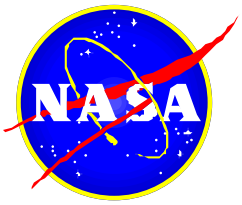

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas 77058

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System Safety Program Plan for the Human Research Facility

CCB CONTROLLED

LS-71002

PROJECT DOCUMENT APPROVAL SHEET

DOCUMENT NUMBER	DATE	NO. OF PAGES
LS-71002	7/24/98	8

TITLE:

System Safety Program Plan
for the
Human Research Facility

APPROVED:	SM4/C HAVEN TECHNICAL MONITOR	Signature On File	7/24/98
APPROVED:	SM4/D. GROUNDS HRF PROJECT MANAGER	Signature On File	7/24/98

DATE	PREPARED BY	CHANGE APPROVALS	CHANGE NUMBER

Report Number	LS-71002	**Date**	4 / 3 / 98

System Safety Program Plan for the Human Research Facility

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CONTENTS

ACRONYMS AND ABBREVIATIONS

CDR	Critical Design Review
EXPRESS	Expedite the Processing of Experiments to Space Station
FMEA	Failure Modes and Effects Analysis
GSE	Ground Support Equipment
HR	Hazard Report
HRF	Human Research Facility
HRs	Hazard Reports
IPR	Interim Process Review
ISS	International Space Station
IVT	Integrated Verification Test
JSC	Johnson Space Center
KSC	Kennedy Space Center
NASA	National Aeronautics and Space Administration
NSTS	National Space Transportation System
PDR	Preliminary Design Review
PPDR	Payload Preliminary Design Review
PRD	Program Requirements Documents
PSRP	Payload Safety Review Panel
SDP	Safety Data Packages
SIR	Standard Interface Rack
SR&QA	Safety, Reliability, and Quality Assurance
SSP	System Safety Program
SSPP	System Safety Program Plan
TDR	Technical Design Review
TIM	Technical Interchange Meeting

1.0 INTRODUCTION

The System Safety Program Plan (SSPP) for the Human Research Facility (HRF) clarifies requirements, responsibilities, and schedules for the development of Flight and Ground Safety Data Packages to ensure timely compliance with the Program Management Office requirements. The flight packages shall be submitted to the Johnson Space Center (JSC) Payload Safety Review Panel (PSRP). The ground package shall be submitted to Kennedy Space Center (KSC) ground safety review panel. Personnel at these two facilities have the responsibility for review and Hazard Report sign off. The JSC PSRP has responsibility for certification of all International Space Station (ISS) payloads.

The HRF is a facility class payload that consists of a suite of generic human life sciences hardware needed to support a multidisciplinary research program that encompasses basic, applied, and operations research. The HRF will include equipment to support research to understand the effects of weightlessness and the space environment on human systems and to develop, where appropriate, methods to counteract these effects to ensure safe and efficient crew operations.

Basic research and clinical investigations from both the intramural and extramural communities, as well as investigations from other federal agencies, and the international community will all be conducted using the HRF. All hardware elements to be used during the conduct of human research on ISS may not necessarily be included in the HRF racks. The ability to conduct thorough, multidisciplinary investigations will depend on the interaction of the Human Research Facility with ISS systems, the Crew Health Care System (CHeCS) program, and the Space Station Biological Research Project (SSBRP), as well as other hardware provided by the international partners. In addition, the HRF subsystems and experiment packages will be modular in design so that the HRF can be configured to meet many sets of research objectives for the duration of the ISS program.

The Program Requirements Document (PRD), LS-71000, “Program Requirements Document for Human Research Facility/International Space Station Program” classifies the HRF hardware as Medium Priority, Medium/High risk. The hardware criticality will be determined by Failure Modes and Effects Analysis (FMEA).

1.1 PURPOSE

This System Safety Program Plan (SSPP) defines the organization, process, and deliverables required to meet the System Safety milestones throughout the HRF project life cycle and establishes a systematic approach to the development and revision of the Safety Data Packages.

This SSPP describes the responsibilities of the Contractor System Safety Office to facilitate the timely development and submittal of the HRF Safety Compliance Data Packages from Phases 0, I, II and III through the National Space Transportation System (NSTS)/ISS safety certification process.

1.2 SCOPE

Program system safety includes all HRF supplied hardware hazard identification, control, and verification during ground handling, shuttle flight, transfer to ISS, on orbit installation, operations and maintenance, and return to earth. The hardware shall meet the requirements of KHB 1700.7A "Space Transportation System, Payload Ground Safety Handbook" and NSTS 1700.7B "Safety Policy and Requirements for Payloads Using the Space Transportation System" with the ISS addendum.

1.3 APPROACH

The HRF Expedite the Processing of Experiments to Space Station (EXPRESS) Rack safety data package, PSRP review, and certification will be provided by Marshall Space Flight Center (MSFC) through Phase II. The HRF hardware complement will be presented to the JSC PSRP by the JSC HRF Project Office. Phase III Flight Safety Review of the HRF integrated rack will be presented by the JSC HRF Project Office.

1.4 APPLICABLE DOCUMENTS

The following documents provide the requirements relevant to the preparation of Safety Compliance Data Packages.

JSC 11123	Space Transportation System Payload Safety Guidelines Handbook
JSC 26943	Guidelines for Preparation of Payload Safety Data Packages and Hazard Reports
KHB 1700.7B	Space Transportation System, Payload Ground Safety Handbook
MSFC-HDBK-0527/JSC-09604	Materials Selection List and Materials Documentation
NHB 8060.1C	Flammability, Odor, and Offgassing Requirements and Test Procedures for Materials in Environments that Support Combustion
NSTS 13830B	Implementation Procedure for NSTS Payloads System Safety Requirements
NSTS 1700.7B	Safety Policy and Requirements for Payloads Using the Space Transportation System with ISS Addendum
NSTS 18798	Interpretations of NSTS Payload Safety Requirements

2.0 SAFETY ORGANIZATION

The general responsibilities for members of the primary HRF safety project team are addressed in this section.

2.1 JSC HRF PROJECT MANAGER

Acts as the primary interface to the JSC and KSC PSRPs and as the prime signatory on payload Safety Data Packages (SDPs) and the associated hazard reports.

2.2 HRF SAFETY ENGINEER

Specific responsibilities of the HRF Safety Engineer are to (1) serve as the HRF safety technical contact; (2) identify and interpret system safety requirements; (3) prepare safety documentation for the HRF and science-related hazards or interface hazards; (4) incorporate all safety data into the HRF SDPs; and (5) submit required safety documentation to the JSC and KSC System Safety Offices in a timely manner.

3.0 SYSTEM SAFETY SCHEDULE

This plan is predicated on each HRF integrated rack and its complement of stowed payloads being taken before the PSRP as a payload package. Due to the number of hardware items within HRF, items will be presented to the PSRP in groups which will be selected based on the items PDR and CDR dates. Each hardware item will be a specific chapter within the SDP.

The template for the reviews shall be a draft of the Phase 0 flight SDP included with the Interim Process Review (IPR) package and review thereafter. The Phase I package will be included with the system PDR package. The draft Phase II flight SDP shall be included with the Critical Design Review (CDR) package. The review is approximately 45 days after the draft phase. Phase III review shall be scheduled for approximately 30 days before the beginning of rack integration. The Phase III ground review shall occur 30 days prior to shipment of the integrated rack to KSC.

4.0 SYSTEM SAFETY REQUIREMENTS/PRODUCTS

4.1 These are systems safety requirements and products:

- Identify and track safety hazards during the period from hardware requirements definition through design, development, and delivery of flight hardware for payload integration.
- Obtain technical information from any contractor building hardware for development of Hardware Hazard Reports.
- Coordinate safety data from International Partners providing hardware for HRF racks.
- Develop Phase 0, I, II, and III Flight and Phase 0/I/II and III Ground Safety Data Packages for HRF hardware items.

- Develop Phase III Flight and Ground Safety Data Package for the HRF integrated rack.
- Prepare, track, close-out payload Safety Hazard Reports for both Flight and Ground Safety Data Packages.
- Participate in and support equipment design reviews (PDR, CDR, TDR, etc.) and acceptance activities.
- Develop Safety Data packages and presentation material for phase 0, I, II, III, and TIM safety reviews
- Review all proposed configuration changes for safety impact and participate as an active member in Configuration Control Board meetings

4.2 SAFETY DOCUMENTATION ACTIVITIES

Appendix "A" flow charts show the process of creating and updating a flight safety package for presentation at Flight Safety Reviews.

Phase 0/I Flight review normally coincides with the PDR. (If Phase 0 package is submitted, then the review is a working group meeting rather than a full safety review.) The phase package shall consist of, as a minimum, a conceptual payload description, mission scenario, description of safety-critical subsystems with operations, and HRs. The description shall be of sufficient detail to permit identification of all subsystems, especially those with stored energy, which may create hazards.

The HR shall have the description of the hazard and hazard causes identified. Other safety forms required for a safety package include JSC Form 1230, Flight Payload Standardized Hazard Control Report, JSC Form 542B, Payload Hazard Report, JSC Form 44, Ionizing Radiation Source Data Sheet Space Flight Hardware and Applications.

A document number shall be assigned at Phase 0 and used throughout the entire phase updates. At each phase, the package shall reflect the next revision number. After all the redlines have been incorporated and final editing is completed (such as, table of contents, page numbers, and other such items), the package shall be sent to reproduction for copies to be made.

After each safety review, the action items shall be tracked and incorporated into the next safety package. When the package is submitted, action item closures shall be identified.

Before each PSRP meeting, presentation material shall be made and original HRs shall be available for signature at the safety review.

The Phase I Flight package is updated to a Phase II Flight package by incorporation of the latest hardware information including additional drawings, pictures, wiring diagrams and other such items. The HRs are updated and Safety Verification Methods are added. The safety review occurs within the same time frame as the CDR. Open items shall be closed prior to launch vehicle integration (L-3 month).

Phase III reviews shall be at the Payload Integration Readiness Review. The description shall accurately reflect the hardware as-built and the Status of Verification shall be completed. For items not closed, these should be transferred to the Payload Safety Verification Tracking Log, (JSC Form 764, NSTS Payload Safety Verification Tracking Log).

A Delta Phase III Flight Safety Review or Technical Interchange Meeting (TIM) may be held at approximately L-3 months if significant changes occur or anomalies have been encountered during test and integration. Changes since Phase III shall be presented to the PSRP.

GROUND SAFETY DOCUMENTATION PROCESS

The KSC requirements for International Space Station (ISS) are TBD. The Ground Safety Data package shall include the payload description, mission scenario, description of Ground Support Equipment (GSE), ground handling procedures, ground HRs (such as radiation or toxic materials). Only two reviews are planned; Phases 0/I/II and III. The reviews shall be by telecon after receipt of comments from KSC.

5.0 RISK MANAGEMENT

By definition, system safely is, “The optimum degree of risk management within the constraints of operational effectiveness, time and cost attained through the application of management and engineering principles throughout all phases of a program”. Risk management provides the least amount of risk, or the maximum amount of safety through the management of the safety and engineering design effort. Safety shall be designed into the hardware by material selection and controls that meet PSRP approval. All potential contaminates and toxins shall have multiple containment consistent with the degree of hazard. All stored energy devices such as pressure vessels shall have margins of safety consistent with NSTS 1700.7B ISS addendum and batteries shall be approved by Battery Working Group. All electronic failures by design, shall be “soft” failures. All protocols involving human subjects will be in compliance with the “Human Research Policy and Procedures for Space Flight and Related Investigations” and approved by the NASA JSC Institutional Review Board.

6.0 VERIFICATIONS

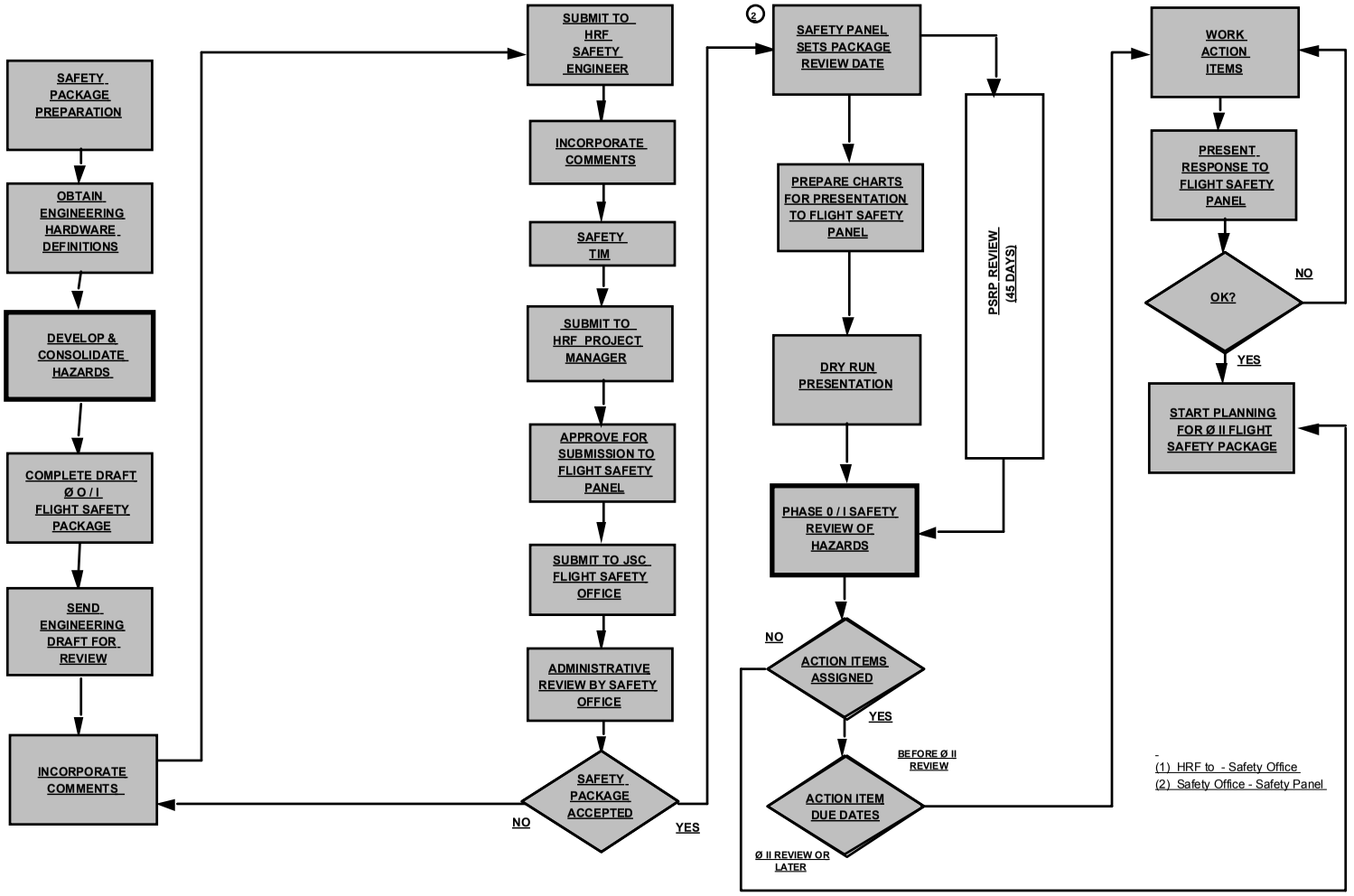
Quality Assurance personnel shall have the primary responsibility for fabrication verification and engineering for inhibits and controls designed into the hardware. Integration Verification shall be the responsibility of the Integration Engineer with assistance of the Safety Engineer. On orbit installation verification shall be in accordance with the Verification Plan Procedures established by the HRF Integration Engineering.

APPENDIX A

HRF FLIGHT SAFETY PACKAGE DEVELOPMENT

PHASE 0 / I

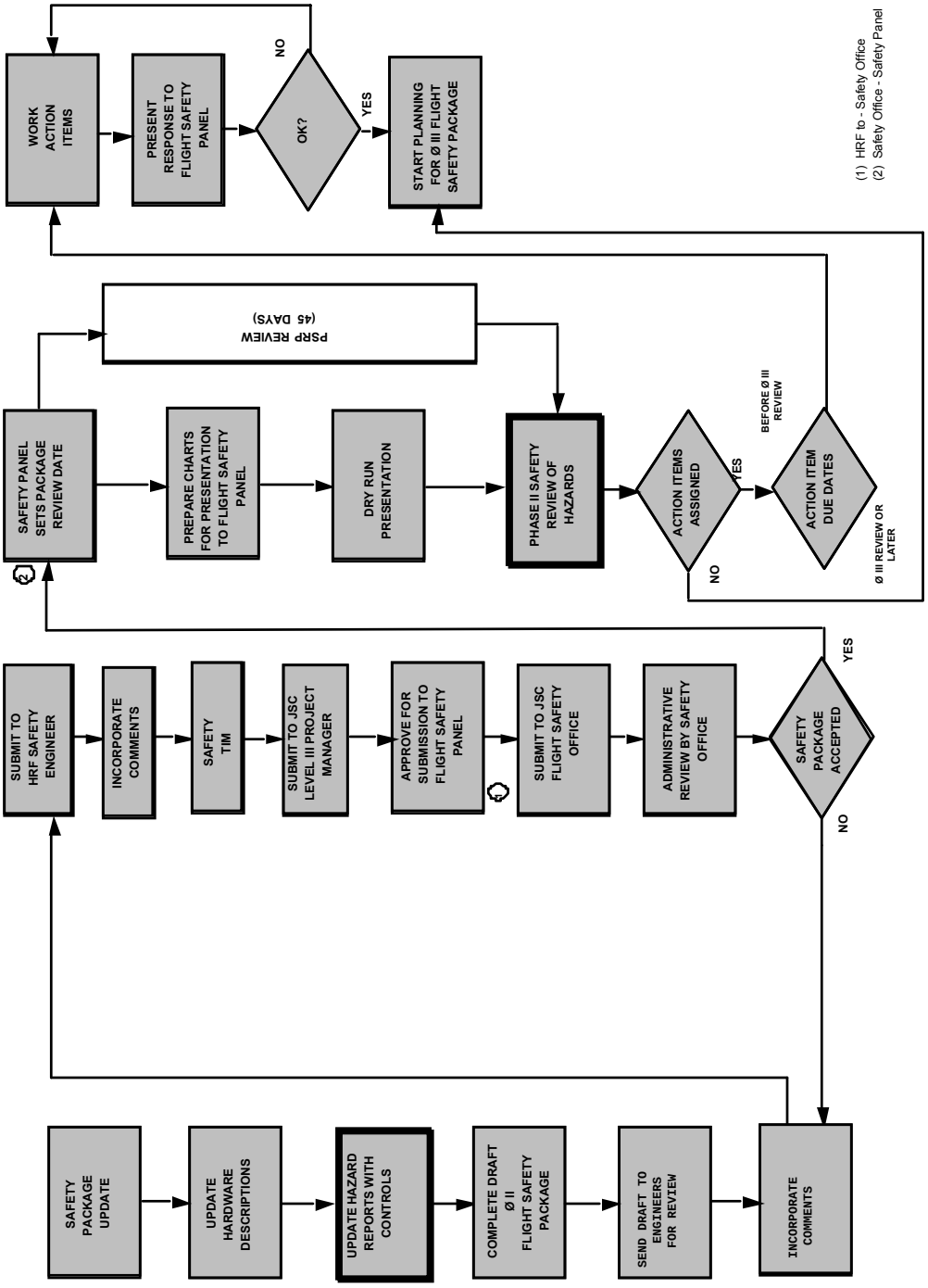
IDENTIFICATION OF HAZARDS



HRF FLIGHT SAFETY PACKAGE DEVELOPMENT

PHASE II

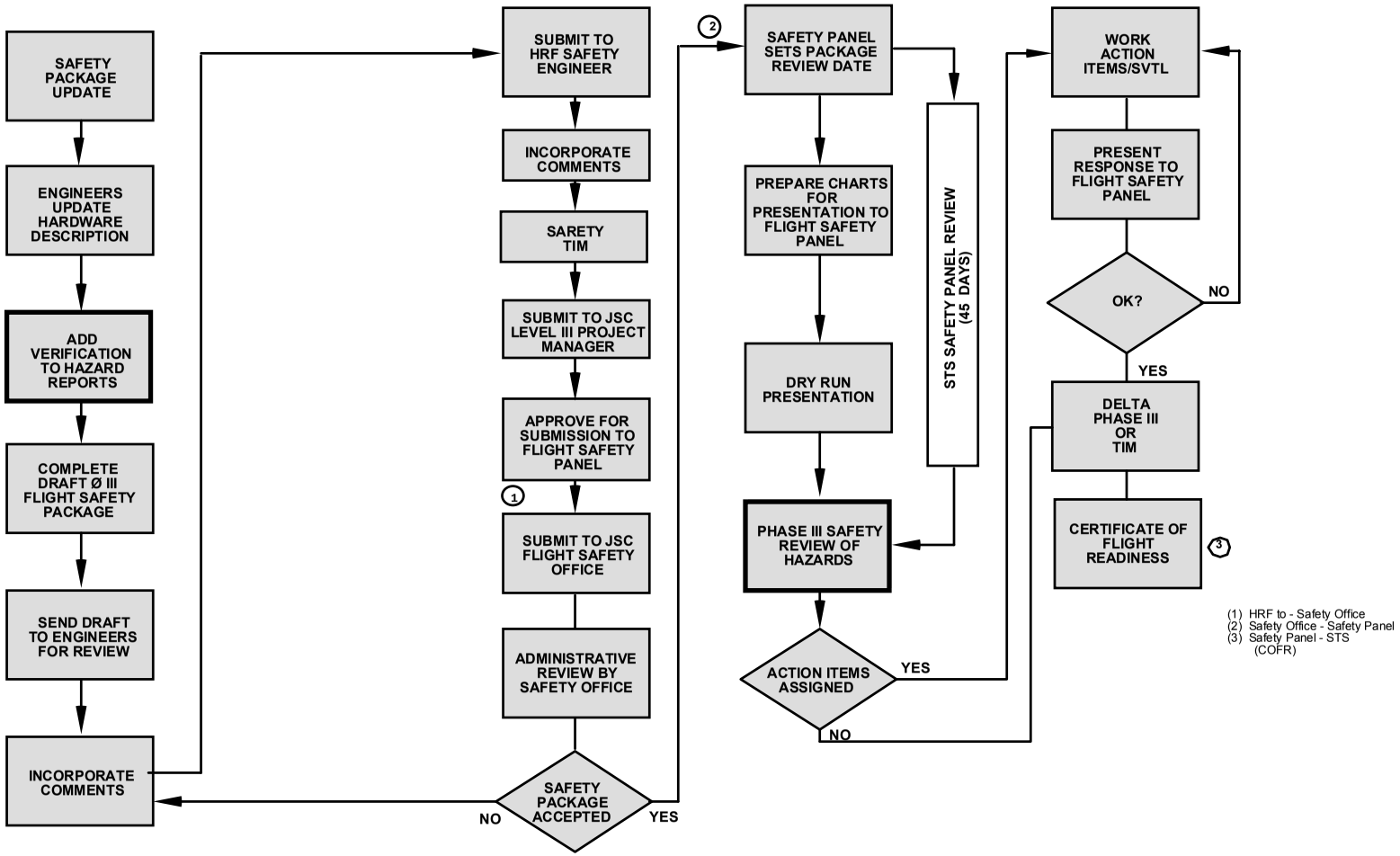
IDENTIFICATION OF CONTROLS FOR HAZARDS



HRF FLIGHT SAFETY PACKAGE

PHASE III

VERIFICATION OF CONTROLS FOR HAZARDS



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