CONTROL REPORT</td><td>STD-</td><td></td><td>Phase</td><td colspan="2"></td><td></td></tr>
<tr><td colspan="3">D. ISS BASIC AND INTERMEDIATE HARDWARE, DTO, or GFE (Include Part Number(s), if applicable)</td><td colspan="3">HAZARD TITLE</td><td colspan="3">E. VEHICLE</td></tr>
<tr><td colspan="3"></td><td colspan="3">STANDARD HAZARDS</td><td colspan="3"></td></tr>
<tr><td colspan="2">F. DESCRIPTION OF HAZARD:</td><td>G. HAZARD CONTROLS: (complies with)</td><td>H. APP.</td><td colspan="5">I. VERIFICATION METHOD, REFERENCE AND STATUS:</td></tr>
<tr><td>PHASE II</td><td colspan="3"></td><td colspan="5"></td></tr>
<tr><td>PHASE III</td><td colspan="3"></td><td colspan="5"></td></tr>
<tr><td></td><td colspan="3"></td><td colspan="5"></td></tr>
</table>

INSTRUCTIONS FOR REPORT JSC Form 1366, ISS FLIGHT HARDWARE STANDARDIZED HAZARD REPORT

This form is applicable to all hardware as well as Type A Basic and Intermediate, Developmental Test Objectives (DTOs), and GFE. Instructions for the completion of JSC Form 1366, Flight Hardware Standardized Hazard Report follow:

A. NUMBER
A unique alphanumeric designation provided by the hardware developer used to track this hazard report. These designations will be assigned when the report is first submitted and must be retained for all future updates of the hazard report. The prefix "STD" is used to identify this report as a standardized hazard report.

B. PHASE
Identify the appropriate phase safety review number.

C. DATE
Date that this form was completed or revised.

D. ISS HARDWARE, DTO, or GFE *(Include part number(s), if applicable)*
Name of hardware, DTO, or GFE *(including number).* When GFE is used, use a separate Form for each item and include part number. Top assembly groupings may be used if acceptable to the SRP.

E. VEHICLE
Identify the appropriate vehicle.

F. DESCRIPTION OF HAZARD
A hazard is defined as a potential risk situation caused by an unsafe act or condition. The ISS SRP identified the applicable standard hazards which can be documented on this hazard report form.

G. HAZARD CONTROLS/VERIFICATION METHODS
Identified design feature/method used to assure the effectiveness of the hazard control.

H. APPLICABLE
Check the applicable box for each hazard and hazard control consistent with the design of the hardware.

I. VERIFICATION METHOD, REFERENCE, AND STATUS
This block should summarize the results of the completed tests, analyses, and/or inspections; refer to particular test reports by document number and title; and crossreference unique hazard reports when applicable. The status of the activity should be indicated. Use a continuation sheet if required. If the cause is not applicable, rationale must be given in this section and controls should not be marked. Any additional comments may be added in this section (NCR#'s, Unique Hazard #'s, etc.)

Note: This form must be signed by the hardware organization Program manager before the safety data package is submitted.

APPENDIX G – LIST OF FORMS

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

1.0 JSC FORMS

Current versions of the JSC forms are available on the JSC Forms Web Page. Contact the ISS SRP Executive Officer for the electronic address.

JSC Form 44 Ionizing Radiation Source Data Sheet - Space Flight Hardware and Applications

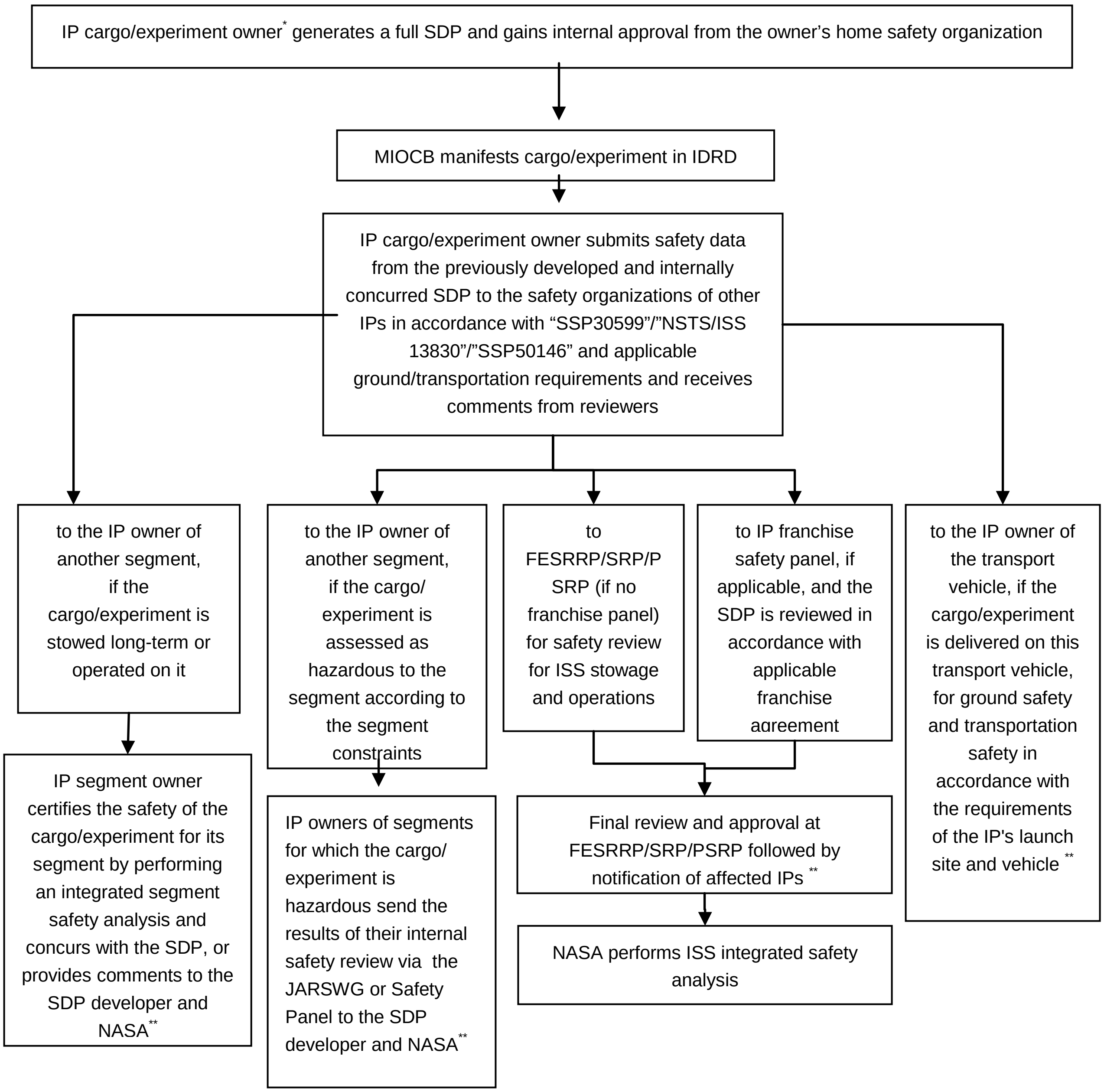
JSC Form 906 Flight Safety Certificate
JSC Form 907 Multilateral Category 1 Constraints
JSC Form 1366 ISS Flight Hardware Standard Hazard Control Report

2.0 KSC FORMS

Current versions of the KSC/GSRP forms and matrices are available on the NASA/ISS GSRP home page at http://kscsma.ksc.nasa.gov/GSRP/index.htm or contact the GSRP Executive Secretary.

JSC Form 1114A Certificate of NSTS/ISS Payload Safety Compliance
KSC Form 20-201 Certification for Ground Safety Review of Category 1 Cargo/Hardware or Government Furnished Equipment (GFE)
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 I – ISS IP CARGO SAFETY CERTIFICATION DATA EXCHANGE FLOWCHART



* IP cargo/experiment owner – ISS international partner who owns the cargo/experiment or has a contract with any individual or legal entity for the cargo/experiment

** Any issues identified will be worked through the item owner, the segment or vehicle owner, and a safety panel. If consensus cannot be reached, the item may be rejected.

APPENDIX J – PAYLOAD SAFETY REVIEW AND DATA SUBMITTAL REQUIREMENTS

NSTS/ISS 13830, Revision C, Payload Safety Review and Data Submittal Requirements has been placed in Appendix J to preserve the Requirements after the completion of the Shuttle Program. NO TECHNICAL CHANGES have been made to NSTS/ISS 13830, Revision C.

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SECTION 1
INTRODUCTION

Implementation of the payload safety process is the joint responsibility of the Payload Organization (PO); the flight operator, Lyndon B. Johnson Space Center (JSC); and the launch/landing site operator, John F. Kennedy Space Center (KSC).

The International Space Station (ISS) and Space Shuttle Program (SSP) safety policies and requirements for ISS and Shuttle payloads are specified in the current version of NSTS 1700.7 "Safety Policy and Requirements for Payloads Using the Space Transportation System" and the current version of the NSTS 1700.7 ISS Addendum, "Safety Policy and Requirements for Payloads Using the International Space Station." In addition, unique ground safety policies and requirements are specified in the current version of 45 SPW HB S-100/KHB 1700.7, "Space Shuttle Payload Ground Safety Handbook." These documents require the PO to conduct a systematic safety analysis and to document and submit a Safety Data Package (SDP) in support of safety reviews to be conducted by the flight operator (JSC) and the launch/landing site operator (KSC).

National Aeronautics and Space Administration (NASA) Headquarters has assigned the responsibility to review submitted payload safety documentation to the Space Shuttle and Space Station Program Directors at JSC and the Director of Safety and Mission Assurance at KSC. The JSC Payload Safety Review Panel (PSRP) will assess the payload design and flight operations; the KSC Ground Safety Review Panel (GSRP) will assess the Ground Support Equipment (GSE) design and ground operations. These two panels were formed to accomplish the following:

- Assure that PO interpretation of the safety requirements is consistent with NASA payload safety policy.
- Conduct safety reviews as appropriate during the development of the payload, associated GSE, and related operations.
- Evaluate hazard analyses and Noncompliance Reports (NCRs).
- Negotiate the resolution of safety issues involving design and operation to ensure compliance with all applicable safety requirements.
- Assess payload design features that have been implemented for controlling identified hazards and the verification approach that confirms intended system performance.
- As human spaceflight has expanded to multinational activities through the cooperation in the ISS Program (ISSP), and recognizing the responsibility and experience of the International Partner (IP) Safety Organizations, it is appropriate that the PSRP function not be limited to a single United States (U.S.) panel only. With respect to that goal, the JSC PSRP has developed understandings and agreements of internal IP payload safety methodologies and processes that meet or exceed the standards of the JSC PSRP and assure the safe implementation of the requirements dictated within this document.

SECTION 2
PURPOSE

The purpose of this document is to define the payload safety review process in order to assist the Shuttle/ISS POs in documenting compliance with the payload requirements documents specified in section 1. Specifically, this document accomplishes the following:

- Defines the safety reviews necessary to comply with the system safety requirements that are applicable to payload design, flight operations, GSE design, and ground operations for both ISS and Space Shuttle.
- Identifies the required content of the 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.
- Explains safety review process variations.
- Defines the payload series/reflight review process.

SECTION 3
SCOPE

Data submittal requirements included herein apply to hardware being submitted to both the PSRP and the GSRP unless specified otherwise. This document outlines the minimum data submittal requirements; the PSRP and the GSRP reserve the right to request additional data as deemed necessary to support safety documentation.

The objective of the safety review process is to review the payload, GSE, and operations for adequate safety implementation. The mission success and any scientific objectives of the payload are the responsibility of the PO and are beyond the scope of this document and process.

This document does not establish design requirements.

3.1 APPLICABLE HARDWARE

This document applies, but is not limited to, the following payload hardware that flies/operates on the Space Shuttle and/or ISS during any mission phase (prelaunch, launch, ascent, on-orbit, entry, landing, or postlanding):

- New Payload Hardware
- Existing (reflown and series) Payload Hardware
- Hardware Associated with Developmental Test Objectives (DTOs), Detailed Supplemental Objectives (DSOs), Risk Mitigation Experiments (RMEs), Space Medicine Program (SMP), and Human Exploration and Development of Space Technology Demonstrations (HTDs) Experiment Hardware

The document also applies, but is not limited to, the following payload-related hardware:

- Government-Furnished Equipment (GFE)
- Airborne Support Equipment (ASE)
- GSE

3.2 EXPORT CONTROL

The PSRP complies with the United States export control laws and regulations as established by the U.S. Department of Commerce in the Export Administration Regulations (EAR) and the U.S. Department of State in the International Traffic in Arms Regulations (ITAR). The PSRP also complies with the Space Shuttle Program's export control policy in NSTS 07700 Volume V and the ISSP's export control policy in SSP 50223.

Export control factors significantly into two areas of the payload safety review process:

- Distribution of Payload Data
- Conduct of Safety Reviews

The PSRP Executive Officer serves as the primary exporter of payload data to the ISS IPs and other foreign persons in support of the payload safety review process. Payload data includes safety data packages, hazard reports, safety review presentation materials and other payload related information. Specific export control data submittal requirements for payload organizations are listed in section 4.3.1.5 of this document.

The PSRP Executive Officer takes special precautions when conducting safety reviews for payloads under export control restrictions. These precautions may include restricting attendance, limiting presentation materials, posting signs, or conducting the review in a secure facility.

SECTION 4
RESPONSIBILITIES OF THE PAYLOAD ORGANIZATION

The PO is responsible for assuring the safety of its payload and for complying with the safety requirements contained in the technical requirements documents cited in section 1. To this end, the PO must accomplish the following:

- Perform a Safety Analysis
- Identify Hazards
- Document Compliance with the Safety Requirements
- Present the Documentation to the PSRP/GSRP

4.1 SAFETY ANALYSIS

To meet the requirements of the current version of NSTS 1700.7 and NSTS 1700.7 ISS Addendum, paragraph 301, **the PO shall perform a safety analysis** of the payload and GSE. The analysis shall consider hardware design, verification, testing, and flight/ground operations. The safety analysis shall begin during the payload concept phase and shall be refined and expanded as the design matures. For situations in which payload hardware will be installed or reconfigured on-orbit or in which the payload will be on-orbit for an extended time, safety analyses shall consider the necessity of on-orbit verification/reverification of hazard controls.

4.1.1 Level of Analysis

In order to identify the hazards applicable to a payload, the PO shall conduct safety analyses both at the system and subsystem levels. Each system and subsystem shall be evaluated to determine the applicability of each technical safety requirement.

Selection of subsystem groupings varies and any convenient grouping may be used. The following is a suggested list of subsystems: biomedical, caution and warning, cryogenic, electrical, environmental control, human factors, hydraulics, materials, mechanical, optical, pressure systems, propulsion, pyrotechnics, radiation, and structures.

For hardware developed for or provided to the PO, the PO shall:

- Obtain the appropriate safety data from the supplier or conduct an independent safety analysis.
- Conduct a safety analysis of the interfaces between the subject hardware and other elements.

4.1.2 Analysis Techniques

Depending on the complexity of the payload, the PO should use established analytical techniques (e.g., preliminary hazard, sneak circuit, fault tree, operational hazard, and failure modes and effects analyses) to obtain the data necessary to complete, present, and support payload hazard reports.

4.1.3 Safety Verifications for Payloads with Catastrophic Hazard Potential (Flight Only)

The current version of NSTS/ISS 18798 specifies data requirements to document the verification program for payload systems/subsystems that have catastrophic hazard potential. An excerpt from this document is included below for convenience.

Table 4-1. - NSTS/ISS 18798

All payload systems having catastrophic hazard potential for the orbiter or crew as a result of operations in or near the orbiter must use hardware and procedures that have been subjected to a rigorous verification program. Verification programs normally require testing to verify adequate performance margins under all environmental conditions (qualification testing) as well as demonstrating intended system performance on flight hardware. Comprehensive system-level testing on payload flight hardware supported by qualification test on protoflight or flight type hardware are the preferred verification methods. It is essential that payload system performance be verified from the input stimuli to the end function. Safety-critical system performance that cannot be verified by test shall be verified by independent parties using dissimilar analysis techniques whenever possible. Single party analytical efforts can be used to verify performance only when the methodology is widely accepted and conservative margins are applied to the results. The payload organization must focus its attention to all parts of the payload verification program and orbiter interface verification activities to assure that the sub-elements of the total verification program are integrated into a comprehensive system verification effort that confirms the intended system performance. When the use of ground test equipment (apparatus) is required to replace flight hardware functions, verification methods shall be developed by engineering personnel independent from those designing the flight system. Test requirements, procedures, and test apparatus shall be derived from intended functional requirements rather than from the design, and all items must be maintained under strict configuration control. The payload organization is responsible for developing and presenting sufficient data to the PSRP [GSRP] to substantiate that the test requirements, procedures, and test apparatus will provide an adequate simulation in substitution for the end function.

4.2 HAZARD IDENTIFICATION

The primary objectives of the safety review process are to identify the potential hazards applicable to a payload, including its flight, GSE, and ground operations, and to assure that the hazard controls and verifications (including on-orbit verification/reverification of hazard controls where applicable) are adequate and in compliance with the safety requirements. To assist the PO in accomplishing these objectives, appropriate safety terminology has been defined in the current version of NSTS 1700.7.

Although not exhaustive, the following is a list of some previously identified flight hazard groups that have been used on hazard reports: collision, contamination, corrosion, electrical shock, explosion, fire, injury and illness, loss of orbiter entry capability, and inability to egress.

The following are basic hazard groups applicable to ground operations: structural failure of support structures and handling equipment; collision during handling; inadvertent release of corrosive, toxic, flammable, or cryogenic fluids; loss of habitable/breathable atmosphere; inadvertent activation of ordnance devices; ignition of flammable atmosphere/material; electrical shock/burns; personnel exposure to excessive levels of ionizing or nonionizing radiation; use of hazardous/incompatible GSE materials; inadvertent deployment of appendages; working under suspended loads; and rupture of composite epoxy overwrapped pressure vessels.

4.3 DOCUMENTATION OF COMPLIANCE WITH THE SAFETY REQUIREMENTS

The safety analysis results shall be documented in the SDP, which includes applicable payload hazard report forms (JSC Form 542B and JSC Form 1230) and presented to both the JSC PSRP and the KSC GSRP as described in this document. Guidelines for completing the flight hazard report forms and preparing the SDPs are found in JSC 26943, "Guidelines for the Preparation of Payload Flight Safety Data Packages and Hazard Reports for Payloads Using the Space Shuttle," current issue.

Low hazard potential hardware may qualify as Basic (Category 1), as defined in paragraph 5.4. Submitted requirements for IP-sponsored payload meeting the Basic (Category 1) criteria are Described in paragraph 5.4.

For SDP preparation, the PO is responsible for using the current version of all applicable forms and safety documentation. The PO may verify current forms/documents by contacting the Executive Officer to the PSRP or the Chairman of the GSRP. These forms are listed in section 11.

4.3.1 <u>Data Submittals</u>

Although there will be some duplication of material contained in data submittals prepared for PSRP and GSRP reviews, each package serves a different purpose and must stand alone.

Data submittals, which may include SDPs and other supporting information (e.g., action item responses), should identify the flight on which the payload is manifested (if known) and be formally submitted in English to the Executive Officer, PSRP, or the Executive Secretariat, GSRP. Data should be formally transmitted under the signature of the Program Manager.

Safety review meetings are scheduled to be held approximately 45 calendar days after receipt of an acceptable SDP (i.e., an SDP that satisfies all the requirements in this document).

The SDP will be made available to the PSRP/GSRP members and various other NASA/contractor technical and administrative personnel who support the Panels. For ISS payloads, this may include International Partner representatives to the PSRP.

Payload safety data must be submitted electronically via the Internet using the Payload Safety Data Management System (DMS) located at the following URL:

http://psrp.jsc.nasa.gov

The DMS System Administrator (tel. 281-335-2446) can provide information on acceptable software applications, electronic addresses, detailed login instructions, and system procedures. POs may also access the DMS via a hyperlink at the top of the Payload Safety homepage located at the following URL:

http://wwwsrqa.jsc.nasa.gov/pce

POs must obtain approval from the PSRP Executive Officer or Executive Secretariat, GSRP to submit flight or ground safety data, respectively, by alternate means or to submit supplementary data in hard copy format. Hard copy submittals must be single-sided and sequentially paginated from the cover sheet to the last page of the package.

Once the SDP has been electronically submitted, the PO must send the transmittal letters, document signature pages, and signed original Hazard Reports (HRs) to the appropriate Panel contact:

Executive Officer, PSRP
NASA Lyndon B. Johnson Space Center
Mail Code NE12
2101 NASA Parkway
Houston, TX 77058-3696

Executive Secretary, GSRP
NASA John F. Kennedy Space Center
Mail Code SA-C3
Kennedy Space Center, FL 32899-0001

4.3.1.1 Submittal of Proprietary Data

If proprietary data are submitted in the SDP, the transmittal letter must include the following statement:

> This payload safety data package contains proprietary data on the following pages: [list the appropriate page numbers]. [Insert name of the payload organization] acknowledges awareness and acceptance of the GSRP and the PSRP's policies and methods of processing proprietary data. [Insert name of the payload organization] also will provide any additional protective measures it deems necessary over and above that provided by the panels during meetings.

The transmittal letter and the first page of the SDP must identify the specific pages that contain proprietary information. Insert the word "PROPRIETARY" at the top and bottom of each page that contains proprietary data. The word "PROPRIETARY" shall be in all capital letters in a large font size and style that is easily discernible from the rest of the text.

In addition to the proper submittal of proprietary information, the PO should be aware of the following while attending PSRP/GSRP safety reviews, Technical Interchange Meetings (TIMs), and action item closure meetings:

- PSRP/GSRP meetings are not conducted in secure facilities. Thus, when it is necessary to recess meetings (e.g., lunch and breaks), the POs will be responsible for protecting any proprietary data distributed during the meeting (other than that logged and distributed by NASA as part of the SDP).
- If any proprietary data are to be presented or discussed during the meeting, prior to the meeting the PO will notify the PSRP Executive Officer/GSRP Chairman who will then make arrangements to monitor attendance, close the doors, and post a sign noting that access to the meeting is controlled.
- The PO will be responsible for retrieval and disposition of any proprietary material distributed at the meeting (other than that logged and distributed by NASA as part of the SDP), with the exception that two copies of proprietary material distributed by the PO at the meeting will be retained by the PSRP/GSRP in a protected file.

When the PSRP/GSRP receives proprietary data included in the SDPs, such data will be handled in a manner that will protect the interests of the PO. These procedures include tracking distributed materials, protecting files, and restricting reproduction. In order to exercise reasonable care in protecting proprietary data in connection with the payload safety review process, NASA will ensure that proprietary data are distributed only to persons who have a need to review such data in support of panel functions. Furthermore, distributed data that is returned to the PSRP Executive Officer/GSRP Chairman after use will be destroyed via the NASA secure disposal process.

The protection of material marked “PROPRIETARY” creates an added burden on the PSRP/GSRP review support system, so the PO should mark only those items that are proprietary. The PO should coordinate with the PSRP Executive Officer/GSRP Chairman to explore such alternatives as providing the proprietary material in a separate package when it is a very small portion of the overall SDP. If a separate, proprietary briefing package (not contained in the SDP) is to be presented to the PSRP/GSRP during the review, the PO shall provide at least 20 copies of such material for distribution at the review.

If the PO discovers that some portion of the SDP marked “PROPRIETARY” is no longer considered such, the PO must inform the PSRP Executive Officer and/or the GSRP Chairman in writing.

4.3.1.2 Submittal of Copyrighted Data

Payload organizations are hereby informed that payload documentation submitted to NASA must be reproduced and distributed to the members of the PSRP/GSRP and to associated technical support personnel. Accordingly, copyrighted data shall not be included in the submitted documentation unless the PO 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.

4.3.1.3 Submittal of Translated Data

For all documents submitted by the PO to the PSRP/GSRP that have been translated into English, the English translation shall be the official document.

4.3.1.4 Submittal of Toxicological Data for SSP and ISS Payloads (Flight Only)

The Shuttle/ISS payload safety review process requires biomedical safety assessments of potentially hazardous materials, such as chemicals, microorganisms, and radioisotopes. In order for these assessments to be available for the safety reviews, the JSC Toxicology Group requires POs to submit test sample data substantially in advance of the safety reviews. See JSC 27472, “Requirements for Submission of Test Sample-Materials Data for Shuttle Payload Safety Evaluations,” current issue, for the timeline and data requirements for these early submittals. The PO must attach both the data submitted to JSC Toxicology Group and the JSC response (when available) to the applicable hazard report that is a part of the SDP. Should toxicology submittals involve proprietary data, see section 4.3.1.1.

4.3.1.5 Submittal of Export Control Data (Flight Only)

The export control data requirements in sections 4.3.1.5.1 and 4.3.1.5.2 apply to U.S. payload organizations only. In the event an IP SDP requires an international review, the IP PO shall distribute the data to the other ISS IP organizations.

4.3.1.5.1 ISS Payloads

Distribution of ISS payload safety data packages to the ISS IPs is a standard part of the payload safety review process.

The PO must identify the export control classification of the SDP payload data in its transmittal letter. The first page of the SDP must also identify the export control classification of the data.

The PSRP Executive Officer will not distribute an SDP with an unknown export control classification to the IPs. Safety reviews may be delayed or cancelled for ISS payloads with unresolved export control issues.

The PO's safety review presentation materials must have the same export control classification as the SDP submitted for review or a less restrictive export control classification.

4.3.1.5.2 Shuttle Payloads

Distribution of Shuttle payload safety data packages to the ISS IPs is not a standard part of the payload safety review process.

Shuttle payload safety data packages are not distributed to the IPs unless the PSRP identifies a specific need to do so. If a need is identified, the PSRP Executive Officer will work with the PO and the SSPs export control resources to obtain the export control classification of the SDP.

The PO may include the export control classification of the SDP payload data in its transmittal letter and on the first page of the SDP, if the classification is known prior to SDP submittal.

4.3.2 Hazard Reports

The purpose of the hazard reports is to document the PO's safety assessment in a manner that reflects how the payload design demonstrates compliance with the safety requirements. The hazard reports are used as a method to systematically assess compliance with the safety requirements.

The flight SDP submittal must contain all flight hazard reports; the ground SDP submittal must contain all ground hazard reports. Each hazard report must be signed and dated by the payload program manager prior to submittal. Hazard reports shall be prepared on JSC Form 542B, JSC Form 542B-1, or JSC Form 1230 (see section 11) or an equivalent form that contains all information required on the JSC forms. Section 7, organized by area of design, identifies minimum support data for flight hazard reports. JSC 26943 contains guidelines for preparing payload flight hazard reports.

Following any technical discussion, the PSRP/GSRP Chairman will provide a disposition for each hazard report. This disposition may take one of the following forms: 1) approved as written, 2) approved with modification, 3) approved with an action to be performed by the PO and/or PSRP/GSRP, and 4) not approved.

The PO is responsible for retaining and maintaining the original hazard reports after approval.

4.4 SAFETY REVIEW PRESENTATION

The PO should be prepared to present information submitted in the SDP to the appropriate safety panel during scheduled reviews (see sections 6.1.1 and 6.1.2). During reviews, the PO should provide briefing chart handouts sufficient for the number of people expected to attend the review.

SECTION 5
SAFETY REVIEW OVERVIEW

5.1 LOCATION

Safety reviews for payload design and flight operations are usually conducted at JSC. The safety reviews for GSE design and ground operations will normally be conducted at KSC. The PO shall coordinate the timing of the PSRP reviews with the PSRP Executive Officer. The PO shall coordinate the timing and location of the GSRP reviews with the GSRP Chairman.

5.2 INITIAL CONTACT MEETING

The PO may receive initial contact safety briefings by the JSC and KSC safety representatives. The JSC briefing, normally held during the first integration meeting at JSC, should be scheduled by contacting the Payload Integration Manager (PIM) at JSC. For ISS payloads, contact the ISS PIM. The KSC briefing is usually held in conjunction with the first Ground Operations Working Group (GOWG) meeting, which is scheduled through the assigned payload representative at KSC.

The briefing includes an overview of the technical and system safety requirements to be met by the PO, plus instructions for conducting the safety reviews. The PO should provide a schedule of payload milestones and request a phase 0 or phase I safety review when the payload design concept has been developed.

5.3 TYPES OF MEETINGS

Safety reviews may take place in person, via teleconference, or by correspondence. Review meetings may be formal or out-of-board as deemed appropriate by the Panel Chairman.

- Formal Meeting: Formal meetings constitute a gathering of the safety review panel, representatives of the PO, and the appropriate supporting technical staff.
- Out-of-Board Meeting: Out-of-board meetings do not require the full safety panel. Attendees may include the Panel Chairman, Safety representative(s), representatives of the PO, and others necessary to address the issues that may be involved.
- Safety TIM: The review panel and/or associated technical staff may convene upon request in order to assist in interpreting safety requirements or to coordinate safety analyses/issues prior to safety reviews. Requests for flight safety TIMs should be coordinated with the PSRP Executive Officer. Requests for Ground Safety TIMs should be coordinated with the GSRP Chairman. Material to be addressed during the TIM should be provided 14 calendar days prior to the TIM.
- Splinter Meetings: Splinter meetings may be held concurrently with a safety review to discuss detailed technical concerns.

5.4 PAYLOAD CATEGORIES

Traditional payload safety compliance assessment is accomplished using a phased safety review process (phases 0, I, II, III) that corresponds to the hardware conceptual, preliminary, and critical design review phases and verification/validation of the payload (see section 6). Successful completion of each safety phase is documented by SDP/HR submittals to and approval by the PSRP/GSRP.

To streamline this process, the PSRP has implemented procedures and data requirements to minimize formal PSRP review time for payloads with routine hazards/standard controls/verifications. This allows the PSRP to concentrate review time on payload systems with the highest hazard potential, “must-work” functions, and/or nonstandard controls and verification methods. POs may document routine hazards and standard controls and verifications on the JSC Form 1230, “Flight Payload Standardized Hazard Control Report.”

Based on the phase I SDP, new payloads are categorized by the PSRP into one of three categories of complexity (basic, intermediate, or complex) with respect to hazard potential as shown in Table 5-1 below. The review process is then tailored to the complexity of the payload design and adequacy of documentation. In addition, the process permits all payloads to document standard hazards that have standard controls and verifications on JSC Form 1230, which may be approved by the PSRP without a formal PSRP meeting. Details concerning basic and intermediate categories are contained in sections 5.4.1 and 5.4.2, respectively. Complex payloads use the review process detailed in section 6. Reflown and series payloads use the review process outlined in section 9.

For IP-sponsored payloads, an additional simplified safety review process has been developed that facilitates increased IP cooperation, a decreased level of documentation required for submittal to the PSRP, and agreements on how to process payload hardware that represents the lowest risk for ISS stowage and/or operations. Only IP-sponsored hardware items that qualify as low hazard potential may use this simplified process. All other hardware items must use the process as dictated within table 5-1.

The definition of the simplified safety review process termed Basic (Category 1) is based on the constraints as listed within the JSC Form 907. Those payloads which do not meet the constraints of the Basic (Category 1) shall be classified as Category 2.

Table 5-1. - PAYLOAD CATEGORIES

Payload Category	Defined Hazards
Basic (1230) Basic (Category 1)	The only hazards identified are "standard" as specified on the JSC Form 1230. The appropriate hazard controls are found on JSC Form 1230. **OR** The only hazards identified are "standard" as constrained by the JSC Form 907. This use of this payload category is restricted to IP safety organizations that have committed to the May 2006, Multilateral Safety and Mission Assurance Panel (MSMAP) simplified payload safety process agreement and documentation of compliance to appropriate hazard controls is accepted upon submission of JSC Form 906.
Intermediate	1) The payload has "unique" hazards (i.e., hazards not found on the JSC Form 1230) but has controls and verification methods that have been historically accepted by the PSRP **OR** 2) The payload has "standard" hazards (i.e., hazards identified on the JSC Form 1230) but uses controls and verification methods other than those identified on the JSC Form 1230.
Complex	The payload has unique hazards with hazard controls that are: a. Active "must work" functions, such as electromechanical or pyrotechnic separation systems or actuators/mechanisms providing structural load paths, **OR** b. Nonstandard or have nonstandard verification methods that depart from historically accepted techniques, **OR** c. Operationally complex requiring flight or ground personnel intervention to assist in controlling the hazard.

If, after a payload category has been assigned, the PO a) identifies previously undefined hazards or b) implements design changes that may create new hazards, the PO must submit a revised SDP, which may result in a reclassification of the payload category.

5.4.1 Review Process for Basic Payloads (Flight Only)

Basic (1230) payloads (see Table 5-1, above) have a very low level of complexity, which may allow the payload to complete the safety process out of board. However, the PO will submit an SDP that will document the applicable hazards, controls, and verifications. Submittal will follow the standard procedure detailed in section 4.3.1, and approval may be obtained without a meeting. The following data are required for the simplified SDP for hardware design and flight operations:

- Brief description of the hardware design and flight operations with schematics and block diagrams, as appropriate
- Summary of the safety analysis results that documents compliance with the design, verification, and applicable on-orbit verification/reverification requirements for the identified standard hazards
- Documentation of all applicable hazards, controls, and verifications on hazard report(s) (e.g., JSC Form 1230/Form 542)
- Certificate of Payload Safety Compliance (JSC Form 1114A) signed by the Program Manager or Flight Safety Certificate (JSC Form 906)

  Basic (Category 1) payloads (see Table 5-1, above) also have a very low level of complexity and require only a subset of the data set as noted above for Basic (1230). This classification is reserved for IP-sponsored items (items that have been reviewed and approved by an IP safety organization that is part of the multilateral agreement), and as such, the IP only needs to send the following set of documentation to the PSRP:

- Completed JSC Form 906

  In addition to submitting this data, the IP will include the hardware in their Certification of Flight Readiness (CoFR) endorsement inputs for the relevant flight or stage. SDPs generated from IP safety analyses shall be maintained by the sponsoring IP for potential audit by the PSRP. Any partner may request a copy of the complete safety data package for review, if necessary. Should this request be made, the sponsoring IP is required to provide the package within two weeks of the request.

5.4.2 Review Process for Intermediate Payloads (Flight Only)

In addition to the standard hazards found in Basic payloads, the Intermediate payload has unique hazards that have standard controls and verification methods (including applicable on-orbit verifications/reverifications) that have been historically accepted by the PSRP. Intermediate category payloads should require one or two reviews of the unique hazards, but the basic hazards may be addressed on a Form 1230/Form 906 and approved out of board/accepted. The PSRP will determine the need for a second review for unique hazards at the completion of the first review. The determination will be based primarily upon the completeness and quality of the unique hazard reports. Requirements for SDP submittal are the same as those stated in section 4.3.1.

5.5 SCHEDULE OF REVIEWS/PHASES

The schedule for formal phase 0, I, and II payload safety reviews generally relates to the payload development schedule. Phase 0 is held during the concept phase or at the start of payload design. Phase I is near the Preliminary Design Review (PDR); phase II is near the Critical Design Review (CDR). The PO should set the review schedule to obtain maximum benefit to payload development based on the results of the safety reviews.

ISS payloads may include multiple major systems or components, each working to a unique schedule. These may be individually baselined and categorized (see section 5.4), which allows them to progress through the payload safety process in accordance with their own schedule (see section 8.2).

Phase III is associated with completion of payload safety verifications and/or the start of ground processing. When establishing a timeline for phase III, the PO 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. The flight and ground phase III completion requirements restated below are in the current version of NSTS 1700.7 and NSTS 1700.7 ISS Addendum and apply to all payloads:

> The JSC and KSC Phase III safety review and ground safety certification must be completed 30 days prior to delivery of the payload, ASE, and GSE to the launch site…

If any verification items remain open on the flight hazard reports, the PO must provide rationale to support the safety of starting ground processing with these items open. The rationale is to be submitted to both the PSRP and GSRP. The PSRP will review the rationale and provide concurrence to the GSRP.

To schedule KSC Ground safety reviews, contact the GSRP Chairman; to schedule JSC Flight safety reviews, contact the PSRP Executive Officer (see section 4.3.1).

5.6 SAFETY REVIEW COMPLETION

5.6.1 Documentation of Phase Completion

During a formal meeting, the Panel Chairman will make an official announcement that the safety phase is complete or incomplete (open). This announcement will be recorded and distributed by the PSRP/GSRP in the official meeting minutes. Incomplete phases are usually attributable to overdue/open action items or unsigned (open) hazard reports. The PSRP/GSRP will issue official correspondence to document closure of open action items/signature of open hazard reports that occurs after the phase review. The correspondence that closes the last open action item/hazard report for that phase will include a statement that the safety phase is considered complete.

For out-of-board reviews, safety review process completion will be documented by formal correspondence.

5.6.2 Completion Criteria for Phase I, II, and III

Successful completion of phase I and II reviews is accomplished by obtaining approval (Panel Chairman's signature) of hazard reports at the appropriate phase level and closure of applicable phase I/II action items.

After submission of all required data, the criteria for successful completion of the safety review process at the phase III level for both flight and ground reviews are as follows:

- All payload hazard reports are signed by the payload Program Manager and the Panel Chairman at the phase III level.
- All NCRs are approved.
- Safety review action items are formally closed in the safety review meeting minutes or documented closed in separate correspondence.
- A signed Certificate of Ground Payload Safety Compliance provided to the GSRP (for phase III ground safety).

Approval of the phase III safety data by the PSRP and GSRP is with the understanding that the data represent the actual design and operations of the payload. Should safety issues arise after the safety process is complete, the safety panels reserve the right to request additional data deemed necessary to reassess the payload.

5.6.3 Completion Criteria for Series/Reflight

The criteria for successful completion of a series or reflight safety review is that all data required by section 9, Reflown and Series Payload Hardware, have been submitted and approved.

5.7 POST PHASE III SAFETY ACTIVITY

5.7.1 Certificate of Flight Payload Safety Compliance/Flight Safety Certificate

A safety assessment must be conducted to determine the payload's safe operational life and safe design life, as defined on the Certificate of Payload Safety Compliance (JSC Form 1114A - NSTS 1700.7B, section 306, figure 3) or the Flight Safety Certificate (JSC Form 906).

The PO must present a signed Certificate of flight Payload Safety Compliance or final Flight Safety Certificate to the PSRP Executive Officer no later than 10 days prior to the Flight Readiness Review (FRR) or ISS Stage Operations Readiness Review (SORR) , whichever occurs first.

5.7.2 Configuration Control

When changes to the design, configuration, or operations of the payload are required subsequent to phase III, the PO shall assess those changes for possible safety implications, including the effect on all interfaces. The assessment shall be forwarded to the PSRP/GSRP for review and approval. If the change has ground safety implications, it must be reviewed with the KSC panel prior to proceeding with ground processing. New or revised hazard reports and support data shall be prepared where applicable and submitted for approval as indicated in section 4.3.1. The need for delta phase III safety reviews will be determined by the PSRP/GSRP Chairman. Satisfactory completion of these activities is mandatory prior to the start of affected ground activities or launch.

Any test failures, anomalies, or accidents involving payload flight hardware or software that occurs between the completion of phase III and launch must be promptly reported to the PSRP/GSRP. Safety impacts, if any, should be identified.

5.7.3 Verification Tracking Log

Open verification items must be tracked on a flight or ground safety Verification Tracking Log (VTL) (see section 11).

- Flight Safety: From Phase III until L-60 days, the PO shall update and provide the VTL to the PSRP Executive Officer once a month. From L-60 days until launch, the PO shall provide a weekly update to the VTL. All VTL open items must be closed no later than 4 p.m. Central time on the last business day prior to launch. Items that cannot be closed at this time will require the transmission of a facsimile closing the open VTL items to the Mission Evaluation Room (MER) at NASA JSC no later than L-6 hours. Contact the PSRP Executive Officer for MER delivery instructions.

- Ground Safety: The initial submittal of the ground safety VTL is required with the phase III ground SDP. Following the completion of the phase III review, the ground safety VTL shall be updated monthly prior to hardware arrival at KSC. If there are open flight verifications that are constraints to ground processing, the PO must also include those items of the flight VTL. After the delivery of the payload, ASE, or GSE to the launch site, the safety VTL(s) shall be updated at least weekly. More frequent updates to the safety VTL(s) may be required if the open items must be closed to allow work to continue.

5.7.4 Documentation of Safety Process Completion

Final flight safety approval is documented by the PSRP Chairmans signature on the CoFR for the planned flight. The CoFR will include IP certification of completion of the safety review of Category 1 (Basic) items and will be provided as part of CoFR inputs to the PSRP.

Final ground safety approval is documented by a letter from the KSC Director, Safety Assurance to the KSC Director, Customer Service Space Station and Shuttle Payloads Processing stating that the Ground Safety Review Process has been completed and the payload may begin ground processing.

SECTION 6
SAFETY PROCESS

6.1 GENERAL

6.1.1 Preparation

In preparation for a phase safety review, the PO will submit an SDP as indicated in section 4.3.1. If phase reviews are combined (e.g., a phase I/II review), the SDP shall include the data requirements that apply to all the appropriate phases. The depth and number of the planned reviews are dependent on the complexity, technical maturity, and hazard potential of the payload, and may be modified by the Panel Chairman in conjunction with the PO.

The PO should provide sufficient technical support personnel to answer questions posed by the PSRP/GSRP in support of the agenda items.

Listed below are general agenda topics for safety review meetings. These insure that the safety review meetings proceed smoothly and contain the necessary information to facilitate the review.

6.1.2 General Meeting Agenda Guidelines

The PO should coordinate all meeting agenda with the PSRP Executive Officer or the GSRP Chairman prior to the safety review meeting and provide the final agenda in advance. The fundamental elements of all Safety Review Meeting Agenda are as follows:

a. Introduction of the Meeting and Participants by the JSC Safety Reliability and Quality Assurance (SR&QA) Payload Safety Engineer (PSE).

b. Opening Remarks by Chairman and the Payload Program Manager.

c. Discussion of Pre-Review Activity Led by the PSE.

d. Program-level Overview (including areas of responsibility).

e. Program Milestone Schedule: Provide the Program Milestone Schedule, including, but not limited to,

    (1) design stages and reviews,

    (2) hardware/software build status,

    (3) testing and verification activities,

    (4) delivery, integration, and launch activities, and

    (5) safety review dates.

f. Mission Objectives, including overview of mission objectives and general criteria for a successful mission.

g. System/Subsystem Technical Presentation Overview, including enough information to allow the PSRP/GSRP to gain a general technical understanding of the systems involved in the payload operations. Highlight any design changes since the previous safety reviews.

h. Operations Overview, describing planned operations and known contingencies. Plan to discuss detailed operations that relate to payload safety in conjunction with the appropriate hazard report presentation. Highlight any operations changes made to the operations that impact the safety of the payload since the previous review.

i. Safety Assessment Summary, including safety assessments performed to identify hazards, any failures or anomalies that occurred after development testing, and the corrective actions. Present responses to agreements and formal action items, including a summary of open action items and associated plans for closure. Provide sufficient information to demonstrate that a comprehensive hazard analysis has been performed. Provide an overview of hazards and how they relate to the hazard reports, and discuss safety-related items that are not reflected in the hazard reports.

j. Phase-specific Topics: Additional, phase-specific topics for the agenda should be drawn from the data that are required to be included in the SDP for that phase (see sections 6.2.1, 6.3.1, 6.4.1, and 6.5.1). If not included as one of the general agenda topics, these data should be addressed as separate agenda items.

k. Hazard Report Presentation: Unless otherwise agreed to by the PSRP/GSRP, present all hazard reports in full, associated noncompliance reports/waivers/deviations, previously assigned action items/agreements that involved modification of hazard reports, and associated action item/agreement responses.

l. Action Item Review: Both the PO and the PSRP/GSRP will review and agree to actions and due dates assigned during the course of the safety review to ensure that there are no misunderstandings. These action items will be printed and signed during the review.

m. Closing Comments Payload Program Manager and Panel.

6.2 PHASE 0 SAFETY REVIEW

The optional phase 0 safety review is provided as a service to the PO. The objectives of the meeting are to:

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

6.2.1 Phase 0 Data Requirements

The following data are required for the phase 0 SDP and must be submitted as stated in paragraph 4.3.1:

a. For payload design and flight operations:

(1) Conceptual payload description (including subsystems) and mission scenario.

(2) Description of safety-critical subsystems and their operations.

(3) Flight hazard reports (JSC Form 542B/Form 1230).

b. For GSE design and ground operations:

(1) Conceptual payload description and brief mission scenario.

(2) Conceptual GSE description and operations, and description of payload design that is safety critical during ground operations.

(3) Ground operations scenario.

(4) Ground hazard reports (JSC Form 542B).

The description of the payload 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 PO shall 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.

6.2.2 Phase 0 Hazard Reports

The purpose of a phase 0 hazard report is to document and scope the specific hazards identified. It is intended to be a working document for discussion and critique at the phase 0 safety review and will not require signatures. A hazard report must be prepared for each unique hazard identified in the safety analysis. The hazards contained on the phase 0 hazard report must reflect the payload conceptual design and operations existing at the time of the phase 0 review. For phase 0, the PO may identify hazard controls, verification methods, or status of verifications.

6.3 PHASE I SAFETY REVIEW

The purpose of the phase I safety review is to obtain PSRP/GSRP approval of the updated safety analysis that reflects the preliminary design and operations scenario of the payload. At this point, the PO shall present a refined safety analysis that identifies all hazards and hazard causes inherent in the preliminary design; evaluates all hazards for means of eliminating, reducing, or controlling the risk; and establishes preliminary safety verification and on-orbit verification/reverification methods. The PO shall provide a preliminary identification of the payload interfaces and of the hazards presented by these interfaces.

6.3.1 Phase I Data Requirements

The following data are required for the phase I SDP and must be submitted as stated in paragraph 4.3.1:

a. For payload design and flight operations:

(1) Updated payload description (including subsystems) and mission scenario.

(2) Updated descriptions of safety-critical subsystems and their operations, including schematics and block diagrams with safety features, inhibits, and controls identified. Identify any safety-critical subsystems that are computer controlled, and identify the functional architecture associated with that computer control.

(3) Updated and additional flight hazard reports (e.g., JSC Form 542B/JSC Form 1230) including appropriate support data (see section 7). For payloads that have catastrophic hazard potential, document the verification program outlined in NSTS/ISS 18798.

(4) A summary list (in the payload description) of orbiter- and/or ISS program-provided critical services, and an explanation (in the appropriate hazard reports) of the orbiter and/or ISS services used to control and/or monitor payload hazards (NSTS 1700.7 and NSTS 1700.7 ISS Addendum, current version).

(5) For ISS payloads, a presentation of the Fire Detection and Suppression (FDS) implementation approach. For sub-rack payloads, the PO shall address the integrated system approach (using sub-rack services and/or ISS services) to fully define the FDS implementation strategy. In addition, submit JSC Form 1428 to document methods and verifications used to detect and suppress a fire event for each payload volume.

(6) Discussion of design features supporting verification/reverification of hazard controls on-orbit and associated constraints.

(7) A tabulated list of tentative toxic materials and support data per JSC 27472 (see section 4.3.1.4).

(8) A list of all battery types, their uses, manufacturer, and applications.

(9) A preliminary description of all pyrotechnic devices and their functions.

(10) Preliminary on-orbit maintenance safety assessment as outlined in NSTS/ISS 18798.

(11) A preliminary life safety assessment. Provide an updated list of payload hardware 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.

b. For GSE design and ground operations:

(1) Updated payload description and brief mission scenario.

(2) Updated descriptions of GSE, payload subsystems that present a potential hazard during ground processing, and their ground operations. Schematics and block diagrams with safety features and inhibits identified should be included. Design data for hazardous systems (pressure, lifting, etc.) shall be summarized in a matrix. Contact the GSRP Chairman for sample formats.

(3) Updated ground operations scenario including postflight ground operations at the primary, alternate, and contingency landing site. The scenario should highlight unique payload requirements at the launch pad, such as continuous power through a T-0 umbilical.

(4) Updated ground hazard reports (JSC Form 542B) including appropriate support data.

(5) Ordnance data required by the current version of KHB 1700.7, Appendix D.

(6) Estimated KSC on-dock arrival date.

6.3.2 Phase I Hazard Reports

The PO shall prepare phase I hazard reports for each hazard identified as a result of the safety analysis for the preliminary design and operations scenario of the payload. Hazard reports shall be added to or deleted from those agreed to during phase 0 to reflect the updated safety analysis. Rationale for deleting a hazard agreed upon at phase 0 shall be presented during the phase I review.

For phase I, the PO shall identify hazard controls for each hazard cause identified at phase 0. A direct correlation between each hazard cause and the corresponding hazard control(s) must be clearly shown on the report. Sufficient supporting information detailing each hazard control must be provided.

Verifications should include the types of tests, analyses, inspections, or procedures to be used to verify each hazard control, including all orbiter- or ISS-provided services or interfaces, both prelaunch and on-orbit. A direct correlation between each verification method and the corresponding hazard control must be clearly shown on the report. Each verification item should be independent and have a designator that allows for individual tracking of verification status.

Manufacturing/assembly procedures/processes that are critical in controlling hazards that cannot or will not be verified by subsequent inspection or test must be verified during the manufacturing/assembly process. An independent verifier, as specified by the PO, shall attest to proper completion of the procedure/process. Critical procedures/processes, which require special monitored verification (Mandatory Inspection Points [MIPs]), shall be identified in preliminary fashion (NSTS 1700.7 and NSTS 1700.7 ISS Addendum, current version).

If available, the PO should provide a tentative schedule for completion of each verification task and correlate with the integration schedule.

6.4 PHASE II SAFETY REVIEW

The purpose of the phase II safety review is to obtain panel approval of the updated SDP that reflects the CDR-level design and operations scenario of the payload. The phase II safety analysis identifies all hazards and hazard causes; defines and documents implementation of a means for eliminating, reducing, or controlling the risks; and documents finalized, specific safety verification and on-orbit verification/reverification methods (test plans, analysis, and inspection requirements, etc.). Payload interfaces, mission and ground operations, procedures, and timelines that were not addressed during the phase I safety review shall be assessed for safety hazards. The payload interfaces to be assessed shall include those between the Shuttle and/or ISS and the payload and among the various components that make up the payload (the spacecraft, upper stages, space platforms, pallets, experiments, ASE, ancillary flight equipment, GSE, KSC Facilities, GFE, etc.). Newly identified hazards shall be documented in additional hazard reports. For this review, the PO should provide the estimated KSC on-dock arrival date.

6.4.1 Phase II Data Requirements

The following data are required from the PO for phase II and must be submitted as stated in paragraph 4.3.1:

a. For payload design and flight operations:

(1) Updated payload description (including subsystems) and mission scenario.

(2) Updated descriptions of safety-critical subsystems and their operations, including schematics and block diagrams with safety features and inhibits identified. Provide electrical schematics that clearly identify the required number of independent inhibits, controls, and monitoring provisions. Present a summary of the test and analytical efforts required to verify the intended performance of all safety-critical hardware.

For a computer-based control system that is used to prevent critical/catastrophic hazards, provide the following data/descriptions:

Functional architecture

Expected interactions

Results of unexpected interactions

Protections for common cause failures

Development process for databases, hardware, software, and hardware/software

(3) Updated and additional flight hazard reports (e.g., JSC Form 542B/JSC Form 1230), including appropriate support data (see section 7). For payloads that have catastrophic hazard potential, document the verification program outlined in NSTS/ISS 18798.

(4) Updated summary list and explanation of orbiter- and/or ISS-provided critical services.

(5) For ISS payloads, an update of the FDS implementation approach. Include information on use of forced air flow, wire derating, circuit protection, materials usage, parameter monitoring (fan speeds, temperatures, current, etc.) and responses to an out-of-limit condition, and suppression approach. For sub-rack payloads, the PO shall address the integrated system approach (using sub-rack services and/or ISS services) to fully define the FDS implementation strategy. Updated JSC Form 1428 to reflect specific test (or analysis) procedures to be used along with the schedule for completion of FDS verification tests, analyses, or inspections.

(6) Verification methods associated with hazard controls that require on-orbit verification and/or reverification and the applicable approach (include rationale, constraints, and detailed methodology.)

(7) An updated tabulated list of planned toxic materials and support data per JSC 27472 (see section 4.3.1.4). Updates should include changes in test materials, changes in test conditions, and any alternate test materials.

(8) Updated list of all battery types, their uses, manufacturer, and applications.

(9) A list of all pyrotechnic devices, their functions, chemical composition, critical components inspection plan, verification plan, and aging degradation evaluation plan.

(10) List of hazard controls that require crew procedures and/or training.

(11) A record of test failures, anomalies, and accidents involving qualification or potential flight hardware. Include a safety assessment for items which may affect safety.

(12) The status of all action items assigned to the PO during phase I.

(13) Detailed on-orbit maintenance safety assessment as outlined in NSTS/ISS 18798. Identify maintenance activities, safe access areas, and reverification of safety critical features.

(14) Update life safety assessment. Provide an updated list of payload hardware 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.

b. For GSE design and ground operations:

(1) Updated payload description and brief mission scenario.

(2) Updated descriptions and matrices of the GSE, the payload subsystems that present a potential hazard during ground processing, and their ground operations. Include updated schematics and block diagrams with safety features and inhibits identified. Electrical schematics must show all payload/GSE grounding.

(3) Updated ground operations scenario, including postflight ground operations at the primary, alternate, and contingency landing sites.

(4) Updated and additional ground hazard reports (JSC Form 542B), including appropriate support data.

(5) Updated ordnance data required by the current version of KHB 1700.7, Appendix D.

(6) Updated KSC on-dock delivery date.

(7) Specific engineering drawings and stress analyses of subsystems when requested by the GSRP Chairman.

(8) A list of safety-related failures and mishaps that have occurred.

(9) The status of all action items assigned to the PO during phase I.

(10) A list of technical operating procedures that will be used at KSC with a preliminary designation as to which ones are considered hazardous.

6.4.2 Phase II Hazard Reports

The PO shall prepare the phase II hazard reports by revising the phase I hazard reports to reflect the completed payload design and flight/ground operating procedures. If the payload design changes from phase I to phase II so that a phase I hazard report may be deleted, present a brief statement of rationale for deleting the report in the phase II SDP. The GSRP/PSRP will disposition the hazard reports.

Address all critical procedures/processes, including the plan for verification. Verifications shall refer to specific test (or analysis) procedures and summarize pass/fail criteria to be used. Specify the schedule for the completion of each specific verification test, analysis, or inspection.

6.5 PHASE III SAFETY REVIEW

The purpose of the phase III safety review is to obtain PSRP/GSRP approval of the SDP and safety compliance data that reflects the safety verification findings. The focus of this review is to assess safety verification testing and analysis results. If verifications critical for establishing the acceptability of the fundamental design of the payload for safety are not completed prior to the phase III review, then subsequent reviews may be required prior to hazard report approval. All verifications that are open at the time of the phase III SDP submittal must be included on the safety VTL. Items listed on the VTL should be planned open work items, such as ground processing at KSC.

6.5.1 Phase III Data Requirements

The following data are required for the phase III SDP and must be submitted as stated in paragraph 4.3.1:

a. For payload design and flight operations:

(1) Final as-built payload description (including subsystems) and mission scenario.

(2) Updated descriptions that define the final configuration of the safety-critical subsystems and their operations, including schematics and block diagrams with the as-built payload safety features and independent inhibits, controls, and monitoring provisions identified. Address applicable features and constraints relating to on-orbit verification/reverification of hazard controls.

For a computer-based control system that is used to prevent critical/catastrophic hazards, provide verifications for the following:

Functional architecture

Expected interactions

Results of unexpected interactions

Protections for common cause failures

Flight article databases, hardware, software, and hardware/software operate as designed

(3) Updated (and additional, if required) flight hazard reports, including support data that reflect the final configuration of the as-built payload and planned use. For payloads that have catastrophic hazard potential, document the verification program outlined in NSTS/ISS 18798.

(4) Final summary list and explanation of orbiter- and/or ISS-provided critical services.

(5) For ISS payloads, a finalized FDS implementation approach. Include information on use of forced air flow, wire derating, circuit protection, materials usage, parameter monitoring (fan speeds, temperatures, current, etc.) and responses to an out-of-limit condition. For sub-rack payloads, the PO shall address the final integrated system approach (using sub-rack services and/or ISS services) to fully define the FDS implementation strategy. Final JSC Form 1428 to summarize the results of the completed tests, analyses, and/or inspections and refer to particular test reports by document number, title, and date.

(6) Updated (and additional, if required) verification methods associated with hazard controls that require on-orbit verification and/or reverification and the applicable approach (include rationale, constraints, and detailed methodology).

(7) A final tabulated list of toxic materials and support data per JSC 27472 (see section 4.3.1.4), including additions and changes in test materials, changes in test conditions, and any alternate test materials.

(8) A final list of all battery types, their uses, manufacturer, and applications.

(9) A final list of all pyrotechnic devices installed or to be installed on the payload. The list will identify for each cartridge the function to be performed, the part number, the lot number, and the serial number.

(10) Updated list of hazard controls that require crew procedures and /or training.

(11) An updated record of test failures, anomalies, and accidents involving qualification or potential flight hardware or baselined flight software if the software is used for hazard control. Include a safety assessment for items which may affect safety.

(12) The status of all action items assigned to the PO through phase II.

(13) Payload Flight Safety VTL (JSC Form 764).

(14) Identification of flight safety noncompliances. Flight safety NCRs must be approved as either a waiver or a deviation before the phase III safety review can be completed. A signed copy of each approved safety waiver and/or deviation shall be included in the phase III SDP attached to the appropriate hazard report.

(15) Final/updated on-orbit maintenance safety assessment as outlined in NSTS/ISS 18798.

(16) Final/updated life safety assessment. Provide a final listing of payload hardware 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. Processing of final signed Certificate of Flight Payload Safety Compliance for Flight Safety Certificate shall be in accordance with section 5.7.1.

b. For GSE design and ground operations:

(1) Final as-built payload description and brief mission scenario.

(2) Updated descriptions and matrices defining the final configuration of the GSE, the payload 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 postflight ground operations at the primary, alternate, and contingency landing sites.

(4) Updated and additional ground hazard reports, including support data that reflect the final configuration of the as-built GSE and planned payload/GSE use.

(5) Updated and finalized ordnance data required by the current version of KHB 1700.7, Appendix D.

(6) Updated and finalized KSC on-dock delivery date.

(7) Specific engineering drawings and stress analyses of subsystems when requested by the GSRP Chairman.

(8) A summary and safety assessment of all safety-related failures and accidents applicable to payload processing, test, and checkout. Identify impact to the Space Shuttle, other payloads, and facilities.

(9) The status of all action items assigned to the PO through phase II.

(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 of the procedure at KSC.

(11) Verification that each payload flight system pressure vessel has a pressure vessel logbook that shows pressurization history, fluid exposure, and other applicable data. This verification should account for the planned testing at KSC.

(12) Payload Ground Safety VTL, if required.

(13) Certificate of Payload Safety Compliance (JSC Form 1114A) signed by the PO program manager for GSE design and ground operations.

(14) Procedural hazard control matrix that identifies hazard control criteria within the associated work-authorization documents for all procedural hazards. Contact GSRP Chairman for format.

(15) Identification of ground safety noncompliances. Ground safety noncompliances must be approved as either a waiver or a deviation before the phase III safety review can be completed. A signed copy of each approved waiver/deviation shall be included in the phase III SDP (see section 10).

6.5.2 Phase III Hazard Reports

The phase III hazard reports shall reflect the final, as-built design and operations of the payload and GSE. If the payload or GSE design is changed from phase II to phase III, so that a phase II hazard report may be deleted, provide in the phase III SDP a brief statement of rationale for deleting the report. By phase III, all safety analysis efforts should be completed. Verifications completed by phase III shall be indicated as such on the hazard report and shall refer to particular test reports, analyses reports, and/or inspection records by document number, title, and date. Additional information that may be required to support phase III verification closure includes the results of the completed tests, methods of verification, analyses, and/or inspections. Copies of the appropriate ground safety verification documentation shall be provided with the ground phase III hazard reports. This verification documentation shall consist of those items agreed to by the Payload Organization and the GSRP.

For those hazards controlled by the design-for-minimum-risk approach (per the current version of NSTS 1700.7, paragraph 200.2), in addition to data provided for phases I and II, the PO must provide additional data listed in section 7 of this document.

For payload systems having catastrophic hazard potential for the vehicle or crew as a result of operations in or near the vehicle, see paragraph 4.1.3.

6.5.3 Verification Tracking Log

All flight safety verifications that are still incomplete at Phase III, must be “closed” on the hazard report and transferred to the flight safety VTL for further tracking. This log will allow the PSRP Chairman to sign the hazard reports, indicating completion of the safety analysis, but with the understanding that approval for flight will be withheld until all flight verification activity is completed.

Similarly, all open ground verifications must be listed on the ground safety VTL. This log will allow the GSRP Chairman to sign the hazard reports, indicating completion of the ground safety analysis. Open ground verifications and open flight verifications that have been identified as a constraint against payload processing must be closed before the applicable ground operation can be performed.

SECTION 7
SUPPORTING TECHNICAL DATA SUBMITTALS

The information in this section applies to flight safety only, except for the data identified in sections 7.5 and 7.6, which applies to both flight and ground safety.

To further define the general data requirements in section 6, this section addresses SDP data submittals related to various technical disciplines to support hazard reports. Hazard reports (JSC Form 542 and Form 1230) must be supported by the minimum set of data as outlined below. Each such hazard report shall clearly identify the supporting data. This supporting data shall be submitted in one of the following manners: a) attached to the hazard report, b) as part of the SDP, or c) submitted to the PSRP Executive Officer/GSRP Chairman. This official submittal path is not intended to preclude direct technical coordination between the PO and the appropriate JSC/KSC technical disciplines.

Technical areas of design, such as structures, pressure vessels, and pressurized lines, fittings, and components are typically Design-For-Minimum-Risk (DFMR) areas of design. The data submittal requirements in sections 7.1 and 7.2 are the minimum DFMR requirements for those particular design areas. The remainder of section 7 contains the minimum data submittals required by the PSRP for either DFMR or failure tolerant designs.

7.1 STRUCTURES

7.1.1 Phase I

- Proposed Structural Verification Plan in accordance with NSTS 14046, “Payload Verification Requirements” and/or SSP 52005 “ISS Payload Flight Equipment Requirements and Guidelines for Safety Critical Structures.”
- Verification plans for structural integrity of payloads stowed or installed on ISS.
- Fracture Control Plan (FCP)
- If applicable, identify use of JSC-25863 Fracture Control Plan for JSC Flight Hardware (current revision) in the Safety Data Package and in the Fracture Control Summary Report.
- Damage Control Plan for all fracture critical and low-risk composite structures.
- Methodology for assurance of fastener integrity.

7.1.2 Phase II

- Final structural verification plan, including: 1) summary of design loads derivation leading to critical load cases, and 2) math model verification plan.
- Fracture control status (including parts categorization).
- Identification of Material Usage Agreements (MUAs) and Stress Corrosion Cracking Control Certifying Organization and point of contact information for structural materials, the failure of which would cause a hazard (including, but not limited to, stress corrosion, hydrogen embrittlement, and materials compatibility).
- For payloads 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.

7.1.3 <u>Phase III</u>

- Structural Verification Report that provides a summary of verification tests/analyses/inspections results.
- Fracture control summary report.
- New/approved MUAs as defined in phase II.
- Documentation of compliance with fastener integrity program.
- For payloads 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.
- Final Stress Corrosion Cracking Control Certification Compliance for structural materials.
- Final Loads Analysis Summary.

7.2 PRESSURIZED SYSTEMS (vessels, lines, fittings, components)

7.2.1 <u>Phase I</u>

- Preliminary pressurized system schematic and operating parameters (e.g., temperature, pressure and other environmental conditions).
- Preliminary summary of the derivation of system Maximum Design Pressures (MDPs) per NSTS 1700.7 and NSTS 1700.7 ISS Addendum.
- Preliminary list of all system working fluids, their complete chemical composition, amounts, potential hazards (e.g., flammability, explosion, corrosion, toxicity) and hazard category (e.g., catastrophic, critical, nonhazard).
- Summary of pressure vessel(s) design and qualification approach.
- Damage control plan and stress rupture life assessment (Composite Overwrapped Pressure Vessels (COPVs) only).
- Fracture Control Plan.
- 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) Safety Factor - (design burst pressure divided by MDP), 5) Safety Factor required by ‘1700, 6) Proof Factor (Maximum Test Pressure divided by MDP), 7) Leak rate method used for hazardous materials and 8) Containment integrity required (maximum allowed leak rate). If the Proof Factor will be less that 1.5 X MDP provide an explanation. See Appendix C, Table 1 (EXAMPLE), Pressure System Compliance.
- Proposed pressurized system(s) verification approach for controls to ensure pressure integrity.
- 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 DFMR).

- For the DFMR approach 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 (e.g., in the Shuttle Payload Bay (PLB)) and 2) preliminary identification of fusion and bi-metallic joints within the system.

7.2.2 Phase II

- Complete and updated pressurized system schematic(s) and operating parameters, addressing all pressurized hardware.
- Complete summary of the derivation of system MDP(s) per NSTS 1700.7 and NSTS 1700.7 ISS Addendum.
- 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".
- 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.
- Fracture control status.
- Identification of MUAs on pressurized system materials the failure of which would cause a hazard (including, but not limited to, stress corrosion, hydrogen embrittlement, and materials compatibility [including working and cleaning fluids]).
- Final pressurized system(s) verification approach for controls to ensure pressure integrity including a summary of qualification and acceptance test plans and analyses.
- 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.
- 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.

7.2.3 Phase III

- Final pressurized system schematic(s) and operating parameters, addressing all pressurized hardware.
- Final MDP derivation summary and table of pressurized system hardware, including the "Proof Factor (Maximum Test Pressure)" and "Leak rate method for hazardous materials".

- Final list of all system working fluids, their complete chemical composition, amounts, hazards and categories.
- Certification of pressure vessel(s) design, including qualification and acceptance test results.
- Fracture control summary report.
- New/approved MUAs as defined in phase II.
- For safe life and limited life pressure vessels, document existence of a Pressure Log, including log number.
- Summary of results from verification tests/analyses/inspections for controls to ensure pressure integrity.
- For fluids whose leakage is hazardous also include: Summary of results from verification tests/analyses/inspections for controls to prevent leakage.
- For the DFMR approach 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.

7.3 PYROTECHNIC DEVICES

7.3.1 Phase I

- List of pyrotechnic devices and the functions performed.

7.3.2 Phase II

- Detailed drawings of devices.
- Chemical composition of any booster charge(s).
- Inspection plan(s) for critical components.
- Plan for evaluation of aging degradation.
- Verification plan summary, including acceptance and qualification approach(s) (including margin demonstration), in accordance with NSTS 08060, “System Pyrotechnic Specifications.”

7.3.3 Phase III

- Summary of verification tests/analyses/inspections results.

7.4 MATERIAL FLAMMABILITY, TOXICITY, AND COMPATIBILITY

7.4.1 Phase I

- Approach used to assure materials compatibility and crew safety.

- A tabulated list of tentative toxic materials and support data per JSC 27472, "Requirements for Submission of Test-Sample Materials Data for Shuttle Payload Safety Evaluations" (see also section 4.3.1.4).

7.4.2 Phase II

- Materials compatibility status.
- Toxicological evaluation of test sample materials in accordance with JSC 27472.
- Offgassing test plan.
- Preliminary flammability assessment.
- Provide certifying organization point of contact information for Offgassing and Flammability.

7.4.3 Phase III

- Final materials compatibility status.
- Update to toxicological evaluation of test sample materials in accordance with JSC 27472.
- Flammability Assessment in accordance with JSC-29353, "Flammability Configuration Analysis for Spacecraft Applications."
- Provide Certification for Offgassing and Flammability Compliance per document JSC-29353.

7.5 IONIZING RADIATION

7.5.1 Phase I

PSRP:

- Ionizing Radiation Source Data Sheet (JSC Form 44). To initiate the JSC Form 44 process, use the following web link for obtaining and submitting the JSC Form 44: http://srag.jsc.nasa.gov/form44/form44link.cfm.

GSRP:

- Forms in accordance with KNPR 1860.1, "KSC Ionizing Radiation Protection Program," if required.

7.5.2 Phase II

PSRP:

- New/Updated JSC Form 44 must be submitted and obtained at the following web link: http://srag.jsc.nasa.gov/form44/form44link.cfm.

GSRP:

- Forms in accordance with KNPR 1860.1, "KSC Ionizing Radiation Protection Program," if required.

7.5.3 Phase III

PSRP:

- Approved JSC Form 44.

GSRP:

- Forms in accordance with KNPR1860.1, "KSC Ionizing Radiation Protection Program," if required.OP

7.6a NON-IONIZING RADIATION

7.6.a1 Phase I

PSRP:

- List of equipment that generates non-ionizing radiation (RF transmitters, light sources, etc.).
- Proposed Electromagnetic Interference (EMI)/Electromagnetic Compatibility (EMC) Test Plan, for Conducted Emissions (CE), Radiated Emissions (RE), Conducted Susceptibility (CS), and Radiated Susceptibility (RS); applicable tests as determined by the hardware's intended application and criticality.

GSRP:

- Forms in accordance with KNPR1860.2, "KSC Non-ionizing Radiation Protection Program," if required.

7.6.a2 Phase II

PSRP:

- Updated list of equipment that generates non-ionizing radiation, including expected nominal operational characteristics of all non-ionizing radiation sources.
- Final EMI/EMC Test Plan, for CE, RE, CS, and RS: applicable tests as determined by the hardware's intended application and criticality.

GSRP

- Forms in accordance with KNPR1860.2, "KSC Non-ionizing Radiation Protection Program," if required.

7.6.a3 Phase III

PSRP:

- Final list of equipment that generates non-ionizing radiation, including actual nominal operational characteristics of all non-ionizing radiation sources.
- Submit final report of Electromagnetic Effects Panel (EMEP) approval of relevant EMI/EMC test results, including any Tailoring Agreements (TIAs) approved by the EMEP.

GSRP:

- Forms in accordance with KNPR1860.2, "KSC Non-ionizing Radiation Protection Program," if required.

7.6b NON-IONIZING RADIATION - LASERS

7.6.b1 Phase I

PSRP:

- Identify each laser, its operating location, and its complete beam path.

- Identify the laser hazard classification per ANSI Z136.1.
- Identify each laser's operating characteristics (wavelength(s), (Continuous Wave) (CW)/pulsed).
- For CW lasers, provide average and peak powers.
- For pulsed lasers, provide pulse shape and energy characteristics and repetition frequency.
- Provide the laser manufacturer's specification sheet, if available.
- 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.
- Preliminary description of controls and inhibits to contain laser beam or prevent inadvertent laser operation and/or crew exposure (interlocks, barriers, beam stops, etc.)
- Preliminary list of crew protective equipment (goggles, etc,), if required for hazard control.

GSRP:

- Forms in accordance with KNPR 1860.2, "KSC Non-ionizing Radiation Protection Program," if required.

7.6.b2 <u>Phase II</u>

PSRP:

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

GSRP:

- Forms in accordance with KNPR 1860.2, "KSC Non-ionizing Radiation Protection Program," if required.

7.6.b3 Phase III

PSRP:

- Summary of verifications and test results

GSRP:

- Forms in accordance with KNPR 1860.2, "KSC Non-ionizing Radiation Protection Program," if required.

7.7 PAYLOAD COMMANDING

7.7.1 Phase I

- List of hazardous commands and implementation.

7.7.2 Phase II

- Updated list of hazardous commands and detailed implementation plan.

7.7.3 Phase III

- Verification of implementation plan.

7.8a ELECTRICAL (POWER, BONDING AND GROUNDING) SUBSYSTEMS

7.8.a1 Phase I

- Preliminary power distribution schematic(s) showing wire sizing and circuit protection.
- Preliminary bonding and grounding diagram/plan.

7.8.a2 Phase II

- Updated power distribution schematic(s) showing wire sizing and circuit protection.
- Final bonding and grounding diagram.

7.8.a3 Phase III

- As-built power distribution schematic(s) that show wire sizing and circuit protection.
- Summary of verification tests/analyses/inspection results for bonding and grounding.

7.8b AVIONICS CONTROL

7.8.b1 Phase I

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

7.8.b2 Phase II

- Updated schematics of safety-critical subsystems that indicate inhibits, controls, monitors, and Orbiter interfaces.
- Verification approach (test pass/fail criteria) for each avionics leg of the hazard control/monitor subsystem, including test location (e.g., cargo integration test equipment stand [CITE], orbiter, payload rack checkout unit [PRCU], other) procedures, and test apparatus used in substantiating end function.

- Provide a "payload hazard event table" listing the subsystem interface connector, pin number, payload function nomenclature, and whether the pin is command, monitor, or power.

7.8.b3 Phase III

- As-built schematics of safety-critical subsystems that indicate inhibits, controls, monitors, and Orbiter interfaces.
- Summary of test results and summary of test procedures, including payload organization testing and/or fully integrated testing (e.g., CITE, orbiter, PRCU, or other).
- As-built/final "payload hazard event table."

7.8.c COMPUTER SYSTEMS (Avionics)

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

7.8.c1 Phase I

- Identify computer system hazard controls.
- Describe the function(s) controlled by computer systems that prevent a hazard from occurring or control a hazardous function.
- Provide a block diagram of the Computer-Based Control System (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.
- Provide design features for CBCSs planned to control multiple inhibits to a hazard (i.e. designed to be greater than zero-fault tolerant).
- Describe the development process (including verification) of software/hardware and computer based control.

7.8.c2 Phase II

- Describe the independence of computer and non-computer methods of hazard control and update block diagrams that detail the control of inhibits to a hazard.
- Update the 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.
- Summarize the functional testing of the software/hardware, and describe the verification approach for the computer based hazard control system.

7.8.c3 Phase III

- 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.

- Update 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.

7.9 MECHANISMS IN CRITICAL APPLICATIONS

7.9.1a Phase 0

- Provide a draft Mechanical Systems Verification Plan (MSVP) approach.
- Where applicable simple mechanisms and/or design for minimum risk mechanisms design approaches are used, a request for approval shall be submitted to the Mechanical Systems Working Group (MSWG).

7.9.1b Phase I

- Preliminary MSVP identifying safety-critical mechanisms and design approach for each mechanism.
- Identification of areas of applicability of holding or operating force or torque margin requirements and planned verification approach (test or analysis).
- Formally request approval from the MSWG to pursue a simple mechanism approach, and/or to pursue a DFMR approach to any safety-critical mechanisms, prior to Phase 1 SDP submittal.
- Provide a Fault Tolerance Matrix for Fault Tolerant Mechanisms.
- Provide a tolerance analysis with tolerance stackup and thermal effects for all safety-critical mechanisms.
- Fracture Control Plan.

7.9.2 Phase II

- Final MSVP includes updates of critical procedures and processes to meet safety requirements using either a) failure tolerant approach or b) DFMR approach that required compliance with JSC letter MA0-00-057.
- Include fault-tolerance analysis for the safety-critical mechanisms explaining the independent success legs in place to meet fault-tolerance requirements and, if using DFMR approach, a completed 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.
- A complete discussion of the verification approach, including qualification and acceptance tests and analyses, for each critical mechanism operation or feature is required for the MSVP.
- List of MIPs.
- Fracture control status (including parts categorization).

7.9.3 Phase III

- Provide Mechanical Systems Verification Report (MSVR) that describes the verifications performed on all safety-critical mechanisms previously described in the MSVP and the results of those verification activities, and include any trade/special studies supporting mechanisms hazard reports.
- Fracture control summary report.

7.10 SOLID ROCKET MOTORS

7.10.1 Phase I

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

7.10.2 Phase II

- 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.
- Updated characteristics of SRM, including motor manufacturer, total mass and type of propellant, propellant formulation/ingredients, motor/propellant explosive classification, and case description.
- Cutaway diagram of the initiator.
- Diagram of the safe-and-arm device, indicating design and operation.
- SRM case Fracture Control Plan.
- 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.

7.10.3 Phase III

- 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.
- Final characteristics of SRM, including motor manufacturer, total mass and type of propellant, propellant formulation/ingredients, motor/propellant explosive classification and case description.
- A table listing the inhibits, when last cycled (actuated), and the final pre-launch state.
- Final cutaway diagram of the initiator.

- Updated diagram of the safe-and-arm device, indicating design and operation.
- SRM case fracture control summary.
- 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.

7.11 BATTERIES

7.11.1 Phase I

- Preliminary list of type and number of cells and batteries, cell size (capacity), battery configuration, cell/battery chemistry, cell/battery manufacturer, model number(s), voltage, capacity, details of on-orbit operations, and documentation of anomalies.
- State whether on-orbit cell/battery charging is intended.
- Provide a copy of EP Form 03, as submitted to JSC-EP5 Battery Office, for each cell/battery model.

7.11.2 Phase II

- Updated list of type and number of cells and batteries, cell size (capacity), battery configuration, cell/battery chemistry, cell/battery manufacturer, and model number(s) and charging circuit.
- Electrical power diagram detailing cell/battery circuit diagram including charging circuit showing compliance with NSTS 1700.7 and NSTS 1700.7 ISS Addendum. See requirements in JSC 20793, “Crewed Space Vehicle Battery Safety Requirements.”
- Charging characteristics and procedures, e.g., pulse charging, charge rate, trickle charge rate, and method of charge termination.
- Describe on-orbit operations including charging, discharging, battery replacement, stowage and disposal procedures. Provide design details and a diagram for battery boxes that indicates materials of construction, absorbent material, venting provisions, minimization of hydrogen accumulation from aqueous electrolyte batteries, protective coatings on battery box interiors and on exposed cell terminals, and cell physical retention techniques.
- Verification plan, including qualification and acceptance tests.
- Diagram of charging devices, characteristics, and implementation procedures.
- Fracture control approach for battery cells where leakage causes a catastrophic hazard and for nickel-hydrogen batteries. (Refer to section 7.2 for data submittal on fracture critical pressurized components or pressure vessels).
- Update EP Form 03 for each cell/battery model (as submitted to EP5/Battery Office).

7.11.3 Phase III

- Final list of type and number of cells and batteries, cell size/battery configuration (capacity), cell/battery chemistry, cell manufacturer, and model number(s).

- Final circuit diagrams, including safety circuitry and charging circuit showing compliance with NSTS 1700.7 and NSTS 1700.7 ISS Addendum. See requirements in JSC 20793, “Crewed Space Vehicle Battery Safety Requirements.”
- Final on-orbit operations including charging and discharging, battery replacement, stowage and disposal procedures.
- As-built diagram/drawings for battery boxes that indicates materials of construction, absorbent material, venting provisions, minimization of hydrogen accumulation from aqueous electrolyte batteries, protective coatings on battery box interior and on exposed cell terminals, and cell physical retention techniques.
- Results of verification tests, analyses, and inspections.
- Fracture Control Summary Report for NiH_2, battery cells. Approved EP Form 03 for each cell/battery model.

7.12 FLUID PROPULSION SYSTEMS

7.12.1 Phase I

- Preliminary propulsion system schematic(s) and operating parameters (e.g., temperature, pressure, other environmental conditions, number of thrusters).
- Preliminary summary of the derivation of system MDP(s) per NSTS 1700.7 and NSTS 1700.7 ISS Addendum.
- Preliminary list of all system working fluids, their complete chemical composition, amounts, potential hazards (e.g., flammability, explosion, corrosion, toxicity) and hazard category (e.g., catastrophic, critical, non-hazard).
- Summary of pressure vessel(s) design and qualification approach.
- Fracture Control Plan.
- Safe distance assessment and planned thrust level(s) used to determine it.
- 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.
- Proposed propulsion system(s) verification approach for controls to ensure pressure integrity.
- 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 (e.g., in the Shuttle PLB), 2) preliminary identification of fusion and bi-metallic joints within the system.
- 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.

- Since fluid propulsion systems are normally pressure systems, the data requirements for 7.2 Pressure Systems are also applicable to 7.12 Fluid Propulsion Systems.

7.12.2 Phase II

- Complete and updated propulsion system schematic(s) and operating parameters, addressing all pressurized hardware.
- Complete summary of the derivation of system MDP(s) per NSTS 1700.7 and NSTS 1700.7 ISS Addendum. 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).
- 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.
- Fracture control status.
- Identification of MUAs on propulsion system materials the failure of which would cause a hazard (including, but not limited to, stress corrosion, hydrogen embrittlement, and materials compatibility [including working and cleaning fluids]).
- Updated safe distance assessment and planned thrust level(s) used to determine it.
- 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.
- Final propulsion system(s) verification approach for controls to ensure pressure integrity, including a summary of qualification and acceptance test plans and analyses.
- 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.
- 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.
- Since fluid propulsion systems are pressure systems, the data requirements for 7.2 Pressure Systems are also applicable to 7.12 Fluid Propulsion Systems.

7.12.3 Phase III

- Final propulsion system schematic(s) and operating parameters, addressing all pressurized hardware.
- Final MDP derivation summary and table of propulsion system hardware.

- Final list of all system working fluids, their complete chemical composition, amounts, hazards, and categories.
- Certification of pressure vessel(s) design, including qualification and acceptance test results.
- Fracture control summary report.
- New/approved MUAs as defined in phase II.
- For safe life and limited life pressure vessels, document existence of a Pressure Log, including log number.
- Final safe distance assessment.
- 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.
- Summary of results from verification tests/analyses/inspections for controls to ensure pressure integrity.
- 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.
- Since fluid propulsion systems are pressure systems, the data requirements for 7.2 Pressure Systems are also applicable to 7.12 Fluid Propulsion Systems.

7.13 SEALED CONTAINERS (STRUCTURES)

7.13.1 Phase I

- List the name of each sealed container.
- Provide preliminary identification of MDP, fluid(s), materials of construction for container enclosure, stored energy due to pressure, and environmental conditions.
- Confirm/show sealed container meets design requirements per NASA-STD-5003 or NASA-STD-5019, for sealed containers, respectively.

7.13.2 Phase II

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

7.13.3 Phase III

- List the name of each sealed container and verify that information furnished at Phase II is still valid. If not, identify and explain changes.

- Provide final identification of MDP, fluid(s), materials of construction for container enclosure, stored energy due to pressure, and environmental conditions.
- Provide final acceptance rationale for each sealed container including a summary of any required analyses and tests.

7.14 EXTRAVEHICULAR ACTIVITIES

7.14.1 Phase I

- 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.
- Preliminary safety assessment of payload hazards related to ISS/NSTS environment. (Reference: SSP50021, NSTS 1700.7B, NSTS 1700.7B ISS Addendum and JSC-28918).
- Description of hardware affect on ISS/NSTS floating potential.
- Description of EVA safety design features. (Reference: SSP50021, NSTS 1700.7B, NSTS 1700.7B ISS Addendum and JSC-28918).

7.14.2 Phase II

- Clarification of EVAs including scheduled, unscheduled, and contingency, identifying all EVA operational controls.
- Update description and verification approach (including qualification and acceptance test/analysis/inspections) used to address hazards related to EVA Payload and ISS/NSTS environments. (Reference: SSP50021, NSTS 1700.7B, NSTS 1700.7B ISS Addendum and JSC-28918)
- Update description of EVA hardware design features’ affect on ISS/NSTS floating potential; if the hardware impacts the ISS/NSTS floating potential, evidence of coordination with the space environments group must be provided.
- Supporting verification data to demonstrate compliance with applicable Interface Control Documents (ICDs).
- Updated description of EVA design features. (Reference: SSP50021, NSTS 1700.7B, NSTS 1700.7B ISS Addendum and JSC-28918)

7.14.3 Phase III

- Results of verification test, analyses, fit checks, and inspections.
- Final design information of any design features which may affect ISS/NSTS floating potential or create electrical shocks.
- Final verification data to demonstrate compliance to applicable ICDs.
- All safety non-compliance reports for external hardware shall have a concurrence signature from the EVA analysis integration team.

7.15 BIOLOGICAL MATERIALS

7.15.1 Phase I

- The Payload Organization shall provide a JSC form 713, "Inflight Biohazardous Materials Approval Form" via http://microbiology.jsc.nasa.gov/microbrb.htm per JSC-63828, "Biosafety Review Board Operations and Requirements Document".

7.15.2 Phase II

- The Payload Organization shall provide an updated JSC form 713, "Inflight Biohazardous Materials Approval Form" via http://microbiology.jsc.nasa.gov/microbrb.htm per JSC-63828, "Biosafety Review Board Operations and Requirements Document".

7.15.3 Phase III

- The Payload Organization shall provide a final JSC form 713, "Inflight Biohazardous Materials Approval Form" via http://microbiology.jsc.nasa.gov/microbrb.htm per JSC-63828, "Biosafety Review Board Operations and Requirements Document".

SECTION 8
VARIATIONS OF THE SAFETY REVIEW PROCESS

This section identifies variations of the safety review process described in section 6.

8.1 VARIATIONS FOR INTEGRATED MULTIPAYLOAD CARGO COMPLEMENTS

An integrated, multipayload cargo complement usually is an assembly of experiments mounted on or in a dedicated carrier, rack(s), module, or the orbiter or ISS. When an integrated, multipayload cargo complement has payload elements that are in various stages of development, the mission manager, who is responsible for integrating the payload into the orbiter or ISS, should submit separate SDPs for individual payload elements or appropriate groups for separate review.

The complete payload complement (all experiments and the carrier, rack, module, etc.), however, must be addressed together at an integrated phase III safety review. Hazards associated with the interaction between 1) two or more experiments, or 2) an experiment and the carrier, orbiter, or ISS must be addressed in an integrated hazard report and presented at phase III.

Many payloads will serve as "hosts" that provide services for experiments and other payloads. Developers that plan to extend host services to client experiments or payloads must document the adequacy of services that control hazards in a hazard report. Any limits or restrictions to the provided safety service must be clearly specified. The hazard report may reference a user's guide or Interface Control Document (ICD) as verification of hazard controls. Verifications apply to the overall design and include the specific verifications that assure that required services are present for each client experiment or payload. On-orbit verifications/reverifications must also be included.

8.2 VARIATIONS FOR ISS PAYLOADS

Since ISS payloads are subject to differing development schedules, mobility of hardware on-orbit, potential on-orbit upgrades/modifications, and extended lifetimes, a modular data documentation and review strategy is encouraged. For payloads with multiple independent or unique systems, SDPs should be a compilation of payload system-level assessments that documents safety compliance of payload hardware and operations for each payload system. SDPs should have chapters for each of these systems and shall contain an integrated safety analysis at the rack or carrier level. Assessment will include on-orbit verification/reverification of hazard controls where applicable. Cumulative and unique integrated hazards should constitute the final SDP chapter. The rack integrator will perform integrated assessments for payloads co-manifested in a rack. The process defined in section 5, if applicable, allows a payload to progress through the payload safety process in accordance with its own schedule.

8.2.1 On-orbit Reconfigured Payloads

On-orbit reconfigured payloads are defined as payloads that while on-orbit either 1) will be physically reconfigured by modular substitution/addition, or 2) will experience a change in planned use or manifested location.

Safety assessments will be subject to the series/reflown hardware process detailed in section 9 and will address on-orbit verification/reverification of hazard controls.

8.2.2 Payloads Returning to Earth

Return payloads are defined as payloads or elements of payloads that are manifested for return from ISS on the STS.

Payloads that were launched on the Space Shuttle, transferred to the ISS, and later will be returned on the Space Shuttle must address all hazards for Space Shuttle delivery and transfer to ISS, ISS integration and operations, ISS deintegration, transfer to the Space Shuttle, and Space Shuttle return in the initial phase I/II/III safety data packages and hazard reports. If there have been changes to the payload hardware, safety assessments will be subject to the series/reflown hardware process detailed in section 9 and will address on-orbit verification/reverification of hazard controls and waste materials.

Payloads or hardware that were not launched on the Space Shuttle but will return on the Space Shuttle must meet the requirements of NSTS 1700.7B, NSTS1700.7B ISS Addendum, and KHB 1700.7. Safety assessments will be subject to the series/reflight reflown hardware process detailed in NSTS/ISS 13830C, section 9 and will address on-orbit verification/reverification of hazard controls. The analysis will identify hazard controls that must be verified while on-orbit; integrated hazards; and postlanding hazards or hazardous operations that occur at the primary, alternate, and contingency landing sites.

8.3 VARIATIONS FOR SSP PAYLOADS

Where a payload design has not met a specific requirement in NSTS 1700.7b but can demonstrate it achieves an acceptable level of safety, the SSP may at its discretion direct the PO to process an Accepted Risk Hazard Report (ARHR) in lieu of an NCR. The PO will receive direction to proceed with the ARHR approach through their normal interactions with the PSRP and will utilize the existing Space Shuttle ARHR classification and process as noted within section 10.1.1.

SECTION 9
REFLOWN AND SERIES PAYLOAD HARDWARE

Reflown hardware is defined as payloads or elements of payloads that have flown on the Space Shuttle or ISS and are manifested for reflight. Series flight hardware is defined as payloads or elements of payloads that are of the same or similar design as previously flown hardware (NSTS 1700.7 and NSTS 1700.7 ISS Addendum, current version). “Series” is not an applicable category for GSE. Variations to the procedures of section 6 have been developed for series payloads and reflown hardware to eliminate unnecessary duplication of effort from previously accomplished safety activity.

The PO is responsible for the safety of the total payload/GSE, including the series/reflown elements and associated interfaces. To fulfill this responsibility, the PO shall assess the previously approved safety data of the series/reflown payloads, payload elements, or GSE for applicability to the new payload and make all appropriate changes. Changes that may warrant revisions to baseline hazard reports include such things as hardware redesign, operational changes, or the need for additional controls. When any revisions are made to baseline hazard reports, a new, unsigned version shall be submitted as part of the reflight package.

The safety certification responsibility, as well as the number and depth of the safety reviews, will be discussed and negotiated with the PO at an early payload integration meeting.

The following unique data for series/reflown payloads, payload elements, and associated GSE shall be submitted (per section 4.3) as a Reflight SDP:

a. Identification of all series/reflown payloads, payload elements, and GSE to be used and the baseline safety analyses by document number, title, and release date. If chemicals are used, provide a new list, even though the chemicals are the same as those used previously.

b. Assessment of each series/reflown payload, payload elements, and GSE to indicate that the proposed use is the same as currently approved (analyzed and documented).

c. New or revised hazard reports, additional data, and identification of hazard reports that are no longer applicable based on the reflight application. Identification and assessment of changes in hardware/software and operations that have any safety impact, including on-orbit verification/reverification of hazard controls.

d. A copy of the approved baseline phase III hazard reports (attachments not required).

e. Report on the completion and results of applicable safety verifications. Submission of safety VTL (JSC Form 764) that identifies all safety verifications from the applicable baseline hazard reports that must be reverified for the reflight mission. In addition, open verifications from new hazard reports must be included.

f. Assessment of all safety noncompliances.

g. Assessment of limited life items for reflown hardware, including an updated list of payload hardware items that could create a hazardous condition if they were to remain in service past their certification 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. Description of maintenance, structural inspections, and refurbishment of reflown hardware and assessment of safety impact.

i. Assessment of all testing or ground/flight anomalies and failures during the previous usage of the series/reflown payload or payload element along with corrective action taken and rationale for continued use. (flight hardware/software only)

j. For flight reviews: A list of all pyrotechnic initiators installed or to be installed on the payload. The list will identify for each initiator the function to be performed, the part number, the lot number, and the serial number.

   For ground reviews: Verification that each payload flight system pressure vessel has a pressure vessel logbook that shows pressurization history, fluid exposure, and other applicable data. This verification should account for the planned testing at KSC.

k. Ionizing and non-ionizing radiation forms for each source within the flight hardware or GSE. A definitive statement of non-use is required in the event that no radioactive materials or ionizing sources are present on the reflight payload.

l. For payloads that flew and were assessed for safety on either the shuttle or the ISS and are being reflown on the other vehicle: Results of the assessment of the payload with respect to the safety requirements of the new host vehicle (Flight safety only: current versions of NSTS 1700.7 for the shuttle and the NSTS 1700.7 ISS Addendum for the ISS).

m. A final list of procedures for ground processing (ground only).

n. Certificate of Payload Safety Compliance or Flight Safety Certificate. (Note: For GSE design and ground operations, the Flight Safety Certificate is not an acceptable substitute).

o. A copy of the approved baseline phase III FDS form (ISS payloads only)

As noted within section 8.2, “Variations for ISS Payloads”, in certain instances in which simple payload hardware is either modified or reconfigured on-orbit and/or is planned for transport on a different vehicle than originally anticipated, a payload may demonstrate compliance to the requirements as noted above via a decreased data submittal (formal memorandum to be provided to the PSRP). This approach must be coordinated and approved by the PSRP Executive Officer (prior to submittal) and will require substantiating technical rationale. Items in the subject formal memorandum shall include (as a minimum) confirmation of the following:

a. The subject payload falls within the classification of a “series/reflight safety assessment” per NSTS/ISS 13830 section 9, and includes a reference to and confirmation of continued applicability of the baselined safety data package, hazard reports, and safety verification methods previously approved by the PSRP;

b. The updated on-orbit operations and/or planned transport introduces no additional hazards or required hazard control re-verifications (Example: The soft-stowed transport configuration falls within the originally-assessed/approved structural analysis with no required additional verification activity);

c. The originally-submitted JF-1114a/JF-906 remains valid for the updated on-orbit operations plan/return flight with no issues related to stated safe operations or safe design life (Note: Baselined safety certificate shall also be included);

d. There have been no safety-relevant anomalies/failures which have occurred with the hardware during on-orbit or ground operations;

During the coordination with the PSRP Executive Officer, additional information and/or requested clarifications may also be requested and shall be included within the formal memorandum as noted above

For series/reflown IP hardware transported to stowed and/or operated aboard the ISS and meeting the constraints of the Category 1 criteria as specified within section 5.4 (flight only), the following unique data for series/reflown payloads and payload elements shall be submitted (per section 4.3) as a reflight SDP:

a. Identification of all series/reflown payloads, payload elements, and GSE to be used and the baseline Flight Safety Certificate by document number, title, and release date.

b. Confirmation that the following statements are true:

(1) There have been no changes to the hardware or its configuration

(2) There have been no changes to the procedures

(3) There have been no anomalies with the use of the hardware

(4) All reverifications of hazard controls (if applicable) will be performed and completed prior to launch

SECTION 10
PAYLOAD SAFETY NONCOMPLIANCE REPORT

The PO shall meet all the requirements of the current versions of NSTS 1700.7, NSTS 1700.7 ISS Addendum, and KHB 1700.7 or process an ISS safety NCR and/or SSP ARHR for each specific case of noncompliance. The PO shall document each noncompliance and submit the completed NCR/ARHR form(s) to the PSRP or GSRP. Each NCR/ARHR shall refer to the applicable payload element, subsystem, or component(s) of the payload.

The PO must develop the acceptance rationale that explains the design features and/or procedures used to conclude that the noncompliant condition is safe. The PO shall attach the supporting data for the acceptance rationale to the NCR/ARHR.

Approval of an NCR/ARHR for the design or operation of one element, subsystem, or component of the payload will not relieve the PO of the responsibility to meet the requirement in any other element, subsystem, or component of the payload. The NCR/ARHR must be approved before the PSRP will approve the associated hazard report(s).

Ground NCRs shall be approved prior to the start of associated KSC ground operations that are impacted by the NCR. The GSRP has been granted the authority to approve NCRs that impact only ground processing and have no impact to the payload flight hardware design, flight operations, or flight safety.

10.1 NCR/ARHR SUBMITTAL AND PROCESSING

All NCRs/ARHRs shall be coordinated with the PSRP or the GSRP, as appropriate, as soon as it is determined that the safety requirement cannot be met.

NCRs/ARHRs for payload design and flight operations shall be submitted to the PSRP Executive Officer in accordance with section 4.3.1. For GSE design and ground operations (KSC), the NCR shall be submitted to the GSRP Chairman in accordance with applicable GSRP processes. If the NCR/ARHR involves payload design that could have an impact on ground operations, the NCR/ARHR shall be concurrently submitted to both the PSRP and the GSRP.

The PO shall ensure that the NCR/ARHR is processed through the appropriate SSP/ISS approval process and is responsible for the development and coordination of the NCR/ARHR presentation to the appropriate panel(s) and/or board(s).

10.1.1 SSP ARHRs

The PO shall document SSP ARHRs in accordance with NSTS 22254. SSP ARHRs are reviewed and approved via the SSP Program Manager in compliance with existing SSP Configuration Management (CM) agreements and processes.

10.1.2 ISS NCRs

The PO shall document all ISS NCRs via use of the form “ISS-CM-031, ISS Safety Non-Compliance Report”. ISS NCRs are reviewed/approved via the associated ISS NCR CM process as noted within SSP 50123.

PSRP chair approval of safety non-compliances that fall within the PSRP assessment as “equivalent safety” is a delegated authority from the ISS program and the processing of those NCRs shall fully comply with existing ISS CM agreements and processes.

"Equivalent safety" may be granted for noncompliant conditions that do not meet specific requirements in the exact manner specified; however, the payload design, procedure, or configuration satisfies the intent of the requirement by achieving a comparable or higher degree of safety. Criteria for establishing an "equivalent safety" is based on:

a. Use of alternative methods/controls;

b. Utilization of procedures, protective devices, preflight verification activities, and crew experience base;

c. Reduced time of exposure;

d. Likelihood/probability of additional failures after loss of first control/inhibit;

e. Reduction of hazard category, and/or other factors such as minimum of single fault tolerance (1FT) with a robust design.

Specific requirements and details with respect to this delegated authority and the scope of noncompliant conditions to which it applies will be addressed during the conduct of flight safety review meetings when an applicable noncompliant condition is identified. Under these circumstances, the NCR condition shall be documented on the HR, and the PSRP chair will disposition the NCR.

10.2 EFFECTIVITY

SSP payload ARHRs have an effectivity of one flight only. The PO has the responsibility to correct the noncompliant condition prior to reflight of the same payload or payload element, or prior to the flight of subsequent payloads of the same series.

ISS payload NCRs may have an effectivity of one or more flights or increments. The PO shall state the desired effectivity on the NCR form. The ISS program may concur with or limit the requested effectivity. After expiration of the effectivity and prior to reflight of the same payload or payload element, or prior to the flight of subsequent payloads of the same series, the PO has the responsibility to correct the noncompliant condition.

10.2.1 Waivers

Waivers are granted for noncompliant conditions that do not meet specific requirements.

Shuttle payload waivers have an effectivity of one flight only. The PO has the responsibility to correct the noncompliant condition prior to reflight of the same payload or payload element, or prior to the flight of subsequent payloads of the same series.

Station payload waivers may have an effectivity of one or more flights or increments. The PO shall state the desired effectivity on the NCR form. The ISS program may concur with or limit the requested effectivity. After expiration of the waiver's effectivity and prior to reflight of the same payload or payload element, or prior to the flight of subsequent payloads of the same series, the PO has the responsibility to correct the noncompliant condition.

10.2.2 Deviations

Deviations are granted for noncompliant conditions that do not meet specific requirements in the exact manner specified; however, the payload design, procedure, or configuration satisfies the intent of the requirement by achieving a comparable or higher degree of safety.

Both shuttle and station payload deviations may be approved for unlimited use. The effectivity is the applicable flight number or increment number and subsequent flight or increment numbers.

SECTION 11
LIST OF FORMS

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

11.1 JSC FORMS

Current versions of the JSC forms are available in electronic format on the NASA/JSC Payload Safety Home Page. Contact the JSC PSRP Executive Officer for the electronic address.

The PSRP will accept "equivalent" forms (i.e., those that contain all the required information) developed by the payload organization for the following:

JSC Form 542B	Hazard Report and Continuation Sheet
JSC Form 764	Verification Tracking Log
JSC Form 1114A	Certificate of Safety Compliance

The PSRP, however, will not accept substitute "equivalent" forms for the following:

JSC Form 44	Ionizing Radiation
ISS CM 031	International Space Station Non-Compliance Report
JSC Form 1230	Flight Payload Standardized Hazard Control Report
JSC Form 1428	Fire Detection and Suppression Reporting Form
JSC Form 906	Flight Safety Certificate
JSC Form 907	Multilateral Category 1 Constraints

11.2 KSC FORMS

Contact the KSC GSRP Chairman for the KSC forms.

KSC FORM 16-295	Radiation Use Request/Authorization (Radioactive Materials)
KSC FORM 28-34	Radiation Use Request/Authorization (Ionizing Machine/Device)
KSC FORM 16-294	Radiation Training and Experience Summary (Ionizing Radiation)
KSC FORM 16-353	Modification of Radiation Use Authorization
KSC FORM 16-447	Laser Device Use Request/Authorization
KSC FORM 28-626	Optical Device Use Request/Authorization
KSC FORM 16-451	Radiofrequency/Microwave System Use Request/Authorization
KSC FORM 16-450	Training and Experience Summary (Nonionizing Radiation Users)

APPENDIX A

APPLICABLE DOCUMENTS

APPLICABLE DOCUMENTS

The latest revision and changes of the following documents are applicable to the extent stated herein. These documents can be accessed through the Payload Safety website: http://wwwsrqa.jsc.nasa.gov/pce or the KSC GSRP website: http://kscsma.ksc.nasa.gov/GSRP/index.htm. Documents not available on the website may be obtained from the PSRP Executive Officer or GSRP Executive Secretary.

DOCUMENT NUMBERS AND TITLES	REFERENCED IN PARAGRAPH
NSTS 1700.7, Safety Policy and Requirements for Payloads Using the Space Transportation System.	1, 4.1, 4.2, 5.5, 6.3.1.a(4), 6.3.2, 6.5.2, 7.2.1, 7.2.2, 7.11.2, 7.11.3, 7.12.1, 7.12.2, 8.2.2, 9, 10
NSTS 1700.7 ISS Addendum, Safety Policy and Requirements for Payloads Using the International Space Station.	1, 4.1, 5.5, 6.3.1.a(4), 6.3.2, 7.2.1, 7.2.2, 7.11.2, 7.11.3, 7.12.1, 7.12.2, 8.2.2, 9, 10
KHB 1700.7/45 SW HB S-100, Space Shuttle Payload Ground Safety Handbook.	1, 6.3.1.b(5), 6.4.1.b(5), 6.5.1.b(5), 8.2.2, 10
NSTS 07700 Volume V, Information Management Requirements.	3.2
SSP 50223, International Space Station Export Control Plan.	3.2
NSTS/ISS 18798, Interpretations of NSTS/ISS Safety Requirements.	4.1.3, 6.3.1.a(3), 6.3.1.a(10), 6.4.1.a(3), 6.4.1.a(13), 6.5.1.a(3), 6.5.1.a(15)
JSC 26943, Guidelines for Preparation of Payload Flight Safety Data Packages and Hazard Reports for Payloads Using the Space Shuttle.	4.3, 4.3.2
JSC 27472, Requirements for Submission of Data Needed for Toxicological Assessment of Chemicals and Biologicals to be Flown on Manned Spacecraft.	4.3.1.4, 6.3.1.a(7), 6.4.1.a(7), 6.5.1.a(7), 7.4.1, 7.4.2, 7.4.3
NSTS 14046, Payload Verification Requirements.	7.1.1
SSP 52005, ISS Payload Flight Equipment Requirements and Guidelines for Safety Critical Structures.	7.1.1
NSTS 08060, Space Shuttle System Pyrotechnic Specification.	7.3.2
NSTS 22648, Flammability Configuration Analysis for Spacecraft Applications.	7.4.3
NSTS 22254, Methodology for Conduct of Space Shuttle Program Hazard Analyses.	8.3

DOCUMENT NUMBERS AND TITLES	REFERENCED IN PARAGRAPH
KHB 1860.1, KSC Ionizing Radiation Protection Program.	7.5.1, 7.5.2, 7.5.3
KHB 1860.2, KSC Non-ionizing Radiation Protection Program.	7.6.1, 7.6.2, 7.6.3
SSP 50038, Computer-Based Control System Safety Requirements.	7.8c
JSC 20793, Crewed Space Vehicle Battery Safety Requirements.	7.11.2, 7.11.3
NASA-STD-5003, Fracture Control Requirements for Payloads Using the Space Shuttle.	7.13.1
NSTS 22254, Methodology for Conduct of Space Shuttle Program Hazard Analyses	10.1.1
SSP 50123, Configuration Management Handbook	10.1.2

APPENDIX B

ACRONYM LIST

ACRONYM LIST

ANSI	Approved American National Standard
ARHR	Acceptance Risk Hazard Report
ASE	Airborne Support Equipment
CDR	Critical Design Review
CITE	Cargo Integration Test Equipment
CM	Configuration Management
COFR	Certificate of Flight Readiness
COPV	Composite Overwrapped Pressure Vessels
CW	Continuous Wave
DFMR	Design for Minimum Risk
DSO	Detailed Supplementary Objective
DTO	Detailed Test Objective
EAR	Export Administration Regulations
FDS	Fire Detection and Suppression
FRR	Flight Readiness Review
GFE	Government Furnished Equipment
GOWG	Ground Operations Working Group
GSE	Ground Support Equipment
GSRP	Ground Safety Review Panel
HTD	HEDS Technology Demonstrations
ICD	Interface Control Document
IP	International Partner
ISS	International Space Station
ISSP	International Space Station Program
ITAR	International Traffic in Arms Regulations
JSC	Lyndon B. Johnson Space Center
KSC	John F. Kennedy Space Center
LASER	Light Amplification by the Stimulated Emission of Radiation
MDP	Maximum Design Pressure
MER	Mission Evaluation Room
MIP	Mandatory Inspection Point
MSMAP	Multilateral Safety and Mission Assurance Panel
MUA	Material Usage Agreement
NCR	Noncompliance Report
NASA	National Aeronautics and Space Administration
NHZ	Nominal Hazard Zone
NOHD	Nominal Ocular Hazard Distance
NSTS	National Space Transportation System

PDIM	Payload Developer and Integration Manager
PDR	Preliminary Design Review
PIM	Payload Integration Manager
PO	Payload Organization
PRCU	Payload Rack Checkout Unit
PSE	Payload Safety Engineer
PSRP	Payload Safety Review Panel
RF	Radio Frequency
RME	Risk Mitigation Experiment
SDP	Safety Data Package
SMP	Space Medicine Program
SORR	Stage Operations Readiness Review
SR&QA	Safety, Reliability, and Quality Assurance
SSP	Space Shuttle Program
SSP	Space Station Program
TIM	Technical Interchange Meeting
VTL	Verification Tracking Log

APPENDIX C

PRESSURE SYSTEM COMPLIANCE

Table 1 (EXAMPLE)

Pressure System Compliance

Components	Ultimate Strength (design burst pressure – (psig)[1]	Proof pressure (psig)	System MDP (psig)[2]	Ultimate Safety Factor - (design burst pressure divided by MDP)	Minimum Ultimate Safety Factor Required by '1700	Proof Factor (Maximum 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 compnents)	1000	150	100	1000/100 = 10	2.5	150/100 = 1.5	Bubble Soap	No Bubbles Detected
Lines and fittings					4			
Lines (list the different size lines)	5000	150	100	50	4	1.5	Bubble Soap	Bubbles Detected
Fittings (list the different fittings)	4000	150	100	40	4	1.5	Bubble Soap	Bubbles Detected
Pressure Vessel					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 analysis, test, or manufacturers rating

[2] Within a pressure system there may be more than one MDP

[3] If Proof factor is not equal to or greater than 1.5 X MDP explain the reason

[4] Describe the leak test method used (submersion in water, no bubbles; pressure decay, etc)

[5] Small pressure vessels may comply with ASME code, SF of 4 or greater, or space flight rated may be as low a SF of 2 (SF of 1.5 is no longer allowed)