SSP 30223

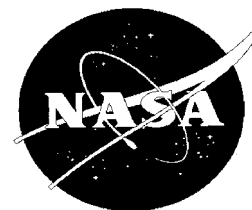# Problem Reporting and Corrective Action for the Space Station Program

International Space Station Program

Revision J
May 29, 2000

Type 1

National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
Houston, Texas
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Rev. H	Revision J reflecting technical clarification agreements.	09-30-99
Rev. J		02-29-00

ii

INTERNATIONAL SPACE STATION PROGRAM
PROBLEM REPORTING AND CORRECTIVE ACTION REPORTING FOR THE SPACE STATION
PROGRAM
MAY 29, 2000

PREFACE

Design, manufacturing, and operational discrepancies discovered in International Space Station (ISS) hardware are resolved through use of an organized system of problem reporting, analysis, resolution, and trending. This document establishes requirements and responsibilities for establishing and operating the Space Station Problem Reporting and Corrective Action (PRACA) system as required by SSP 41173, Space Station Quality Assurance Requirements. The implementation of these requirements provide for effective recurrence control, provides experience data retention, and minimizes the technical and schedule impact of problems.

The objective of the ISS PRACA system is to utilize existing National Aeronautics and Space Administration (NASA), Contractor, Payload Developer, and International Partner/ Participant (IP/P) engineering and management infrastructure for problem resolution and disposition.

The requirements of this document shall apply to the NASA International Space Station Program Office (ISSPO), the ISS Prime Contractor, and NASA/ Prime organizations responsible for providing equipment or processing to be used as a part of the ISS system. These requirements cover the reporting, processing and resolution of all problems on equipment for which the ISSPO, including the ISS Payloads Office, and Government Furnished Equipment (GFE) offices have responsibility.

The IP/Ps shall maintain a Problem Reporting system as defined in the NASA/ International Partners/ Participants Bilateral Agreements.

The contents of this document are intended to be consistent with the tasks and products to be prepared by Program participants. The Problem Reporting and Corrective Action Requirements for the International Space Station Program shall be implemented on all new ISS contractual and internal activities and shall be included in existing contracts through contract changes. This document is under the control of the International Space Station Safety and Mission Assurance (S&MA) Panel, and changes or revisions to this document will be approved by the NASA and Prime S&MA Managers (or delegated representatives).

INTERNATIONAL SPACE STATION PROGRAM
PROBLEM REPORTING AND CORRECTIVE ACTION REQUIREMENTS FOR THE SPACE STATION PROGRAM
MAY 29, 2000

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INTERNATIONAL SPACE STATION PROGRAM
PROBLEM REPORTING AND CORRECTIVE ACTION REQUIREMENTS FOR THE SPACE STATION PROGRAM

LIST OF CHANGES

MAY 29, 2000

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

ENTRY DATE	CHANGE	PARAGRAPH (S)
October 26, 1994 F		1.3, 3.1, 3.2, 3.2.1, 3.2.2, 3.3, 4.1.3,
		4.1.3.1, 5.0, 5.3, 5.4, 6.1, 6.3, A.1, B.1
May 6, 1998	G	All Paragraphs
September 30, 1999	H	2.1, 3.1, 3.2.2, 3.2.3, 3.3, 3.3.1, 3.3.2, 4.2, 5, 9, A.1,
		B.1
February 29, 2000	J	All Paragraphs

v

TABLE OF CONTENTS

1. INTRODUCTION

1.1 PURPOSE

The purpose of this document is to define the requirements of the International Space Station (ISS) Problem Reporting and Corrective Action (PRACA) system.   ISS PRACA provides a closed-loop process for the reporting, processing, dispositioning, and documenting corrective action(s) for problems involving ISS hardware, payloads, and ground support equipment (GSE). The goal is to assure that all reportable problems are evaluated and the appropriate corrective actions taken in a timely and cost effective manner.

The ISS PRACA Data System (PDS) is the database that allows for the reporting of problems defined in this document.   The ISS PDS shall be accessible to everyone under the scope of these requirements. The ISS PDS shall provide the ability to access failure history, allow for the identification of trends and statistics, and provide engineering data for corrective action and design improvement.

The ISS PRACA process for hardware problems is addressed herein. The process for software problems is documented in SSP 50200-01-AnxD, Station Program Implementation Plan Volume 1: Station Program management Plan Annex D: Avionics & Software Office Plan.

1.2 SCOPE

The requirements in this document apply to all elements and sites involved in the manufacture, assembly, handling, testing, use, or repair of ISS hardware, payloads, or GSE equipment with the following exceptions:
  (1) Requirements for the International Partners/ Participants are defined in NASA/ IP/P Bilateral S&MA Requirements documents and NASA/ IP/PsBilateral Data Exchange Agreements, Lists and Schedules documents;
  (2) Johnson Space Center (JSC) GFE shall follow the PRACA requirements and processes established in JSC 28035;
  (3) Software problems shall follow the PRACA requirements and processes established in SSP 50200-01-AnxD;
  (4) Payload problems are only required to report Level 1 problems; and
  (5) On-orbit problems are entered directly into the ISS Problem Partition.

ISS development and sustaining organizations shall specify those activities and processes necessary to comply with the requirements set forth in this document by developing and implementing command media (program directives, procedures, bulletins, etc.) to encompass the scope of their operations and responsibilities for the PRACA process.

1-1

2. DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents of the date and issue shown include specifications, models, standards, guidelines, handbooks, and other special publications. "Current Issue" is shown in parentheses in place of the specific date and issue when the document is under International Space Station Control Board control or the JSC document control system. The status of documents identified by "Current Issue" may be determined from the International Space Station Program Baseline Activity Index and Status Report.

The documents in this paragraph are applicable to the extent specified herein.

DOCUMENT NO.	TITLE
D684-10530-01 Current Revision	PRACA Implementation Procedure
JSC 28035 Current Revision	JSC Government-Furnished Equipment (GFE) Problem Reporting and Corrective Action (PRACA) Requirements
SSP 30234 Current Revision	Failure Modes and Effects Analysis and Critical Items List Requirements for Space Station
SSP 30524 Current Revision	Problem Reporting and Corrective Action (PRACA) Data System (PDS) Requirements Definition Document (RDD) for the Space Station Program.
SSP 41173 Current Revision	Space Station Quality Assurance Requirements
SSP 50200-01-AnxD Current Revision	Station Program Implementation Plan (SPIP) Volume 1: Station Program Management Plan Annex D: Avionics & Software Office Plan
SSP 50431 Current Revision	Space Station Program Requirements for Payloads (PRP)

2.2 ASSOCIATED WEB SITE

The JSC Intranet website that supports ISS PDS may be accessed through the PRACA homepage at address: http://iss-www.jsc.nasa.gov/ss/issapt/praca

All JSC on-site and off-site employees and contractors have access to the JSC Intranet and the PRACA homepage. Refer to SSP 30524 for information on obtaining access to the JSC Intranet.

3. HARDWARE PROBLEM REPORTING AND CORRECTIVE ACTION

The ISS PRACA database shall warehouse program nonconformance records that meet established criteria. This gives the ISS program the capability to address the long-term goals of identifying hardware trends, supporting on-orbit anomaly resolution, and providing management visibility into significant problems. A subset of these nonconformances shall be "promoted" to the status of a problem report in the PDS providing NASA the means to be involved and approve the failure analyses and recurrence control activities. Figure 3-1 depicts an overview of the process for ISS hardware.
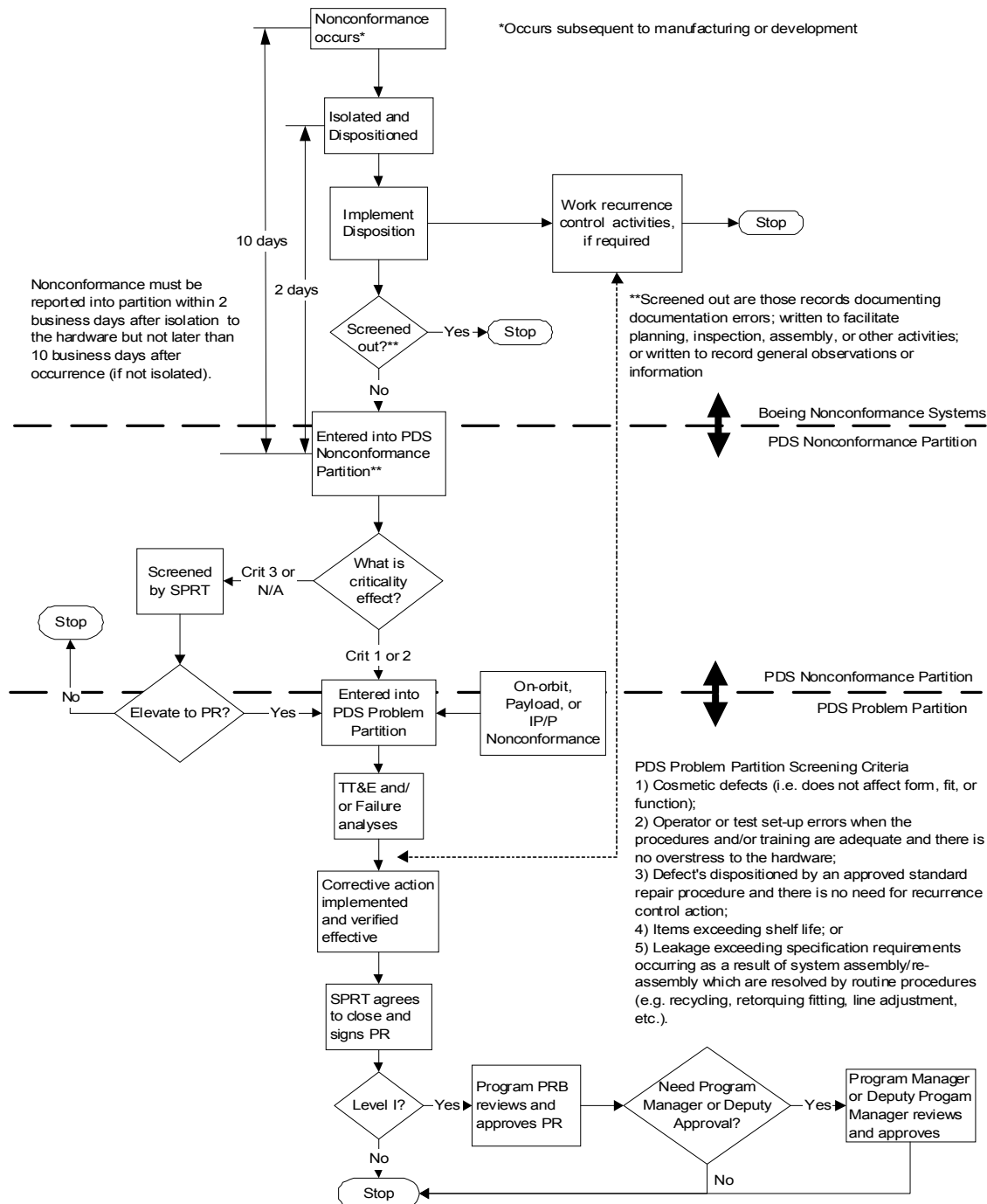
Figure 3-1: Hardware Problem Reporting Process

3-1

3.1 Entering Nonconformance In PDS Nonconformance Partition

Whenever hardware that is representative of the flight hardware to be used on the ISS fails to meet its' specification or is overstressed; a nonconformance report shall be written to document and disposition the condition. This applies to all hardware indenture levels. Nonconformances that occur on hardware that is representative of flight hardware subsequent to manufacturing shall be entered into the ISS PDS Nonconformance Partition. Nonconformance records that shall not be entered are those documenting documentation errors; written to facilitate planning, inspection, assembly, or other activities; or written to record general observations or information.

> Note: "Representative of flight hardware" means Flight hardware (including qualification/proto-flight/flight-like hardware but not Flight Equivalent Unit (FEU)), Flight spares, Flight Support Equipment (FSE), Orbital Support Equipment (OSE) (including Laboratory Support Equipment (LSE)) and safety critical GSE.

Trend codes shall be added to all nonconformance records in the PDS Nonconformance Partition. These codes are the subsystem, criticality, defect, and cause codes per SSP 30524. After coding, those records that will not be promoted require no additional work in the ISS PDS system.

Nonconformance records shall be entered into the PDS Nonconformance Partition within two (2) business days after the nonconformance is isolated to the flight representative hardware but no later than ten (10) business days after *occurrence/detection.*

Should a nonconformance occur which potentially jeopardizes the flight crew's safety, ground crew's safety, or mission success, then the NASA SPRT co-chair shall be notified as soon as possible but not to exceed twenty four (24) hours after occurrence/detection. The NASA SPRT co-chair is responsible for notifying the ISS Program Office of the situation and, if appropriate, the Mission Evaluation Room manager.

3.2 Promoting/Entering Problem In PDS Problem Partition

A nonconformance in the PDS Nonconformance Partition shall be promoted to the PDS Problem Partition when the failure effect criticality is 1, 1R, 1S, 1SR, 1P, 2, or 2R (per SSP 30234) or when the assigned System Problem Resolution Team (SPRT) determines there is a need to document the failure analyses and recurrence control action(s) based on trend data, past experience, or the significance of the nonconformance should it recur on-orbit. Nonconformance records shall not be promoted for the following unless directed by the System Problem Resolution Team (SPRT):

1) Cosmetic defects (i.e. does not affect form, fit, or function);
2) Operator or test set-up errors when the procedures and/or training are adequate and there is no overstress to the hardware;
3) Defect's dispositioned by an approved standard repair procedure and there is no need for recurrence control action;
4) Items exceeding shelf life; or
5) Leakage exceeding specification requirements occurring as a result of system assembly/re-assembly which are resolved by routine procedures (e.g. recycling, retorquing fitting, line adjustment, etc.) and no recurrence control action required.

Nonconformances that are not entered in the PDS Nonconformance Partition shall be entered directly into the PDS Problem Partition per the above requirements.

On-orbit hardware anomalies shall be processed directly into the PDS Problem Partition. However, the following list of anomalies are not required to be reported into the PDS Problem Partition:

1) Unexpected hardware performance that is within specification limits;
2) Hardware failures due to incorrect Crew operations if no damage or overstress exists;
3) Planned maintenance;
4) Explained Caution & Warning indications if no hardware failure exists;
5) Unexpected, incorrect, or inconsistent telemetry if no hardware failure exists;
6) Ground data does not match on-orbit data if no hardware failure exists but can be explained;
7) Vehicle (e.g., Orbiter) failures that do not cross ISS boundaries;
8) Ground facility nonconformances (e.g. Mission Control Center).

3.3 Assigning Levels

Nonconformance records promoted to the PDS Problem Partition shall be classified as Level 1 or Level 2. Level 1 problems are those meeting any one of the following criteria:

1) The failure effect criticality is 1, 1R, 1S, 1SR, 1P, 2, or 2R <u>and</u>
   a) The root cause can not be identified,
   b) Corrective or recurrence control actions, although appropriate for the problem, will not be implemented,
   c) System Problem Resolution Team (SPRT) recommends termination of failure investigation prior to firm determination of root cause,
   d) The problem is not detectable at qualification testing, acceptance testing or inspection, or during the normal service of the component, or
   e) The problem condition is not fully restored to compliance and a "use as is" disposition is proposed.
2) The problem occurrence or its' resolution impacts a launch schedule or on-orbit assembly sequence;
3) The problem affects a functional/physical interface between ISS Prime Contractor, Payload, GFE, and/or IP/P hardware;
4) The problem affects common hardware used by payloads (per SSP 50431); or
5) System Problem Resolution Team (SPRT) determines that Level 1 approval is required.

If the problem report does not meet any of the Level 1 criteria, the problem report is considered a Level 2 problem.

NOTE: When a PR closure is implementing a Program Change Directive (e.g. modification, waiver, exception, etc.) approved by a Program board or panel that would normally have Level 1 authority for the PR closure, the PR may be closed by the Level 2 SPRT with the approved change and supporting documentation attached to the PRACA report.

3.4 Problem Resolution Responsibilities

System Problem Resolution Teams (SPRTs) shall be established and chartered by the ISS Program Office. The SPRTs are responsible for:

1) Evaluating records in the PDS Nonconformance Partition to identify trends;
2) Promoting records to the PDS Problem Partition;
3) Identifying the flight(s)/stage(s) affected; classifying the problem's level;
4) Developing test, teardown, and evaluation (TT&E) and/or failure analyses plans to identify the root cause;
5) Determining the corrective action(s) necessary to prevent recurrence of the problem;
6) Ensuring the verification of the implementation and effectiveness of the corrective action(s);
7) Ensuring the data entered into the PDS Problem Partition is accurate and complete to support future failure history investigations and trending efforts;
8) Coding problem reports to support trending;
9) Closing or presenting to the Program for closure all open problems in the PDS Problem Partition for the respective system, in a timely manner; and
10) Performing trending analyses to identify preventative or maintenance actions.

The appropriate Program Problem Review Boards (PRBs) shall be established and chartered by the ISS Program Office. The Program PRBs are responsible for reviewing and approving the problem reports classified as Level 1.

3.5 Closing Problems

A problem shall be closed when the article in question has been dispositioned, a root cause has been identified, adequate corrective action has been defined, implemented, and verified as effective for preventing recurrence of the problem. In the event corrective action is not implemented, the problem closure must address the root cause or a

most probable cause, rationale for not implementing corrective action, and the consequences of the problem recurring on-orbit. This includes the methods of detection on-orbit, the mission effects, operational workarounds, and methods of recovery.

SSP 30223

APPENDIX A - ABBREVIATIONS AND ACRONYMS

CFE	Contractor Furnished Equipment
FEU	Flight Equivalent Unit
FSE	Flight Support Equipment
GFE	Government Furnished Equipment
GSE	Ground Support Equipment
IP/P	International Partner/ Participant
ISS	International Space Station
ISSPO	International Space Station Program Office
JSC	Johnson Space Center
LSE	Laboratory Support Equipment
MRB	Material Review Board
NASA	National Aeronautic and Space Administration
OSE	Orbital Support Equipment
PDS	PRACA Data System
PR	Problem Report
PRACA	Problem Reporting and Corrective Action
PRB	Problem Review Board
PRP	Program Requirements for Payloads
RDD	Requirements Definitions Document
S&MA	Safety and Mission Assurance
SE	Sustaining Engineering
SPRT	System Problem Resolution Team
TT&E	Test, Teardown and Evaluation

SSP 30223

APPENDIX B - DEFINITIONS

Definitions of technical terms related to the ISS PRACA system are as follows:

Acceptance Testing - Tests to determine that a part, component, subsystem, or system is capable of meeting performance requirements prescribed in purchase specifications or other documents specifying what constitutes the adequate performance capability for the item in question. Refer to SSP 41173.

Adverse Trend - A problem detected during trend analysis by the design or user cognizant organization for hardware nonconformance, which has been shown to need recurrence control.

Anomaly - An unexpected event, hardware damage, a departure from past experience, established procedures or performance, or a deviation of system, subsystem, and/ or hardware performance outside certified design/ performance specification limits.

Approved Standard Repair – Specific repair instructions as documented on the nonconformance record and approved by the Material Review Board (MRB) prior to the repair activity.

Closed Problem - A problem is closed when NASA concurs with the problem analysis (including determination of the cause) and the corrective action to preclude recurrence of the problem is implemented or acceptable rationale is provided for not implementing corrective action.

Contractor-Furnished Equipment (CFE) - Hardware provided under the International Space Station Program (SSP) end item hardware contract by the ISS Prime Contractor.

Corrective Action – An action(s) taken to eliminate the root cause of a problem to prevent its recurrence.

Criticality - per SSP 30234

The FMEA shall include criticality category assignments for the effects of all failure modes considered in the applicable mission phases. The criticality should be assigned based on the identified effects on the SS/ Crew. Prime shall document the assumptions used in relating functional loss to crew effects. In the event failure tolerance has not been allocated to an end item, then the Prime may assume that the redundancy is provided at the segment level and assign the criticality based on this assumption.

Criticality categories are as follows:

Category	Definition
1	Single failure point that could result in loss of Space Station (SS) or loss of flight or ground personnel.
1R	Redundant items, all of which if failed, could result in loss of ISS or loss of flight or ground personnel.
1S	A single failure point of the system component designed to provide safety or protection capability against a potentially hazardous condition or event or a single failure point in a safety or hazard monitoring system that causes the system to fail to detect, or operate when needed during the existence of a hazardous condition that could lead to loss of flight or ground personnel or ISS (e.g., fire suppression, medical hardware, etc.)
1SR	Redundant components designed to provide safety or protection capability against a potentially hazardous condition or event, all of which if failed could cause the system to fail to detect, or operate when needed during the existence of a hazardous condition that could lead to loss of flight or ground personnel or SS; OR redundant components within a safety or hazard monitoring system, all of which if failed could cause the system to fail to detect, or operate when needed during the existence of a hazardous condition that could lead to loss of flight or ground personnel or SS.

B-1

SSP 30223

1P	A single failure point which is protected by a safety device, whereby the proper functioning of the safety device, would prevent the hazardous consequences of the failed (protected) component.
2	Single failure point that could result in loss of critical mission support capability.
2R	Redundant items, all of which if failed, could result in loss of critical mission support capability.
3	All others.

The criticality categorization of a failure mode shall be made on the basis of the worst–case potential failure effect regardless of probability of occurrence. For 1R, 1SR, and 2R items, the number of valid success paths, at the associated level of integration, which are available to accomplish the function as well as the number required to meet failure tolerance requirements shall be identified (reference SSP 30234 Appendix C, Items 32 and 33).

Failure - The inability of a system, subsystem, component, or part to perform its specified function within specified limits, under specified conditions, and for a specified duration.

Flight Constraint - Unacceptable risk to mission or safety that causes a constraint to be placed on the applicable flight.

Flight Equivalent Unit (FEU) - Hardware utilized to functionally demonstrate or simulate flight hardware operations. Hardware configuration does not necessarily match flight configuration.

Flightlike Hardware – Non-flight equipment which is built to the following:
a) Manufacturing processes, which are identical or significantly similar to those, utilized in flight equipment.
b) Contain parts or assemblies which are identical or significantly similar* in design to flight hardware (includes manufacturing processes at the piece part level).
c) Equipment whose design (electrical or mechanical) is identical or significantly similar* to flight equipment when such design is critical to functional performance.

> * Significantly similar is defined as commonality between parts, processes, or design such that the differences have no impact on the final performance of the equipment (e.g., solder, SN60 vs. SN63, has no difference to eventual equipment performance).

Government-Furnished Equipment (GFE) - Equipment in the possession of, or directly acquired by, the government from suppliers other than the ISS Prime Contractor and subsequently made available to the ISS Program.

Ground Support Equipment (GSE) - Ground-based equipment functionally designed to support flight hardware servicing, checkout, test, movement, alignment, protection, or calibration. GSE will be delivered to the government.

International Partner/ Participant (IP/P) - Those non-U.S. space agencies that formally participate in the ISS Program.

Laboratory Support Equipment (LSE) - LSE are devices that are shared on a non-interference basis by multiple research users. LSE varies in size and complexity from a simple thermometer to full size ISPR containing a refrigerator/freezer.

SSP 30223

Launch Processing Constraint - The specific event beyond which processing cannot proceed without incorporation of required remedial action or recurrence control.

Nonconformance - A condition of any article or material in which one or more characteristics do not conform to requirements. Includes failures, discrepancies, defects, malfunctions and problems.

Nonflight Like Hardware - Hardware which, although similar to flight equipment, does not contain parts, processes, or design which are identical or significantly similar* to those utilized in flight hardware.

> *Significantly similar is defined as commonality between parts, processes, or design such that the differences have no impact on the final performance of the equipment (e.g., solder, SN60 vs. SN63, has no difference to eventual equipment performance).

On-orbit Anomaly - An on-orbit anomaly may be detected during on-orbit International Space Station stage operations.

Overstress - A value of any stress parameter in excess of the upper or lower limit of the normal working range or in excess of rated value.

Payload - Any space equipment, flight hardware, or material designed to conduct either coherent sets of experiments (e.g., "Facility Class" instruments) or individual experiments and payload support equipment.

Primary Structure – Provides carriage for the major structural loads of the element (e.g., Node, Lab, Truss, etc.)

Prime Contractor - The organization under contract to NASA for the for design, manufacture, delivery, and integration of ISS contract end items.

Problem – A nonconformance which is, or is suspected of being, a failure, an unsatisfactory condition, an unexplained anomaly, or an overstress occurring during or subsequent to production acceptance testing or qualification testing (i.e. after manufacturing or development).

Problem Reporting and Corrective Action (PRACA) - A management system for identifying, reporting, analyzing for cause, remedying, and preventing recurrence of problems.

Problem Review Board - A problem review board is an existing board or panel (e.g., Material Review Board, Avionics and Software Control Board, Vehicle Systems Integration Panel, Space Station Program Control Board) which exercises approval authority to close a problem report depending on the level of the problem.

Qualification Hardware - Hardware (that includes flight-like hardware) manufactured for the express purpose of undergoing qualification testing.

Qualification Test - Those tests conducted as a part of the certification program to demonstrate that design and performance requirements can be realized under specified conditions.

Recurrence Control - Action taken to prevent repetition of a nonconformance. This action may involve one or more of the following:
a) Design change
b) Manufacturing method/ procedure/ process change
c) Facility/ test equipment change
d) Test, inspection or operating procedure change
e) Training or certification of personnel
f) Maintenance procedure change
g) Limit time or cycle of component
h) Transportation, handling or shipping change

B-3

SSP 30223

i)   Software change or firmware change

<u>Responsible Organization</u> – The Hardware Developer, Payload Developer, or the organization responsible for the sustaining engineering (SE) of the hardware.

<u>Root Cause</u> - The underlying reason for, or cause of, one or more nonconformances or deficiencies identified through investigations and studies which, when corrected, will prevent or reduce the recurrence of the realized or potential nonconformance(s) deficiency(ies).

<u>Safety Critical GSE</u> – GSE necessary to support the program, the failure of which could cause loss of vehicle system or loss of personnel capability. In addition, GSE used in direct contact with hypergolic, cryogenic, explosive, flammable, toxic, corrosive, or harmful material or fluids, equipment using ordinance devices, or devices used for ordinance checkout, equipment using high internal pressure, high electrical energy, high flow volume, high temperature or radiant energy, equipment with high-speed dynamic components in its operation, and hoisting equipment, are considered safety critical. This definition also includes electrical equipment that operate in areas where flammable gases and/or vapors may be present, or where electrical equipment is utilized for control of safety critical GSE. This also includes personnel rescue equipment.

<u>Severity</u> – To be provided

<u>System Problem Resolution Team</u> – A defined group whose purpose is to streamline the process of managing PRACA reportable problem dispositions by integrating NASA/ISS Prime Contractor/IP/P authority into a single entity capable of providing the final disposition of a reportable problem in an effective and timely manner.

<u>Unsatisfactory Condition</u> – Any nonconformance for which engineering resolution is required and which requires recurrence control beyond the specific article under question. Included in this definition are:
    1.   Conditions which cannot be corrected to the specified configuration using standard repair procedures; or
    2.   An event which could lead to a failed condition but does not affect the function of the article such as contamination, corrosion, workmanship, process escape, etc.

<u>Unexplained Anomaly</u> – An anomaly that cannot be repeated (phantom or ghost) or for which a cause cannot be determined.