DIRECTIVE NO. 300-PG-7120.2.2E

EFFECTIVE DATE: May 3, 2005

EXPIRATION DATE: May 3, 2010

Preparation Information:

Perform and document a PHA, based on the hazard assessment criteria provided in Chapter 3 of NPR 8715.3, to obtain an initial risk assessment of the system. Based on the best available data, including mishap data (if assessable) from similar systems and other lessons learned, hazards associated with the proposed design or function shall be evaluated for hazard severity, hazard probability, and operational constraint. Safety provisions and alternatives needed to eliminate hazards or reduce their associated risk to an acceptable shall be included. The PHA shall consider the following for identification and evaluation of hazards at a minimum:

a. Hazardous components.

b. Environmental constraints including the operating environments.

c. Operating, test, maintenance, built-in-tests, diagnostics, and emergency procedures.

d. Facilities, real property installed equipment, support equipment.

e. Safety related equipment, safeguards, and possible alternate approaches.

f. Safety related interface considerations among various elements of the system. This shall include consideration of the potential contribution by software to subsystem/system mishaps. Safety design criteria to control safety-critical software commands and responses shall be identified and appropriate action taken to incorporate them in the software (and related hardware) specifications.

g. Malfunctions to the system, subsystems, or software. Each malfunction shall be specified, the causing and resulting sequence of events determined, the degree of hazard determined, and appropriate specification and/or design changes developed.

h. Include a system description and a description of the methodology used to develop the analysis.

15.6 DID 3-4: OPERATIONS HAZARD ANALYSIS

Title: Operations Hazard Analysis	CDRL No.: 3-4

Reference:

MAG, Paragraph 3.2.3.2

Use:

The Operations Hazard Analysis (OHA) addresses the implementation of safety requirements for personnel, all procedures, and equipment used during, testing, transportation, storage, and integration operations.

Related Documents:

a. 540-PG-8715.1.1 and 1.2, Mechanical Systems Safety Manual" Volume I and II

Place/Time/Purpose of Delivery:

Deliver the OHA to the Project Safety Manager 45 days prior to PER .

During I&T activities a Hazard Tracking Log shall be used to track and close all remaining open items.

GSFC OSSMA will review/approve the OHA and Hazard Tracking Log (HTL) prior to initiating any I&T activities.

NOTE: Closure methodology for the HTL mentioned above is the same as what is in DID 3-7 for the VTL.

Preparation Information:

Contents. The OHA shall include the following information:

1.0 Introduction

a. Provide an abstract summarizing the major findings of the analysis and the proposed corrective or follow-up actions.

b. Define any special terms, acronyms, and/or abbreviations used.

2.0 System Description

a. Provide a description of the system hardware and configuration. List components of subsystems.

b. The most recent schedules for integration and testing of the instrument/spacecraft.

c. Photographs, diagrams, and sketches should be included to support the test.

3.0 Analysis of System Hazards

a. The analysis shall identify all real or potential hazards presented to personnel, equipment, and property during I&T processing.

b. A listing of all identified hazards shall be provided in a tabulated format. Each hazard shall be numbered and shall include the following information:

(1) System Component/Phase. The particular phase/component that the analysis is concerned with. This could be a system, subsystem, component, operating/maintenance procedure or environmental condition.

Preparation Information (continued):

(2) System Description and Hazard Identification, Indication.

(a) A description of what is normally expected to occur as the result of operating the component/subsystem or performing the operating/maintenance action.

(b) A complete description of the actual or potential hazard resulting from normal actions or equipment failures. Indicate whether hazard will cause personnel injury and/or equipment damage.

(c) A description of crew indications which include all means of identifying the hazard to operating or maintenance personnel.

(d) A complete description of the safety hazards of software controlling hardware systems where the hardware effects are safety critical.

(3) Effect on System. The detrimental results an uncontrolled hazard could inflict on the whole system.

(4) Risk Assessment. A risk assessment for each hazard as defined in paragraph shall be provided.

(5) Caution and Warning Notes. A complete list of specific warnings, cautions, procedures required in operating and maintenance manuals, training courses, and test plans.

(6) Status/Remarks.

(a) The status of actions to implement the recommended, or other, hazard controls.

(b) Any information relating to the hazard, not covered in the other blocks, for example, applicable documents, previous failure data in similar systems, or administrative directions.

4.0 References. List all pertinent references such as test reports, preliminary operating and maintenance manuals, and other hazard analysis.

5.0 Appendices. The appendix will contain charts, graphs, or data which are too cumbersome for inclusion in the previous sections, or are applicable to more than one section. It may also contain detailed formulation or analysis which is more conveniently placed in an appendix.

15.7 DID 3-5 SAFETY ASSESSMENT REPORT (SAR)

Title:	CDRL No.:
Safety Assessment Report (SAR)	3-5

Reference:

MAG Section 3.3

Use:

The Safety Assessment Report (SAR) is used to document a comprehensive evaluation of the mishap risk being assumed prior to the testing or operation of an instrument or subsystem. The SAR will be provided to the spacecraft contractor as an input to their preparation of the Missile System Prelaunch Safety Package (MSPSP), which is one of the media through which missile system prelaunch safety approval is obtained.

Related Documents:

a. AFSPCMAN 91-710, Range Safety User Requirements

b. JMR 002, Launch Vehicle Payload Safety Requirements

c. JSC 26943, Guidelines for the Preparation of Payload Flight Safety Data Packages and Hazard Reports

d. KHB 1700.7, Space Shuttle Payload Ground Safety Handbook

e. NSTS/ISS 13830, Payload Safety Review and Data Submittal Requirements

f. NSTS 1700.7, Safety Policy & Requirements for Payloads Using the Space Transportation System

g. RSM-93, Wallops Flight Facility (WFF) Range Safety Manual for Goddard Space Flight Center (GSFC)

h. CSG-RS-10A-CN Centre Spatial Guyanais (CSG) Safety Regulations Vol. 1: General Rules

i. CSG-RS-21A-CN CSG Safety Regulations Vol. 2 Pt. 1: Specific Rules: Ground Installations

j. CSG-RS-22A-CN CSG Safety Regulations Vol. 2 Pt. 2: Specific Rules: Spacecraft

k. P32928-103, "Requirements for International Partner Cargoes Transported on Russian Progress and Soyuz Vehicles".

Note: Other launch range and launch vehicle requirements may apply

Place/Time/Purpose of Delivery:

Deliver the Preliminary SAR, PDR + 30 days (instrument / subsystem).

Deliver the Intermediate SAR, CDR - 30 days (instrument / subsystem).

Deliver the Final SAR, PSR - 30 days (instrument / subsystem).to the Spacecraft Contractor no less than 90 days before

GSFC OSSMA will approve all delivered versions of the SAR.

Preparation Information:

The Safety Assessment Report will identify all safety features of the hardware, software, and system design as well as procedural, hardware, and software related hazards that may be present in the instrument or subsystem. This includes specific procedural controls and precautions that should be followed. The safety assessment will summarize the following information:

1. The safety criteria and methodology used to classify and rank hazards plus any assumptions upon which the criteria or methodologies were based or derived including the definition of acceptable risk as specified by Range Safety
2. The results of hazard analyses (including software) and tests used to identify hazards in the system including:
   a. Those hazards that still have a residual risk and the actions that have been taken to reduce the associated risk to a level contractually specified as acceptable
   b. Results of tests conducted to validate safety criteria, requirements, and analyses
3. Hazard reports documenting the results of the safety program efforts to include a list of all significant hazards along with specific safety recommendations or precautions required to ensure safety of personnel, property, or the environment. **NOTE:** Categorize the list as to whether or not the risks may be expected under normal or abnormal operating conditions.
4. Any hazardous materials generated by or used in the system
5. The conclusion, including a signed statement, that all identified hazards have been eliminated or their associated risks controlled to levels contractually specified as acceptable and that the system is ready to test or operate or proceed to the next acquisition phase
6. In order to aid the spacecraft contractor in completing an orbital debris assessment of the instrument it is necessary to identify any stored energy sources in instruments (pressure vessel, dewar, etc.) as well as any energy sources that can be passivated at end of life.
7. Recommendations applicable to hazards at the interface of Range User systems with other systems, as required

15.8 DID 3-6: SAFETY DATA PACKAGE / MISSILE SYSTEM PRELAUNCH SAFETY PACKAGE

Title:	CDRL No.:
Safety Data Package (SDP) / Missile System Prelaunch Safety Package (MSPSP)	3-6

Reference:

MAG, Paragraph 3.4

Use:

The SDP is used for STS/ISS payloads while the MSPSP is used for ELV and Pegasus payloads.

Provides a detailed description of the payload design sufficient to support hazard analysis results, hazard analysis method, and other applicable safety related information. The developer shall include analyses identifying the ground operations hazards associated with the flight system, ground support equipment, and their interfaces. The developer shall take measures to control and/or minimize each significant identified hazard.

In addition to identifying hazards, the SDP/MSPSP shall also identify applicable hazard controls, and verifications methods for each hazard, and document them in Hazard Reports. The analysis shall be updated as the hardware progresses through the stages of design, fabrication, and test. A list of all hazardous/toxic materials and associated material safety data sheets shall be prepared and included in the final SDP/MSPSP, as well as a detailed description of the hazardous and safety critical operations associated with the payload.

The safety assessment shall begin early in the program formulation process and continue throughout all phases of the mission lifecycle. The spacecraft or instrument Project Manager shall demonstrate compliance with these requirements and shall certify to GSFC and the launch range, through the SDP/MSPSP, that all safety requirements have been met.

Related Documents:

a. AFSPCMAN 91-710, Range Safety User Requirements

b. JSC 26943, Guidelines for the Preparation of Payload Flight Safety Data Packages and Hazard Reports

c. KHB 1700.7, Space Shuttle Payload Ground Safety Handbook

d. JMR 002, Launch Vehicle Payload Safety Requirements

e. NSTS/ISS 13830, Payload Safety Review and Data Submittal Requirements

f. NSTS 1700.7, Safety Policy & Requirements for Payloads Using the Space Transportation System

g. RSM-93, Wallops Flight Facility (WFF) Range Safety Manual for Goddard Space Flight Center (GSFC)

h. CSG-RS-10A-CN Centre Spatial Guyanais (CSG) Safety Regulations Vol. 1: General Rules

i. CSG-RS-21A-CN CSG Safety Regulations Vol. 2 Pt. 1: Specific Rules: Ground Installations

j. CSG-RS-22A-CN CSG Safety Regulations Vol. 2 Pt. 2: Specific Rules: Spacecraft

k. P32928-103, "Requirements for International Partner Cargoes Transported on Russian Progress and Soyuz Vehicles".

Note: Other launch range and launch vehicle requirements may apply

Place/Time/Purpose of Delivery:

Deliver the SDP/MSPSP to GSFC OSSMA for review and approval before submittal to the launch range according to the following schedule

STS:** ***Flight Safety Data Package	***Ground Safety Data Package***
Provide Phase O - Early in conceptual phase	Phase O – Early in conceptual phase
Provide Phase 1 - 60 days prior to PDR	Phase 1 – 60 days prior to PDR
Provide Phase 2 - 60 days prior to CDR	Phase2 – 60 days prior to CDR
Provide Phase 3 - 45 days prior to PSR	Phase 3 – 45 days prior to PSR

***ELV and Pegasus:**

Deliver the Preliminary MSPSP, Mission PDR + 30 days.

Deliver the Intermediate MSPSP, Mission CDR – 30 days.

Deliver the Final MSPSP no less than 60 days before shipment.

GSFC OSSMA will approve all delivered versions of the SDP/MSPSP.

NOTE: The first MSPSP delivery shall contain appropriate launch range safety requirements tailoring (if necessary).

*(See applicable launch range and launch vehicle requirements for details).

SAFETY DATA PACKAGE (cont)

Preparation Information:

Prepare the Safety Data Package to include the following information:

1. Introduction. State, in narrative form, the purpose of the safety data package.

2. System Description. This section may be developed by referencing other program documentation such as technical manuals, System Program Plan, System Specification, etc.

   As applicable, either photos, charts, flow/functional diagrams, sketches, or schematics to support the system description, test, or operation.

3. System Operations.
   a. A description or reference of the procedures for operating, testing and maintaining the system. Discuss the safety design features and controls incorporated into the system as they relate to the operating procedures.
   b. A description of any special safety procedures needed to assure safe operations, test and maintenance, including emergency procedures.
   c. A description of anticipated operating environments and any specific skills required for safe operation, test, maintenance, transportation or disposal.
   d. A description of any special facility requirements or personal equipment to support the system.

4. Systems Safety Engineering Assessment. This section shall include:
   a. A summary or reference of the safety criteria and methodology used to classify and rank hazardous conditions.
   b. A description of or reference to the analyses and tests performed to identify hazardous conditions inherent in the system.
      (1) Hazard Reports for all hazards by subsystem or major component level that have been identified and considered from the inception of the program.
         a. A discussion of the hazards and the actions that have been taken to eliminate or control these items.
         b. A discussion of the effects of these controls on the probability of occurrence and severity level of the potential mishaps.
         c. A discussion of the residual risks that remain after the controls are applied or for which no controls could be applied.
         d. A discussion of or reference to the results of tests conducted to validate safety criteria requirements and analyses. These items shall be tracked and closed-out via a Verification Tracking Log (VTL).

SAFETY DATA PACKAGE (cont)

Preparation Information (continued):

5. Conclusions and Recommendations. This section shall include:
   a. A short assessment of the results of the safety program efforts. A list of all significant hazards along with specific safety recommendations or precautions required ensuring the safety of personnel and property.
   b. For all hazardous materials generated by or used in the system, the following information shall be included.
      (1) Material identification as to type, quantity, and potential hazards.
      (2) Safety precautions and procedures necessary during use, storage, transportation, and disposal.
      (3) A copy of the Material Safety Data Sheet (OSHA Form 20 or DD Form 1813) as required.
   c. Appropriate radiation forms/analysis.
   d. Reference material to include a list of all pertinent references such as Test Reports, Preliminary Operating Manuals and Maintenance Manuals
   e. A statement signed by the Contractor System Safety Manager and the Program Manager certifying that all identified hazards have been eliminated or controlled and that the system is ready to test, operate, or proceed to the next acquisition phase. In addition, include recommendations applicable to the safe interface of this system with the other system(s).

6. The safety package shall be submitted for approval in accordance with the milestones required by the applicable launch site and launch vehicle safety regulation.

15.9 DID 3-7: VERIFICATION TRACKING LOG

Title:	CDRL No.:
Verification Tracking Log	3-7

Reference:

MAG, Paragraph 3.5

Use:

Provides documentation of a Hazard Control and Verification Tracking process or "closed-loop system" that assures safety compliance has been satisfied in accordance to applicable launch range safety requirements.

Related Documents:

a. AFSPCMAN 91-710, Range Safety User Requirements
b. KHB 1700.7, Space Shuttle Payload Ground Safety Handbook
c. NSTS/ISS 13830, Payload Safety Review and Data Submittal Requirements
d. NSTS 14046, Payload Verification Requirements
e. NSTS 1700.7, Safety Policy & Requirements for Payloads Using the Space Transportation System
f. RSM-93, Wallops Flight Facility (WFF) Range Safety Manual for Goddard Space Flight Center (GSFC)
g. CSG-RS-10A-CN Centre Spatial Guyanais (CSG) Safety Regulations Vol. 1: General Rules
h. CSG-RS-21A-CN CSG Safety Regulations Vol. 2 Pt. 1: Specific Rules: Ground Installations
i. CSG-RS-22A-CN CSG Safety Regulations Vol. 2 Pt. 2: Specific Rules: Spacecraft

Place/Time/Purpose of Delivery:

A Payload Safety Verification Tracking Log (VTL) identifying hazard controls still not verified closed shall be prepared and delivered with the final SDP / MSPSP to GSFC OSSMA. Regular updates to this log shall be provided as requested until all hazard control verifications have been closed. Open VTL items must be closed with appropriate documented rationale prior to first operational use/restraint.

Preparation Information:

The Hazard Log (or VTL) provides documentation that demonstrates the process of verifying the control of all hazards by test, analysis, inspection, similarity to previously qualified hardware, or any combination of these activities. All verifications that are listed on the hazard reports shall reference the tests/analyses/inspections. Results of these tests/analyses/inspections shall be available for review and submitted in accordance with the contract schedule and applicable launch site range safety requirements.

The VTL shall contain the following information in tabular format:

a. Log
b. Hazard Report #
c. Safety Verification #
d. Description (Identify procedures/analyses by number and title)
e. Constraints on Launch Site Operations
f. Independent Verification Required (i.e., mandatory inspection points)? Yes/No
g. Scheduled Completion Date
h. Completion Date
i. Method of Closure

15.10 DID 3-8: GROUND OPERATIONS PROCEDURES

Title:	CDRL No.:
Ground Operations Procedures (GOP)	3-8

Reference:

MAG, Paragraph 3.7

Use:

GOP documents all ground operations procedures to be used at GSFC facilities, other integration facilities, or the launch site for submittal to GSFC OSSMA for review and approval. Includes launch site ground operations procedures to be submitted to applicable Range Safety prior to use.

Related Documents:

a. AFSPCMAN 91-710, Range Safety User Requirements

b. KHB 1700.7, Space Shuttle Payload Ground Safety Handbook

c. KNPR 1710.2, Kennedy Space Center Safety Practices Procedural Requirements

d. 540-PG-8715.1.1 and 1.2, Mechanical Systems Safety Manual Volume I and II

Note: Other launch vehicle and/or contractor, or commercial facility requirements as applicable.

Place/Time/Purpose of Delivery:

Launch Range Procedures:

Provide to GSFC OSSMA 45 days after PSR and submit to applicable Range Safety 45 days prior to first use.

GSFC Procedures:

Provide all GSFC in-house procedures to GSFC OSSMA for review 7 days prior to first operational use. GSFC OSSMA will approve all hazardous operational procedures

Preparation Information:

Identify all hazardous ground operations as well as the procedures to control them..

Verify all launch site ground operation procedures comply with applicable launch site safety regulations.

15.11 DID 3-9: SAFETY VARIANCE

Title:	CDRL No.:
Safety Variance	3-9

Reference:

MAG, Paragraph 3.8

Use:

Documents variances of safety requirements that can not be met; explains the rationale for approval of each variance, as defined in NPR 8715.3

The request for Safety Variance may require Range Safety concurrence for the variance to be approved.

Related Documents:

a. AFSPCMAN 91-710, Range Safety User Requirements
b. KHB 1700.7, Space Shuttle Payload Ground Safety Handbook
c. KNPR 1710.2, Kennedy Space Center Safety Practices Procedural Requirements
d. JMR 002, Launch Vehicle Payload Safety Requirements
e. NASA Non-Compliance Report/Corrective Action System (NCR/CAS) Web-based Online System
f. CSG-RS-10A-CN Centre Spatial Guyanais (CSG) Safety Regulations Vol. 1: General Rules
g. CSG-RS-21A-CN CSG Safety Regulations Vol. 2 Pt. 1: Specific Rules: Ground Installations
h. CSG-RS-22A-CN CSG Safety Regulations Vol. 2 Pt. 2: Specific Rules: Spacecraft
i. NPR 8715.3...

Place/Time/Purpose of Delivery:

Deliver to GSFC OSSMA as early as known.

Preparation Information:

Include in the Safety Variance the following information resulting from a review of each waiver or deviation request.

a. A statement of the specific safety requirement and its associated source document name and paragraph number, as applicable, for which a waiver or deviation is being requested.

b. A detailed technical justification for the exception.

c. Analyses to show that the mishap potential of the proposed alternate requirement, method or process, as compared to the specified requirement.

d. A narrative assessment of the risk involved in accepting the waiver or deviation. When it is determined that there are no hazards, the basis for such determination should be provided.

e. A narrative on possible ways of reducing hazards severity and probability and existing compliance activities (if any).

f. Starting and expiration date for waiver/deviation.

15.12 DID 3-10: ORBITAL DEBRIS ASSESSMENT

Title:	CDRL No.:
Orbital Debris Assessment	3-10

Reference:

MAG, Paragraph 3.10

Use:

Ensure NASA requirements for post mission orbital debris control are met.

Related Documents:

a. NPD 8710.3, NASA Policy for Limiting Orbital Debris Generation

b. NSS 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris

Place/Time/Purpose of Delivery:

Provide preliminary assessment at mission PDR – 15 days to GSFC, at PDR to NASA HQ. Final package at CDR – 60 days to GSFC, at CDR – 45 to NASA HQ...

Additional information may be required after NASA HQ review of the report and should be provided as soon as possible to complete the assessment,

NOTE: NASA HQ needs to provide approval prior to shipment to the launch ranges.

Preparation Information:

The assessment shall be done in accordance with NSS 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris. The preliminary debris assessment should be conducted to identify areas where the program or project might contribute debris and to assess this contribution relative to the guidelines in so far as is feasible. Prior to CDR another debris assessment should be completed. This report should comment on changes made since the PDR report. The level of detail should be consistent with the available information of design and operations. When there are design changes after CDR that impact the potential for debris generation, an update of the debris assessment report should be prepared, approved, and coordinated with the Office of System Safety and Mission Assurance.

Orbital Debris Assessment Software is available for download from Johnson Space Center at URL:

http://sn-callisto.jsc.nasa.gov/mitigate/das/das.html

15.13 DID 3-10A: ORBITAL DEBRIS ASSESSMENT REPORT

Title:	CDRL No.:
Orbital Debris Assessment Report	3-10

Reference:

MAG, Paragraph 3.10

Use:

The Orbital Debris Assessment Report provides assurance to NASA the contractor has performed the orbital assessment.

Related Documents:

a. NPD 8710.3, NASA Policy for Limiting Orbital Debris Generation

b. NSS 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris

Place/Time/Purpose of Delivery:

Provide preliminary orbital debris assessment report at mission PDR to NASA HQ.

Provide the final orbital debris assessment report no later than 45 days before CDR.

Additional information may be required after NASA HQ review of the report and should be provided as soon as possible to complete the assessment,

NOTE: NASA HQ needs to provide approval prior to shipment to the launch ranges.

Preparation Information:

Include in the PDR Orbital Debris Assessment Report the applicable topics found in NSS 1740.14, Section 8.1 Format for Report Issued at PDR.

Include in the CDR Orbital Debris Assessment Report the applicable topics found in NSS 1740.14, Section 8.2 Format for Report Issued at CDR.

15.14 DID 4-1: RELIABILITY PROGRAM PLAN

Title: Reliability Program Plan (RPP)	CDRL No.: 4-1

Reference:

Paragraph 4.2

Use:

To provide planning and control for the reliability program.

Related Documents

a. NPD 8720.1, NASA Reliability and Maintainability (R&M) Program Policy.

b. NASA-STD-8729.1, Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program.

c. NPR 8705.5 Risk Classification for NASA Payloads

Place/Time/Purpose of Delivery:

a. Preliminary to be included with proposal for GSFC review and evaluation.

b. Draft 30 days after contract award for GSFC review.

c. Final 30 days before developer PDR for GSFC review and approval.

d. Updates as required including changes for GSFC review and approval.

Preparation Information:

Format: The Reliability Program Plan shall be in the developer's format.

Content: The Reliability Program Plan shall include:

a. A discussion of how the developer intends to implement and comply with reliability program requirements.

b. Charts and statements describing organizational responsibilities and functions conducting each task to be performed as part of the Reliability Program.

c. A summary (matrix or other brief form) which indicates for each requirement, the organization responsible for implementing and generating the necessary documents.

d. Identify in the summary the approval, oversight, or review authority for each task.

e. Narrative descriptions, time or milestone schedules, and supporting documents describing the execution and management plan for each task.

f. Directives, methods, and procedures specific to each task in the plan.

15.15 DID 4-2: PROBABILISTIC RISK ASSESSMENT PLAN

Title:	CDRL No.:
Probabilistic Risk Assessment Plan	4-2

Reference:

Paragraphs 4.3, 7.3

Use:

Provides a structured, disciplined approach to analyzing system risk to support management decisions to: ensure mission success; improve safety in design, operation, maintenance and upgrade; improve performance; and reduce design, operation and maintenance costs.

Related Documents

a. NPR 8705.4 Probabilistic Risk Assessment (PRA) Procedures for NASA Programs and Projects
b. NPR 8705.5 Risk Classification for NASA Payloads

Place/Time/Purpose of Delivery:

a. Preliminary with proposal for GSFC review.
b. Draft 30 days before PDR for GSFC review.
c. Final 30 days before CDR for GSFC approval.
d. Updates as required for GSFC approval.

Preparation Information:

Format: The PRA Plan shall be in the developer's format.

Content: The PRA Plan shall include the following:

a. A definition of the objective and scope of the PRA Plan, and development of end-states-of-interest to the decision-maker,
b. Definition of the mission phases and success criteria,
c. Initiating event categories,
d. Top level scenarios,
e. Initiating and pivotal event models (e.g., fault trees and phenomenological event models),
f. Data development for probability calculations,
g. An integrated model and quantification to obtain risk estimates,
h. An assessment of uncertainties,
i. Summary of results and conclusions, including a ranking of the lead contributors to risk.

15.16 DID 4-3: FAILURE MODE AND EFFECTS ANALYSIS

Title:	CDRL No.:
Failure Mode and Effects Analysis (FMEA)	4-3

Reference:

Paragraph 4.4.1

Use:

Used to evaluate design against requirements, and identify single point failures and hazards to assure mission success.

Used to identify all modes of failure within a system design, its first purpose is the early identification of all catastrophic and critical failure possibilities so they can be eliminated or minimized through design correction at the earliest possible time.

Related Documents

a. Flight Assurance Procedure, FAP P-302-720, Performing a Failure Mode and Effects Analysis.
b. CR 5320.9, Payload and Experiment Failure Mode Effects Analysis and Critical Items List Ground Rules.
c. MIL-STD-1629, Procedures for Performing an FMECA.

Place/Time/Purpose of Delivery:

a. Preliminary 30 days before PDR for GSFC review.
b. Final 30 days before CDR for GSFC review.
c. Revisions as required for GSFC review.

Preparation Information:

Format: The FMEA Report shall be in the developer's format.

Content: The FMEA Report shall include the following:

a. A discussion of the approach of the analysis, methodologies, assumptions, results, conclusions, and recommendations.
b. Objectives
c. Level of the analysis
d. Ground rules
e. Functional description
f. Functional block diagrams
g. Reliability block diagrams
h. Equipment analyzed
i. Data sources used
j. Problems identified
k. Single-point failures
l. Corrective action
m. Work sheets identifying failure modes, causes, severity category, and effects at the item, next higher level, and mission level, detection methods, and mitigating provisions.
n. Critical Items List (CIL) including item identification, cross-reference to FMEA line items, and retention

rationale. Appropriate retention rationale may include design features, historical performance, acceptance testing, manufacturing product assurance, elimination of undesirable failure modes, and failure detection methods.

15.17 DID 4-4: FAULT TREE ANALYSIS

Title:	CDRL No.:
Fault Tree Analysis (FTA)	4-4

Reference:

Paragraphs 4.4.2

Use:

Used to assess mission failure from the top level. Undesired (top-level) states are identified; all possible combinations of basic (lower-level) events are considered to derive credible failure scenarios. The technique provides a methodical approach to identify events or environments that can adversely affect mission success providing an informed basis for assessing system risks.

Related Documents

a. NPR 8715.3 NASA Safety Manual
b. NUREG-0492 Fault Tree Handbook

Place/Time/Purpose of Delivery:

a. Preliminary 30 days before PDR for GSFC review
b. Revisions 30 days before CDR for GSFC review
c. Final 30 days before Mission Operation Review

Preparation Information:

Format: The Fault Tree Analysis Report shall be in the developer's format.

Content: The Fault Tree Analysis Report shall contain:

a. Analysis ground rules including definitions of the undesirable end states
b. References to documents and data used
c. The fault tree diagrams
d. Results and conclusions

15.18 DID 4-5: PARTS STRESS ANALYSIS

Title: Parts Stress Analysis	CDRL No.: 4-5

Reference:

Paragraph 4.4.3

Use:

Provides EEE parts stress analyses for verifying circuit design conformance to derating requirements; demonstrates that environmental operational stresses on parts comply with project derating requirements.

Related Documents

NASA Parts Selection List

Place/Time/Purpose of Delivery:

a. Final 45 days before CDR for GSFC review
b. Revisions to include changes as required for GSFC review

Preparation Information:

Format: The Parts Stress Analysis Report shall be in the developer's format.

Content: The Parts Stress Analysis Report shall contain:

a. Analysis ground rules.
b. Reference documents and data used.
c. Results and conclusions including:
- Design trade study results
- Parts stress analysis results impacting design or risk decisions.

d. Analysis worksheets; the worksheets at a minimum shall include:
- Part identification (traceable to circuit diagrams),
- Assumed environmental (consider all expected environments),
- Rated stress,

- Applied stress (consider all significant operating parameter stresses at the extremes of anticipated environments),
- Ratio of applied-to-rated stress.

15.19 DID 4-6: WORST CASE ANALYSIS

Title: Worst Case Analysis	CDRL No.: 4-6

Reference:

Paragraph 4.4.4

Use:

Demonstrate design margins in electronic and electrical circuits, optics, and electromechanical and mechanical items.

Related Documents

a. NPD 8720.1, NASA Reliability and Maintainability (R&M) Program Policy.
b. NASA-STD-8729.1, Planning, Developing and Managing an Effective R&M Program.

Place/Time/Purpose of Delivery:

a. Available 30 days prior to component CDR
b. Updates with design changes.

Preparation Information:

Format: The Worst Case Analysis Report shall be in the developer's format.

Content: Include in the Worst Case Analysis Report the following:

a. Address worst case conditions performed on each component.
b. Discuss how each analysis includes the mission life.
c. Discuss consideration of critical parameters at maximum and minimum limits.
d. The effect of environmental stresses on the operational parameters being evaluated.

15.20 DID 4-7: RELIABILITY ASSESSMENTS AND PREDICTIONS

Title: Reliability Assessments and Predictions	CDRL No.: 4-7

Reference:

Paragraph 4.4.5

Use:

Used to assist in evaluating alternative designs and to identify potential mission limiting elements that may require special attention.

Related Documents:

MIL-STD-756, Reliability Modeling and Prediction

MIL-HDBK-217, Reliability Prediction of Electronic Equipment

RADC-TR-85-229, Reliability Prediction for Spacecraft

Place/Time/Purpose of Delivery:

a. Available at PDR and CDR for information.

b. Available on request

Preparation Information:

Format: The Reliability Assessment and Prediction Report shall be in the developer's format.

Content: Reliability Assessment and Prediction Report shall include the following:

a. The methodology and results of comparative reliability assessments including mathematical models
b. Reliability block diagrams
c. Failure rates
d. Failure definitions
e. Degraded operating modes
f. Trade-offs
g. Assumptions
h. Any other pertinent information used in the assessment process.
i. A discussion to clearly show how reliability was considered as a discriminator in the design process.

15.21 DID 4-9: LIMITED-LIFE ITEMS LIST

Title: Limited-Life Items List	CDRL No.: 4-9
Reference: Paragraph 4.6	
Use: Defines and tracks the selection, use and wear of limited-life items, and the impact on mission operations	
Related Documents: None	
Place/Time/Purpose of Delivery: a. Preliminary 30 days before PDR for review. b. Final 30 days before CDR for approval. c. Updates as changes are made; between CDR and delivery, for approval.	
Preparation Information: List life-limited items and their impact on mission parameters. Define expected life, required life, duty cycles, and rationale for selecting and using the items. Include selected structures, thermal control surfaces, solar arrays, and electromechanical mechanisms. Atomic oxygen, solar radiation, shelf-life, extreme temperatures, thermal cycling, wear and fatigue are used to identify limited-life thermal control surfaces and structural items. When aging, wear, fatigue and lubricant degradation limit their life, include batteries, compressors, seals, bearings, valves, tape recorders, momentum wheels, gyros, actuators and scan devices.	

15.22 DID 5-1: SOFTWARE ASSURANCE PLAN

Title: Software Assurance Plan	CDRL No.: 5-1
Reference: Paragraph 5.2, 5.8, 6.5.7.1	
Use: The Software Assurance Plan documents the Software Assurance roles and responsibilities, surveillance activities, supplier controls, records collection, maintenance and retention, training and risk management.	
Related Documents: IEEE Standard 730-2002, Software Quality Assurance Plans	
Place/Time/Purpose of Delivery: a. Initial draft due upon project inception. b. Final due no later than requirements phase. c. Updated periodically throughout the lifecycle, if necessary.	
Preparation Information: The Software Assurance Plan (SAP) shall follow the format as specified in the IEEE Standard 730-2002: a. Purpose; Reference documents and definitions; b. Management; c. Documentation; d. Standards, practices, conventions, and metrics; e. Software Reviews; f. Test; g. Problem Reporting and Corrective Action; h. Tools, techniques, and methodologies; i. Media control; j. Supplier control; k. Records, collection, maintenance, and retention; l. Training; m. Risk Management; n. SAP Change procedure and history.	

15.23 DID 5-2: SOFTWARE MANAGEMENT PLAN

Title:	CDRL No.:
Software Management Plan	5-2

Reference:

Paragraphs 5.2, 5.2.1, 5.2.3, 5.8

Use:

This data item provides an outline for the Software Management Plan. The Software Management Plan documents the software development processes and procedures, software tools, resources, and deliverables throughout the development life cycle.

Related Documents:

IEEE Standard 1058-1998

Place/Time/Purpose of Delivery:

a. Initial draft due upon project inception.

b. Final due no later than requirements phase.

c. Updated periodically throughout the lifecycle, as necessary.

Preparation Information:

The Software Management Plan shall include/address:

a. Introduction – Purpose, scope, definitions and references;
b. Project Organization and Responsibilities - Resources and Schedules;
c. Software Development Overview;
d. Software Development Activities by life cycle: 1) Development and test environment; 2) Tools, techniques, and methodologies; 3) Software standards and development processes;
e. Software Configuration Management;
f. Software Assurance;
g. Software Testing;
h. Software Reviews;
i. Risk Management;
j. Software Metrics;
k. Delivery and Operational Transition;
l. Software Maintenance;
m. Software Deliverables;
n. Training.

15.24 DID 5-3: SOFTWARE CONFIGURATION MANAGEMENT PLAN

Title:	CDRL No.:
Software Configuration Management Plan	5-3

Reference:

Paragraph 5.2.1, 5.4, 5.8

Use:

The purpose of the Software Configuration Management Plan is to define the software configuration management system, roles and responsibilities, activities, schedules, resources, and maintenance of the plan.

Related Documents

ANSI-IEEE Standard 828-1998, IEEE Standard for Software Configuration Management Plans

ANSI-IEEE Standard 1042-1987, Guide to Software Configuration Management.

Place/Time/Purpose of Delivery:

a. Initial draft due upon project inception.

b. Final due no later than requirements phase.

c. Updated periodically throughout the lifecycle, as necessary.

Preparation Information:

The Software Configuration Management (SCM) Plan shall follow the following format:

a. Introduction – Purpose, scope, definitions and references;

b. SCM Management Overview -- Organization, responsibilities, and interfaces and relationships to software life cycle;

c. Software Configuration Management Activities: 1) Configuration Identification, 2) Configuration Control, 3) Configuration Status Accounting, 4) Configuration Audits, 5) Interface Control, 6) Subcontractor control;

d. Software Configuration Management Schedules

e. Software Configuration Management Resources -- tools, techniques, equipment, personnel, and training

f. Software Configuration Management Plan Maintenance

15.25 DID 5-5: SOFTWARE REQUIREMENTS SPECIFICATION

Title:	CDRL No.:
Software Requirements Specification	5-5

Reference:

Paragraph 5.2

Use:

The Software Requirements Specification documents all software requirements (e.g., functional, performance, software safety, security), assumptions and dependencies, design and implementation constraints, delivery and installation requirements, and complete requirements traceability to parent requirements or system requirements.

Related Documents

IEEE/EIA 12207.1-1997

Place/Time/Purpose of Delivery:

a. Initial draft due upon customer/supplier agreement on software functionality.

b. .Final due no later than the software requirements review (SRR).

c. Updated periodically throughout the lifecycle, as necessitated by requirement changes.

Preparation Information:

When developing requirements, requirement characteristics include correct, unambiguous, complete, consistent, verifiable, modifiable, and traceable (per IEEE Std 830-1998, Recommended Practice for Software Requirements Specifications).

The Software Requirements Specification shall meet the intent of IEEE/EIA 12207.1-1997:

a. Introduction, Scope, and Applicable Documents
b. Software Functional Overview and flow
c. Functional Requirements
d. External and Internal Requirements
e. Performance Requirements
f. Software Safety Requirements
g. Security and Privacy Requirements
h. Quality Requirements
i. Delivery, Installation, and Environmental Requirements
j. Computer Hardware and Software Resources and Requirements
k. Assumptions and Dependencies
l. Design and Implementation Constraints
m. Qualification Methods and Acceptance Criteria (may be referenced)
n. Requirements Traceability

15.26 DID 7-1: RISK MANAGEMENT PLAN

Title: Risk Management Plan	CDRL No.: 7-1
Reference: Paragraphs 7.2	
Use: The purpose of the Risk Management Plan is to define the Continuous Risk Management (CRM) process by which the developer identifies, evaluates and minimizes the risks associated with program, project, and/or mission goals.	
Related Documents: GPR 7120.4, Risk Management NPR 8000.4, Risk Management Procedures and Guidelines	
Place/Time/Purpose of Delivery:	

Preparation Information:

The Risk Management Plan (RMP) shall be a configuration-controlled document. The RMP shall include:

a. Introduction. Specify the project risk objectives and policy toward risk. Explain the purpose, scope, assumptions, constraints, key ground rules, and policy pertaining to the project CRM process.

a. Overview of Process. Provide an overview of the CRM process and information flow; describe how the CRM process integrates and relates to other project management and system engineering activities. Include general risk mitigation strategies to be employed throughout project life cycle.

b. Organization. Show the organization, roles, and responsibilities of program, project, customer, and supplier key personnel with regard to CRM. Document how team members will be trained in the application of CRM methodology.

c. Process Details. Provide the CRM process details and related procedures, methods, tools, and metrics. Include here, or in an appendix, the specific methodologies to be used for activities of continuous risk management: identify, analyze, plan, track, control, communicate and document. Include the process to be used for continual assessment of the project Risk Profile. Describe how risk information will be communicated both internally to the project staff and throughout the NASA management chain.

d. Documentation of Risks. Specify the format and data elements that will comprise the project Risk List (and/or Risk Database), how configuration control will be applied, and how the list will be used and updated. Tell how team members will be able to access the current list at any time. Include in the RMP the initial set of identified risks and the action plan (for research, acceptance, tracking, or mitigation) for each risk.

Appendix. Material that is too detailed or sensitive to be placed in the main body of text may be placed in an appendix or included as reference. Include the appropriate reference in the main body of the text. Appendices may be bound separately, but are considered to be part of the document and shall be placed under configuration control as such. Include an alphabetized list of the definitions for abbreviations and acronyms used in this document. Include an alphabetized list of definitions for special terms used in the document, i.e., terms used in a sense that differs from or is more specific than the common usage for such terms.

15.27 DID 8-1: MISSION CONCEPT REVIEW

Title:	CDRL No.:
Mission Concept Review (MCR)	8-1

Reference:

Paragraph 8.2.1a

Use:

To affirm the mission need and examines proposed mission objectives and the concept for satisfying them.

Related Documents

None

Place/Time/Purpose of Delivery:

Deliver to IIRT (predetermined number of days) prior to commencement of the review for information.

Preparation Information:

See the SRO review guidelines.

15.28 DID 8-2: MISSION DEFINITION REVIEW

Title:	CDRL No.:
Mission Definition Review (MDR)	8-2

Reference:

Paragraph 8.2.1b

Use:

To establishes that the baseline mission requirements are clearly understood, that the requirements for each independent system element have been determined, and that the currently envisioned system design will fully satisfy those requirements in order to justify that it is ready to complete system definition and to flow down requirements to lower levels of the system..

Related Documents

None

Place/Time/Purpose of Delivery:

Deliver to IIRT (predetermined number of days) prior to commencement of the review for information.

Preparation Information:

See the SRO review guidelines.

15.29 DID 8-3: SYSTEM DEFINITION REVIEW

Title:	CDRL No.:
System Definition Review (SDR)	8-3

Reference:

Paragraph 8.2.1c

Use:

To establish that the baseline mission requirements are clearly understood, that system definition is complete, that the allocation of requirements to each independent system element and their respective subsystems is complete and verifiable, and that those lower level requirements are traceable to the mission level.

Related Documents

None

Place/Time/Purpose of Delivery:

Deliver to IIRT (predetermined number of days) prior to commencement of the review for information.

Preparation Information:

See the SRO review guidelines.

15.30 DID 8-4: PRELIMINARY DESIGN REVIEW

Title: Preliminary Design Review (PDR)	CDRL No.: 8-4
Reference: Paragraph 8.2.1d	
Use: To evaluate compliance with the review criteria delineated in the SRO review guidelines	
Related Documents: None	
Place/Time/Purpose of Delivery: Deliver to IIRT (predetermined number of days) prior to commencement of the review for information	
Preparation Information: • See the SRO review guidelines	

15.31 DID 8-5: CRITICAL DESIGN REVIEW

Title: Critical Design Review (CDR)	CDRL No.: 8-5
Reference: Paragraph 8.2.1e	
Use: To evaluate compliance with the review criteria delineated in the SRO review guidelines	
Related Documents: None	
Place/Time/Purpose of Delivery: Deliver to IIRT (predetermined number of days) prior to commencement of the review for information	
Preparation Information: See the SRO review guidelines	

15.32 DID 8-6: PRE-ENVIRONMENTAL REVIEW

Title: Pre-Environmental Review (PER)	CDRL No.: 8-6
Reference: Paragraph 8.2.1f	
Use: To evaluate compliance with the review criteria delineated in the SRO review guidelines	
Related Documents: None	
Place/Time/Purpose of Delivery: Deliver to IIRT (predetermined number of days) prior to commencement of the review for information	
Preparation Information: • See the SRO review guidelines	

15.33 DID 8-7: PRE-SHIPMENT REVIEW

Title: Pre-Shipment Review (PSR)	CDRL No.: 8-7
Reference: Paragraph 8.2.1g	
Use: To evaluate compliance with the review criteria delineated in the SRO review guidelines	
Related Documents: None	
Place/Time/Purpose of Delivery: Deliver to IIRT (predetermined number of days) prior to commencement of the review for information	
Preparation Information: See the SRO review guidelines	

15.34 DID 8-8: MISSION OPERATIONS REVIEW

Title: Mission Operations Review (MOR)	CDRL No.: 8-8
Reference: Paragraph 8.2.4a	
Use: To evaluate compliance with the review criteria delineated in the SRO review guidelines	
Related Documents: None	
Place/Time/Purpose of Delivery: Deliver to IIRT (predetermined number of days) prior to commencement of the review for information	
Preparation Information: • See the SRO review guidelines	

15.35 DID 8-9: FLIGHT OPERATIONS REVIEW

Title: Flight Operations Review (FOR)	CDRL No.: 8-9
Reference: Paragraph 8.2.4b	
Use: To evaluate compliance with the review criteria delineated in the SRO review guidelines	
Related Documents: None	
Place/Time/Purpose of Delivery: Deliver to IIRT (predetermined number of days) prior to commencement of the review for information	
Preparation Information: See the SRO review guidelines	

15.36 DID 9-1: SYSTEM PERFORMANCE VERIFICATION PLAN

Title:	CDRL No.:
System Performance Verification Plan	9-1

Reference:

Paragraph 9.2.1

Use:

Provides the overall approach for accomplishing the verification program. Defines the specific tests, analyses, calibrations, alignments, etc. that will demonstrate that the hardware complies with the mission requirements

Related Documents

None

Place/Time/Purpose of Delivery:

Preliminary with proposal for GSFC review.

Final at CDR for GSFC approval.

Updates as required.

Preparation Information:

Describes the approach (test, analysis, etc.) that will be utilized to verify that the hardware/software complies with mission requirements. If verification relies on tests or analyses at other level of assemblies, describe the relationships.

A section of the plan shall be a "System Performance Verification Matrix" summarizing the flow-down of system specification requirements that stipulates how each requirement will be verified, and summarizes compliance/non-compliance with requirements. It shall show each specification requirement, the reference source (to the specific paragraph or line item), the method of compliance, applicable procedure references, report reference numbers, etc. The System Performance Verification Matrix may be made a separate document.

The System Performance Verification Plan shall include a section describing the environmental verification program. This shall include level of assembly, configuration of item, objectives, facilities, instrumentation, safety considerations, contamination control, test phases and profiles, appropriate functional operations, personnel responsibilities, and requirements for procedures and reports. For each analysis activity, include objectives, a description of the mathematical model, assumptions on which the model will be based, required output, criteria for assessing the acceptability of the results, interaction with related test activity, and requirements for reports. Provide for an operational methodology for controlling, documenting, and approving activities not part of an approved procedure. Plan controls that prevent accidents that could damage or contaminate hardware or facilities, or cause personal injury. The controls shall include real-time decision-making mechanisms for continuation or suspension of testing after malfunction, and a method for determining retest requirements, including the assessment of the validity of previous tests. Include a test matrix that summarizes all tests to be performed on each component, each subsystem, and the payload. Include tests on engineering models performed to satisfy qualification requirements. Define pass/fail criteria. The Environmental Verification. The Environmental Test Plan section shall include a Environmental Test Matrix that summarizes all environmental tests that will be performed showing the test and the level of assembly. Tests on development/engineering models performed to satisfy qualification requirements shall be included in this matrix.

DID 9-1: System Performance Verification Plan — continued

Title: System Performance Verification Plan (cont.)	CDRL No.: 9-1 (cont.)

Reference:

Paragraph 9.2.1

Use:

Provides the overall approach for accomplishing the verification program. Defines the specific tests, analyses, calibrations, alignments, etc. that will demonstrate that the hardware complies with the mission requirements

Related Documents

None

Place/Time/Purpose of Delivery:

Preliminary with proposal for GSFC review.

Final at CDR for GSFC approval.

Updates as required.

Preparation Information: (cont.)

The Environmental Verification Plan may be made a separate document rather than be a section of the System Performance Verification Plan. As an adjunct to the environmental verification program, an Environmental Test Matrix Summarizing all tests performed and showing the test and the level of assembly will be maintained.

The System Performance Verification Plan shall include an Environmental Verification Specification section that stipulates the specific environmental parameters used in each test or analysis required by the verification plan. Contains the specific test and analytical parameters associated with each of the tests and analyses required by the Verification Plan. Payload peculiarities and interactions with the launch vehicle shall be considered when defining quantitative environmental parameters under which the hardware elements must meet their performance requirements.

15.37 DID 9-2: PERFORMANCE VERIFICATION PROCEDURE

Title: Performance Verification Procedure	CDRL No.: 9-2
Reference: Paragraph 9.2.6	
Use: Describes how each test activity defined in the Verification Plan will be implemented	
Related Documents: None	
Place/Time/Purpose of Delivery: 30 days prior to test for GSFC approval.	
Preparation Information: Describe the configuration of the tested item and the step-by-step functional and environmental test activity conducted at the unit/component, subsystem/instrument, and payload levels. Give details such as instrumentation monitoring, facility control sequences, test article functions, test parameters, quality control checkpoints, pass/fail criteria, data collection and reporting requirements. Address safety and contamination control provisions. A methodology shall be provided for controlling, documenting and approving all activities not part of an approved procedure and establish controls for preventing accidents that could cause personal injury or damage to hardware and facilities.	

15.38 DID 9-3: VERIFICATION REPORTS

Title:	CDRL No.:
Verification Reports	9-3

Reference:

Paragraphs 9.2.7, 9.2.8

Use:

Summarize compliance with system specification requirements and/or provide a summary of testing and analysis results, including conformance, nonconformance, and trend data.

Related Documents

None

Place/Time/Purpose of Delivery:

Verification Reports: Preliminary report 72 hours after test for GSFC information.

Final report 30 days after verification activity for GSFC information

System Performance Verification Report: Preliminary at CDR.

Final report 30 days following on-orbit check out.

Preparation Information:

Verification Report: Provide after each unit/component, subsystem/instrument, and payload verification activity. For each analysis activity the report shall describe the degree to which the objectives were accomplished, how well the mathematical model was validated by the test data, and other significant results.

System Performance Verification Report: Compare hardware/software specifications with the verified values (whether measured or computed). It is recommended that this report be subdivided by subsystem/instrument.

15.39 DID 10-1: PRINTED WIRING BOARDS TEST COUPONS

Title:	CDRL No.:
Printed Wiring Board (PWB) Test Coupons	10-1

Reference:

Paragraph 10.4.2.1

Use:

Validate printed wiring boards procured for space flight and mission critical ground applications are fabricated in accordance with applicable workmanship standards.

Related Documents:

IPC-6011, Generic Performance Specifications for Printed Boards (must use Class 3 Requirements)

IPC-6012, Qualification and Performance Specification for Rigid Printed Boards (must use Class 3 Requirements)

IPC-6013, Qualification and Performance Specification for Flexible Printed Boards (must use Class 3/A Requirements/Performance Specification Sheet for Space and Military Avionics)

IPC-6018, Microwave End Product Board Inspection and Test

IPC A-600, Guidelines for Acceptability of Printed Boards (must use Class 3 Requirements)

Place/Time/Purpose of Delivery:

Prior to population of flight PWBs. Applies individually to each procured lot of boards.

Preparation Information:

Prior to population of printed wiring boards:

- Contact GSFC Materials Engineering Branch (MEB), Code 541 of impending coupon shipment.
- Submit test coupons for destructive physical analysis (DPA) per Code 541 procedures.
- Do not release PWBs for population until notification by MEB that test coupons passed DPA.

15.40 DID 11-1: PARTS CONTROL PROGRAM PLAN

Title: Parts Control Program Plan	CDRL No.:11-1
Reference: Paragraph 11.1	
Use: Description of developer's approach and methodology for implementing PCP, including flow-down of applicable PCP requirements to sub-developers.	
Related Documents	
Place/Time/Purpose of Delivery: The PCP shall be developed and delivered as part of the proposal for GSFC review within 30 days after contract is awarded.	

Preparation Information:

The PCP shall be prepared and shall address all parts program requirements. The PCP shall contain, as a minimum, detailed discussions of the following:

a. The developer's plan or approach for conforming to parts requirements.

b. The developer's parts control organization, identifying key individuals and specific responsibilities.

c. Detailed Parts Control Board (PCB) procedures, to include PCB membership, designation of Chairperson, responsibilities, review and approval procedures, meeting schedules and method of notification, meeting minutes, etc.

d. Part tracking methods and approach, including tools to be used such as databases, reports, NASA Parts Selection List (NPSL), etc. Describe system for identifying and tracking part approval status.

e. Parts procurement, processing and testing methodology and strategies. Identify internal operating procedures to be used for incoming inspections, screening, qualification testing, derating, testing of parts pulled from stores, Destructive Physical Analysis, radiation assessments, etc.

f. Part vendor surveillance and audit plan

g. Electrostatic Control Plan

h. Flow down of PCP requirements to sub-developers

15.41 DID 11-2: AS DESIGNED PARTS, LIST

Title: Parts List Requirements	CDRL No.: 11-2
Reference: Paragraph 11.3	
Use: Listing of all parts intended for use in space flight hardware	
Related Documents: Parts Control Program Plan	
Place/Time/Purpose of Delivery: The PIL, PAPL, ADPL, and ABPL shall be submitted to the PCB, ten days prior to the PCB meeting	

Preparation Information:

The PIL shall be prepared prior to the first PCB meeting. The PIL shall be compiled by instrument, instrument component, or spacecraft component, and shall include the following information, as a minimum:

a. Part name
b. Part number
c. Part description
d. Manufacturer
e. Manufacturer's generic Part number
f. Specifications
g. Comments

The PAPL shall include what is required in the PIL in addition to:

h. Spacecraft/Instrument Name
i. Procurement Part Number
j. Flight Part Number
k. Package Type

l. Additional Testing Required
m. Cage Code
n. Single Event Latch-Up (SEL)
o. Single Event Up-Set (SEU)
p. Displacement damage
q. Total Ionizing Dose (TID)

The ADPL shall include what is required in the PAPL in addition to:

r. Lot date code
s. Quantities
t. Distributor
u. Quantity Needed/Procured
v. Radiation Source Data (TID/SEE)

The ABPL shall include what is required in the ADPL in addition to:

w. Parts location to the sub-assembly level

Any format may be used provided the required information is included. All submissions to GSFC will include a paper copy and a computer readable form.

Updates to PIL, PAPL, ADPL, ABPL shall identify changes from the previous submission.

DIRECTIVE NO. 300-PG-7120.2.2E

EFFECTIVE DATE: May 3, 2005

EXPIRATION DATE: May 3, 2010

15.42 DID 12-1:MATERIALS AND PROCESSES CONTROL PROGRAM PLAN

Title: Materials and Processes Control Program Plan	CDRL No.:12-1
Reference: Paragraph 12.1	
Use: Description of developer's approach and methodology for implementing MPCP, including flow-down of applicable MPCP requirements to sub-developers.	
Related Documents	
Place/Time/Purpose of Delivery: The MPCP shall be developed and delivered as part of the proposal for GSFC review	

Preparation Information:

The MPCP shall be prepared and shall address all MP program requirements. The MPCP shall contain, as a minimum, detailed discussions of the following:

i. The developer's plan or approach for conforming to MP requirements.

j. The developer's MP control organization, identifying key individuals and specific responsibilities.

k. Detailed Materials and Processes Control Board (MPCB) procedures, to include MPCB membership, designation of Chairperson, responsibilities, review and approval procedures, meeting schedules and method of notification, meeting minutes, etc.

l. MP tracking methods and approach, including tools to be used such as databases, reports, etc. Describe system for identifying and tracking MP approval status.

m. MP procurement, processing and testing methodology and strategies. Identify internal operating procedures to be used for incoming inspections, screening, qualification testing, testing of MP pulled from stores, etc.

n. MP vendor surveillance and audit plan

o. Flow down of MPCP requirements to sub-developers

15.43 DID 12-2: AS DESIGNED MATERIALS, AND PROCESSES LIST

Title: As-designed Materials, and Processes List (ADMPL)	CDRL No.: 12-2

Reference:

Paragraph 12.3

Use:

Listing of all MP intended for use in space flight hardware

Related Documents

Materials and Processes Control Program Plan

Place/Time/Purpose of Delivery:

The ADMPL shall be submitted to the MPCB, ten days prior to the first MPCB meeting

Preparation Information:

The ADMPL shall be prepared prior to the first MPCB meeting. The ADMPL shall be compiled by instrument, instrument component, or spacecraft component, and shall include the following information, as a minimum:

x. MP name

y. MP number

z. Manufacturer

aa. Manufacturer's generic MP number

bb. Procurement specification

Any format may be used provided the required information is included. All submissions to GSFC will include a paper copy and a computer readable form.

Updates to ADMPL shall identify changes from the previous submission.

15.44 DID 12-3: MATERIALS USAGE AGREEMENT

Title: Materials Usage Agreement	CDRL No. 12-3
Reference: Paragraph 12.3	
Use: For usage evaluation and approval of non-compliant materials or lubrication usage.	
Related Documents: MSFC -STD-3029, MSFC-HDBK-527, NHB 1700.7, GMI 1700.3, NASA-STD-6001	
Place/Time/Purpose of Delivery: Provide to the MPCB, prior to the first MPCB meeting, with the polymeric and composite materials usage list, flammable materials usage list, odor and toxic offgassing materials usage list or the inorganic materials usage list for approval.	

Preparation Information:

A Materials Usage Agreement (MUA) shall be provided for each non-compliant off-the-shelf-hardware material usage, non-compliant polymeric material outgassing, flammability or toxicity usage and non-compliant inorganic material stress corrosion cracking usage.

The MUA shall be provided on a Material Usage Agreement form, a developer's equivalent form or the developer's electronically transmitted form. The form is available in the Mission Assurance Guide.

The MUA form requires the minimum following information: MSFC 527 material rating, usage agreement number, page number, drawing numbers, part or drawing name, assembly, material name and specification, manufacturer and trade name, use thickness, weight, exposed area, pressure, temperature, exposed media, application, rationale for safe and successful flight, originator's name, project manager's name and date.

The off-the-shelf-hardware usage shall identify the measures to be used to ensure the acceptability of the hardware such as hermetic sealing, material changes to known compliant materials, vacuum bake-out to the error budget requirements listed in the contamination control plan.

DIRECTIVE NO. 300-PG-7120.2.2E

EFFECTIVE DATE: May 3, 2005

EXPIRATION DATE: May 3, 2010

15.45 DID 12-4: STRESS CORROSION EVALUATION FORM

Title: Stress Corrosion Evaluation Form	CDRL No.:12-4

Reference:

Paragraphs 12.3.3

Use:

Provide detailed stress corrosion cracking engineering information required to demonstrate the successful flight of the material usage.

Related Documents:

MSFC -SPEC-522, MSFC-HDBK-527, NHB 1700.7, GMI 1700.3

Place/Time/Purpose of Delivery:

Provide to the MPCB, prior to the first MPCB meeting, with the polymeric and composite materials usage list, flammable materials usage list, odor and toxic offgassing materials usage list or the inorganic materials usage list for approval.

Preparation Information:

The developer shall provide the information requested on the stress corrosion evaluation form, the equivalent information on the developer's form or the equivalent information electronically. The form is available in the Mission Assurance Guide.

The stress corrosion evaluation form requires, as a minimum, the following information: part number, part name next assembly number, manufacturer, material heat treatment, size and form, sustained tensile stresses, magnitude and direction, process residual stress, assembly stress, design stress, static stress, special processing, weld alloy form, temper of parent weldment metal, weld filler alloy, welding process, weld bead removal if any, post-weld thermal treatment, post-weld stress relief, environment, protective finish, function of part, effect of failure, evaluation of stress corrosion susceptibility.

15.46 DID 12-5: POLYMERIC MATERIALS AND COMPOSITES USAGE LIST

Title: Polymeric Materials and Composites Usage List	CDRL No.:12-5
Reference: Paragraph 12.3.4	
Use: For usage evaluation and approval of all polymeric and composite materials applications.	
Related Documents: NASA RP-1124, ASTM E 595, MSFC-HDBK-527, NHB 1700.7, AFSPCMAN91-710V3, GMI 1700.3, NASA-STD-6001	
Place/Time/Purpose of Delivery: Provide to the GSFC Project Office 30 days before developer PDR for review, 30 days before developer CDR for approval and 30 days before acceptance for approval.	

Preparation Information:

The developer shall provide the information requested on the polymeric materials and composites usage list form, the equivalent information on the developer's form or the equivalent information electronically. The form is in the Mission Assurance Guide.

The polymeric materials and composites usage list (1) form requires, as a minimum, the following information: spacecraft, subsystem or instrument name, GSFC technical officer, developer, address, prepared by, phone number, date of preparation, GSFC materials evaluator, evaluator's phone number, date received, date evaluated, item number, material identification (2), mix formula (3), cure (4), amount code, expected environment (5), outgassing values and reason for selection (6). Notes 1 through 6 are listed below:

1. List all polymeric materials and composites applications utilized in the system except lubricants that should be listed on polymeric and composite materials usage list.
2. Give the name of the material, identifying number and manufacturer Example: Epoxy, Epon 828, E. V. Roberts and Associates
3. Provide proportions and name of resin, hardener (catalyst), filler, etc. Example: 828/V140/Silflake 135 as 5/5/38 by weight
4. Provide cure cycle details. Example: 8 hrs. at room temperature + 2 hrs. at 150C
5. Provide the details of the environment that the material will experience as a finished S/C component, both in ground test and in space. List all materials with the same environment in a group. Example: T/V : -20C/+60C, 2 weeks, 10E-5 torr, ultraviolet radiation (UV)

   Storage: up to 1 year at room temperature

   Space: -10C/+20C, 2 years, 150 mile altitude, UV, electron, proton, atomic oxygen
6. Provide any special reason why the materials were selected. If for a particular property, please give the property. Example: Cost, availability, room temperature curing or low thermal expansion.

15.47 DID 12-6: FLAMMABLE MATERIALS USAGE LIST

Title: Flammable Materials Usage List	CDRL No.:12-6
Reference: Paragraph 12.3.5	
Use: For usage evaluation and approval of all flammable materials applications for STS.	
Related Documents: MSFC-HDBK-527, NSTS 22648, NHB 1700.7, GMI 1700.3, NASA-STD-6001	
Place/Time/Purpose of Delivery: Provide to the GSFC Project Office 30 days before developer PDR for review, 30 days before developer CDR for approval and 30 days before acceptance for approval.	

Preparation Information:

The flammability rating of all materials on the polymeric and composite materials usage list shall be provided on the flammable materials usage list. Each material usage shall be examined for flammability characteristics for use on the STS. For the orbiter payload bay area, an oxygen value of 20.9% should be examined. For the crew compartment area, oxygen values of 30% should be examined.

The flammable materials lists shall contain STS stowage location for the assembled piece of flight hardware (i.e., crew compartment or payload bay), and the listing of materials with an associated flammability rating. MSFC-HDBK-527 gives a partial listing of flammability ratings for various materials. MSFC also has a resource, the Materials And Processes Technical Information Service (MAPTIS), which is available to help in gathering flammability ratings. This service is available through computer Telnet applications. The materials lists should also state if a material is not rated, or has not yet been tested. Depending on the operational requirements of the flight hardware, flammability testing may be required. NASA-STD-6001 details the requirements of the flammability tests.

The routine and non-routine operation of the hardware shall not result in a release of flammable materials any area of the STS. Orbiter entry, landing and post landing operations shall not cause ignition of a flammable atmosphere in the payload bay area.

If flammable or untested materials are listed in the materials list, a flammability assessment should then be performed. NSTS 22648 guides the Materials Engineer through the configuration analysis. Flammable materials can be acceptable for STS application provided the flammability reduction methods and container guidelines of NSTS 22648 are used.

15.48 DID 12-7: ODOR AND TOXIC OFFGASSING MATERIALS USAGE LIST

Title: Odor and Toxic Offgassing Materials Usage List	CDRL No.:12-7

Reference:

Paragraph 12.3.5

Use:

For usage evaluation and approval of all odor and toxic offgassing material applications in habitable areas of STS.

Related Documents

MSFC-HDBK-527, KHB 1700.7, NASA-STD-6001

Place/Time/Purpose of Delivery:

Provide to the GSFC Project Office 30 days before developer PDR for review, 30 days before developer CDR for approval and 30 days before acceptance for approval.

Preparation Information:

The toxicity rating of all materials on the polymeric and composite materials usage list and the lubrication list that are operated or stowed in the crew compartments will be provided on the Odor and Toxic Offgassing Materials Usage list. The odor and toxic characteristics of each material on the list shall be evaluated.

The materials lists shall contain STS stowage location for the assembled piece of flight hardware and associated odor and toxicity values. MSFC-HDBK-527 gives a partial listing of these values. MSFC also has a resource, the Materials And Processes Technical Information Service (MAPTIS), which is available to help in gathering odor and toxicity ratings. This service is available through computer Telnet applications. The materials lists should also state if a material is not rated, or has not yet been tested.

For unavailable ratings, or for materials that have not been tested, odor and toxicity values should be measured at the NASA White Sands Test Facility (WSTF). Goddard Materials Engineering personnel will be available to arrange this WSTF testing. WSTF can test individual materials up to entire hardware assemblies. Flight materials or assemblies are required for this test.

15.49 DID 12-8: WAIVER

Title: Waiver	CDRL No.: 12-8

Reference:

Paragraph 12.3.7

Use:

For usage evaluation and approval of a material that has exceeded its shelf life or expiration date.

Related Documents:

None

Place/Time/Purpose of Delivery:

Provide to the GSFC Project Office for approval 30 days prior to the CDR or use.

Preparation Information:

A waiver shall be submitted for approval of uncured polymers that exceeded their expiration date or for flight approval of cured polymers and lubricated mechanism that have a limited shelf life.

For uncured polymers, mechanical and physical properties of polymer or paint samples made from same batch of expired uncured material or test data on identical expired uncured polymer or paint shall be submitted to demonstrate that the cured paint or polymer is acceptable.

For lubricated mechanisms and old polymer products such and o-rings, propellant tank diaphragms, seals dampers and tapes, mechanical and physical property data, test results and heritage performance information shall be submitted to demonstrate the flight acceptability of the hardware.

15.50 DID 12-9: INORGANIC MATERIALS AND COMPOSITES USAGE LIST

Title: Inorganic Materials and Composites Usage List	CDRL No.: 12-9
Reference: Paragraph 12.3.8	
Use: For usage evaluation and approval of all metal, ceramic and metal/ceramic composite material applications.	
Related Documents: MSFC-HDBK-527, NHB 1700.7, MSFC-SPEC-522	

Place/Time/Purpose of Delivery:

Provide to the GSFC Project Office 30 days before developer PDR for review, 30 days before developer CDR for approval and 30 days before acceptance for approval.

Preparation Information:

The hardware provider shall provide the information requested on the inorganic materials and composites usage list, the equivalent information on the hardware developer's forms or the equivalent information electronically.

The inorganic materials and composite usage list (1) form requires, as a minimum, the following information: spacecraft, subsystem or instrument name, GSFC technical officer, developer, developer address, prepared by, phone number, date of preparation, GSFC materials evaluator, evaluator's phone number, date received, item number, materials identification (2), condition (3), application or usage (4), expected environment (5), stress corrosion cracking table number, MUA number and NDE method. Notes 1 through 5 are listed below:

List all inorganic materials (metals, ceramics, glasses, liquids and metal/ceramic composites) except bearing and lubrication materials that should be listed on Form 18-59C.

Give materials name, identifying number manufacturer. Example:

a. Aluminum 6061-T6
b. Electroless nickel plate, Enplate Ni 410, Enthone, Inc
c. Fused silica, Corning 7940, Corning Class Works

Give details of the finished condition of the material, heat treat designation (hardness or strength), surface finish and coating, cold worked state, welding, brazing, etc. Example:

a. Heat-treated to Rockwell C 60 hardness, gold electroplated, brazed.
b. Surface coated with vapor deposited aluminum and magnesium fluoride
c. Cold worked to full hare condition, TIG welded and electroless nickel-plated.

Give details of where on the spacecraft the material shall be used (component) and its function. Example: Electronics box structure in attitude control system, not hermetically sealed.

Give the details of the environment that the material will experience as a finished S/C component, both in ground test and in space. Exclude vibration environment. List all materials with the same environment in a group. Example:

a. T/V: -20C/+60C, 2 weeks, 10E-5 torr, Ultraviolet radiation (UV)
b. Storage: up to 1 year at room temperature
c. Space: -10C/+20C, 2 years, 150 miles altitude, UV, electron, proton, Atomic Oxygen

DIRECTIVE NO. 300-PG-7120.2.2E

EFFECTIVE DATE: May 3, 2005

EXPIRATION DATE: May 3, 2010

15.51 DID 12-10: FASTENER CONTROL PLAN

Title: Fastener Control Plan	CDRL No.: 12-10
Reference: Paragraph 12.3.9	
Use: For evaluation and approval.	
Related Documents: 541-PG-8072.1.2, NHB 1700.7, GSFC 731-0005-83, GMI 1700.3	
Place/Time/Purpose of Delivery: Provide with proposal for GSFC review and 30 days before the PDR for approval.	
Preparation Information: The developer's fastener control plan shall address the following for flight hardware threaded fasteners that are used in structural or critical applications: a. acquisition/supplier control b. documentation/traceability c. receiving inspection/testing	

DIRECTIVE NO. 300-PG-7120.2.2E

EFFECTIVE DATE: May 3, 2005

EXPIRATION DATE: May 3, 2010

15.52 DID 12-11: LUBRICATION USAGE LIST

Title: Lubrication Usage List	CDRL No.:12-11
Reference: Paragraph 12.3.10	
Use: For evaluation and approval of all lubricant usage and applications.	
Related Documents: None	
Place/Time/Purpose of Delivery: Provide to the GSFC Project Office 30 days before developer PDR for review, 30 days before developer CDR for approval and 30 days before acceptance for approval.	

Preparation Information:

The hardware provider shall provide the information requested on the lubricant usage list, the equivalent information on the hardware developer's forms or the equivalent information electronically. The form is in the Mission Assurance Guide.

The lubricant usage list form requires, as the minimum, the following information: spacecraft, subsystem or instrument name, GSFC technical officer, developer, developer address, prepared by, phone number, date of preparation, GSFC materials evaluator, evaluator's phone number, date received, item number, component type, size, material (1); component manufacturer and manufacturer identification; proposed lubrication system and amount of lubrication; type and number of wear cycles (2); speed, temperature and atmosphere of operation (3); type and magnitude of loads (4) and other details (5). Notes 1 through 5 are listed below:

1. Ball bearing (BB), Sleeve bearing (SB), Gear (G), Sliding surfaces (SS), Sliding electrical contacts (SEC), Give generic identification of materials used for the component, (Examples: 440C steel, PTFE)
2. Continuous unidirectional rotation (CUR), Continuous oscillation (CO), intermittent rotation (IR), intermittent oscillation (IO), Small angle oscillation (< 30 degrees) SAM, large angle oscillation (> 30 degrees) (LAM), Continuous sliding (CS), Intermittent sliding (IS). Number of wear cycles: 1 to 1E2 (A), 1E2 to 1E4 (B), 1E4 to 1E6 (C), >1E6 (D)
3. Speed: revolution per min. (RPM), oscillation per min. (OPM), variable speed (VS), sliding speed in cm. per min. (CPM) Operational temperature range Atmosphere: vacuum, air, gas sealed or unsealed and pressure
4. Type of loads: Axial, radial, tangential (gear load). Give magnitude of load.
5. For ball bearings, give type and material of ball cage, number of shields, type of ball groove surface finishes. For gears, give surface treatment and hardness. For sleeve bearings, give the bore diameter and width. Provide the torque and torque margins.

15.53 DID 12-12: LIFE TEST PLAN FOR LUBRICATED MECHANISMS

Title: Life Test Plan for Lubricated Mechanisms	CDRL No.:12-12

Reference:

Paragraphs 12.3.10

Use:

For evaluation and approval of all lubricated mechanisms.

Related Documents

None

Place/Time/Purpose of Delivery:

Provide to the GSFC Project Office 30 days before developer PDR for review, 30 days before developer CDR for approval and 30 days before acceptance for approval.

Preparation Information:

The Life Test Plan for Lubricated Mechanisms shall contain:

a. Table of Contents

b. Description of all lubricated mechanisms, performance functions, summary of subsystem specifications and life requirements.

c. Heritage of identical mechanisms and descriptions of identical applications.

d. Design, drawings and lubrication system utilized by the mechanism.

e. Test plan including vacuum, temperature and vibration test environmental conditions of the test.

f. Criteria for a successful test.

g. Delivery of test hardware to GSFC after a successful test.

h. Final Report.

15.54 DID 12-13: MATERIAL PROCESS UTILIZATION LIST

Title: Material Process Utilization List	CDRL No.: 12-13

Reference:

Paragraph 12.3.11

Use:

For usage evaluation and approval of all material processes that are used to fabricate, clean, store, integrate and test the space flight hardware.

Related Documents:

None

Place/Time/Purpose of Delivery:

Provide to the GSFC Project Office 30 days before developer PDR for review, 30 days before developer CDR for approval and 30 days before acceptance for approval. . A copy of any process shall be submitted to the GSFC Project Office upon request.

Preparation Information:

The provider shall provide the information requested on the material process utilization list form, the equivalent information developer's forms or the equivalent information electronically. The form is in the Mission Assurance Guide.

The material process utilization list requires, as a minimum, the following information: spacecraft, subsystem or instrument name, GSFC technical officer, developer, address, prepared by, phone number, date of preparation, GSFC materials evaluator, evaluator's phone number, date received, date evaluated, item number, process type (1), developer spec. number (2), Military, ASTM, Federal or other specification number, description of material processed (3) and spacecraft/instrument application (4). Notes 1 through 4 are listed below:

1. Give generic name of the process. Example: anodizing (sulfuric acid)
2. If process is proprietary, please state so.
3. Identify the type and condition of the material subjected to the process. Example: 6061-T6
4. Identify the component or structure for which the materials are being processed. Example: Antenna dish.

All welding and brazing of all flight hardware, including repairs, shall be performed by certified operators in accordance with requirements of the appropriate industry or government standards listed in the Materials Process Utilization List , Fig. 12-6. A copy of the procedure qualification record (PQR) and a current copy of the operator qualification test record shall be provided along with the Materials Process Utilization List.

15.55 DID 12-14: CERTIFICATE OF RAW MATERIAL COMPLIANCE

Title: Certificate of Raw Material Compliance	CDRL No.: 12-14

Reference:

Paragraph 12.4.5

Use:

For information assuring acceptable flaw content, chemical composition and physical properties of raw material.

Related Documents:

None

Place/Time/Purpose of Delivery:

Provide to the GSFC project 15 days after request.

Preparation Information:

The provider shall provide information pertaining to the control of raw material. The developer shall provide sufficient information to ensure that the supplied material meets the specified requirements. The developer shall indicate the spacecraft and subsystem or instrument and part using the material.

The generic and manufacturer's designation (if any) shall be provided for the material including the type of test employed to verify material composition.

The provider shall indicate what tests have been performed to verify physical properties and the applicable standards controlling the testing. For example, the heat treat condition of aluminum alloys may be verified by mechanical testing or hardness and conductivity testing.

The provider shall indicate what nondestructive tests have been performed, the applicable standards controlling the testing, the type of flaw detected and the minimum detectable flaw found as a result of the testing.

15.56 DID 13-1: CONTAMINATION CONTROL PLAN

Title:	CDRL No.:
Contamination Control Plan	13-1

Reference:

Paragraph 13.1

Use:

To establish contamination allowances and methods for controlling contamination

Related Documents:

None.

Place/Time/Purpose of Delivery:

Provide to the Project Office 30 days before PDR for GSFC review and 30 days before the CDR for approval.

Preparation Information:

Data on material properties, on design features, on test data, on system tolerance of degraded performance, on methods to prevent degradation shall be provided to permit independent evaluation of contamination hazards. The items should be included in the plan for delivery:

1. Materials
   a. Outgassing as a function of temperature and time.
   b. Nature of outgassing chemistry.
   c. Areas, weight, location, view factors of critical surfaces.
2. Venting: size, location and relation to external surfaces.
3. Thermal vacuum test contamination monitoring plan including vacuum test data, QCM location and temperature, pressure data, system temperature profile and shroud temperature.
4. On orbit spacecraft and instrument performance as affected by contamination deposits.
   a. Contamination effect monitor.
   b. Methods to prevent and recover from contamination in orbit.
   c. How to evaluate in orbit degradation.
   d. Photopolymerization of outgassing products on critical surfaces.
   e. Space debris risks and protection.
   f. Atomic oxygen erosion and re-deposition.
5. Analysis of contamination impact on the satellite on orbit performance.
6. In orbit contamination impact from other sources such as STS, space station, and adjacent instruments.

Appendix A. Acronyms

ADPMPL	As-Designed Parts, Materials and Processes List
ANSI	American National Standards Institute
AR	Acceptance Review
ASIC	Application Specific Integrated Circuits
ASQ	American Society for Quality
ASQC	American Society for Quality Control
ASTM	American Society for Testing of Materials
BB	Ball Bearing
BGA	Ball Grid Array
CCB	Configuration Control Board
CCP	Contamination Control Plan
CDR	Critical Design Review
CDRL	Contract Delivery Requirements List
CI	Configuration Item
CIL	Critical Items List
CM	Configuration Management
CO	Continuous Oscillation
COB	Chip on Board
COTR	Contracting Officer Technical Representative
COTS	Commercial Off-The Shelf
CPT	Comprehensive Performance Test
CRM	Continuous Risk Management
CRMS	Continuous Risk Management System
CS	Continuous Sliding
CSCI	Computer Software Configuration Item
CUR	Continuous Unidirectional Rotation
CVCM	Collected Volatile Condensable Mass
DBMS	Database Management System
DID	Data Item Description
DoD	Department of Defense

DPA	Destructive Physical Analysis
EEE	Electrical, Electronic, and Electromechanical
EIA	Electronics Industry Alliance
ELV	Expendable Launch Vehicle
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
ETA	Event Tree Analysis
ETM	Environmental Test Matrix
ETR	Eastern Test Range
EWR	Eastern and Western Test Ranges
FAP	Flight Assurance Procedure
FAR	Federal Acquisition Regulations
FCA	Functional Configuration Audit
FMEA	Failure Modes and Effects Analysis
FMECA	Failure Modes and Effects and Criticality Analysis
FOR	Flight Operations Review
FRB	Failure Review Board
FRR	Flight Readiness Review
FTA	Fault Tree Analysis
G	Gear
GDS	Ground Data System
GEVS	General Environmental Verification Specification
GEVS-SE	General Environmental Verification Specification for STS & ELV Payloads, Subsystems and Components
GFE	Government-Furnished Equipment
GHB	Goddard Space Flight Center Handbook
GIA	Government Inspection Agency
GIDEP	Government Industry Data Exchange Program
GMI	Goddard Management Instruction
GOTS	Government Off-The-Shelf
GPG	Goddard Procedure and Guidelines
GSE	Ground Support Equipment

GSFC	Goddard Space Flight Center
HST	Hubble Space Telescope
I&T	Integration and Test
IAC	Independent Assurance Contractor
IATO	Independent Acceptance and Test Organization
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronics Engineers
IIRT	Integrated Independent Review Team
IO	Intermediate Oscillation
IOC	In Orbit Checkout
IPC	Association Connecting Electronics Industries
IR	Intermediate Rotation
IS	Instrument Sliding
ISO	International Organization for Standardization
ISS	International Space Station
IV&V	Independent Verification and Validation
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KHB	Kennedy Space Center Handbook
LEO	Launch and Early Orbit
LO	Large Oscillation
LRR	Launch Readiness Review
LRU	Line Replaceable Unit
LSSP	Launch Site Safety Plan
MAE	Materials Assurance Engineer
MAG	Mission Assurance Guidelines
MAPTIS	Materials and Processes Technical Information Service
MCM	Multi-Chip Module
MEB	Materials Engineering Branch
MLD	Master Logic Diagram
MOC	Mission Operations Center
MOR	Mission Operations Review
MOTS	Modified Off-The-Shelf

MPCB	Mass Properties Control Board
MRB	Material Review Board
MSFC	Marshall Space Flight Center
MSPSP	Missile System Prelaunch Safety Data Package
MTBF	Mean Time Between Failure
MTTR	Mean Time To Restore
MUA	Materials Usage Agreement
NASA	National Aeronautics and Space Administration
NHB	NASA Handbook
NPD	NASA Policy Directive
NPG	NASA Procedures and Guidelines
NPSL	NASA Parts Selection List
NRCA	Nonconformance Reporting and Corrective Action
NSS	NASA Safety Standard
NSTS	National Space Transportation System
ODA	Orbital Debris Assessment
OPM	Oscillations Per Minute
OSSMA	Office of Systems Safety and Mission Assurance
PAPL	Project Approved Parts List
PAPMPL	Project Approved Parts, Materials and Processes List
PCA	Physical Configuration Audit
PCB	Parts Control Board
PCP	Parts Control Plan
PDR	Preliminary Design Review
PE	Parts Engineer
PEM	Plastic Encapsulated Microcircuit
PER	Pre-Environmental Review
PFR	Problem/Failure Report
PG	Procedures and Guidelines
PHA	Preliminary Hazards Analysis
PI	Principal Investigator
PMP	Parts, Materials and Processes
PMPCB	Parts, Materials and Processes Control Board

PMPCP	Parts, Materials and Processes Control Program
PO	Post Office
POCC	Payload Operations Control Center
PPL	Preferred Parts List
PQR	Procedure Qualification Record
PRA	Probabilistic Risk Assessment
PSM	Project Safety Manager
PSR	Pre-Shipment Review
PWB	Printed Wiring Board
QA	Quality Assurance
QCI	Quality Conformance Inspection
QCM	Quartz Crystal Microbalance
QML	Qualified Manufacturer's List
QMS	Quality Management System
QPL	Qualified Parts List
RF	Radio Frequency
RFA	Request For Action
RFP	Request for Proposal
RH	Relative Humidity
RHA	Radiation hardness Assurance
RM	Reliability and Maintainability
RMA	Reliability, Maintainability and Availability
RMPP	Reliability and Maintainability Program Plan
RP	Reference Publication
RPM	Revolutions Per Minute
RSM	Range Safety Manual
RVM	Requirements Verification Matrix
SAE	Society of Automotive Engineers
SAM	Systems Assurance Manager
SAR	Safety Assessment Report
SB	Sleeve Bearing
SCC	Stress Corrosion Cracking
SCD	Source Control Drawing

SCM	Software Configuration Management
SDP	Safety Data Package
SEC	Sliding Electrical Contacts
SO	Small Oscillation
SOW	Statement of Work
SQA	Software Quality Assurance
SQE	Software Quality Engineering
SQMS	Software Quality Management System
SRO	Systems Review Office
SRP	System Review Program
SRR	System Requirements Review
SS	Sliding Surfaces
SSIP	System Safety Implementation Plan
STD	Standard
STS	Space Transportation System
SWRR	Software Requirements Review
TML	Total Mass Loss
TR	Torque Ratio
TRR	Test Readiness Review
URL	Uniform Resource Locator
UV	Ultraviolet
V&V	Verification and Validation
VS	Variable Speed
VTL	Verification Tracking Log
WFF	Wallops Flight Facility
WSTF	White Sands Test Facility
WTR	Western Test Range

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	4/7/99	New PG number initiated as a result of cancellation of GPG 8730.4. This PG replaces 300-PG-8730.4.2 with no changes other than numbering references to 7120.2 rather than 8730.4.
A	09/09/01	Total revamp of document.
B	06/24/02	Removed single quotation mark from the document title, section 1.4 References. Removed the quotation marks from the document title, section 1.5 Cancellation. Added GIDEP and NASA advisory as requirements to chapter 2.2.7. Added reference to various NASA software standards in Chapter 5, SW Assurance. Removed specific text specific to technical reviews from Chapter 6, GDS Assurance. Removed text specific to ISO QMS from Chapter 6, GDS Assurance. Added text to address flow-down of quality requirements. Updated references to ISO standard to the 2000 version. Added requirement that the manufacturer shall notify GSFC of any changes to a procured part's specification or design in chapter 11.3.1.1. Minor text edits within safety related sections and DIDs (specifically chapter 3.10 and DID 3-8).
C	03/14/03	Rewrite of chapter 3, Safety. Specific edits include but are not limited to adding software safety related text (chapter 3.11, adding System Safety Program Plan related text and associated DID, and removing System Safety Implementation Plan related text and associated DID. Rewrite of chapter 5 Software Assurance. Specific edits include but are not limited to rewrite of entire section to be in alignment with NASA Software Assurance Standard and to specifically and adequately address the software related disciplines that comprise software assurance including software quality assurance, software safety, software reliability, verification and validation, and IV&V. Added DIDs for software reliability plan and software safety plan, as well as NASA and industry related references pertaining to software. Revised text in chapter 11, specifically chapter 11.3.1.1 to address PEMs and chapter 11.6.1.4 to address parts in same lot date code. Added definitions for several missing terms including but not limited to mission assurance, reliability and maintainability.

Revision	Effective Date	Description of Changes
D	07/21/04	Replaced Chapter 7: Risk Management Requirements and the 7-1 DID. Rewrite to Chapter 5: Software Assurance Requirements. Specific edits include, but are not limited to, the separation of distinct Software Assurance requirements and DIDs from the Software Quality Section, 5.2.1, a change in numbering for DIDs 5.1 and 5.2, a major rewrite for the Software Reliability Section 5.2.3, and updates to Section 5.3 to align with the GPGs for Engineering Peer Reviews and the Integrated Independent Review process. Also deleted and/or wordsmithed detailed text that did not speak to actual software assurance requirements. Updated DIDs 5-1, 5-2, 5-3, 5-4, and 5-5. Major rewrite of Chapter 3: System Safety Requirements. Moved sections to appropriate places, purpose, references, cancellation, definitions and acronyms Significant rewrite of Chapter 8: Integrated Independent Review Requirements.
E	05/03/05	Chapter 1 Rewritten to remove extraneous information and verbiage. Chapter 2 Rewritten to remove extraneous information and verbiage. Modified Control of nonconformances. Chapter 3 – Re-written by Code 302 Chapter 4 - Updated to better define requirements and deliverables. Removed specific Maintainability requirements and deliverables and recommended custom tailoring of maintainability requirements when needed. Chapter 7 - Updated to incorporate requirements of NPR-7120.5C and NPR-8705.4. Chapter 8 - Updated per GPR 8700.4F to incorporate three new reviews prior to PDR (viz. MCR, MDR, SDR) Chapter 10 – Updated multiple sections to incorporate new requirements. Chapter 11 - This section was separated from Parts, Materials and Processes as a standalone Chapter for Parts Requirements .Chapter 12 – Materials and Processes Requirements was separated from Chapter 11 and is now Chapter 12 Chapter 13 – Was originally Chapter 12

		Original Chapter 13 – Electrostatic Discharge Control incorporated as Section 10.7 Original Chapter 14 – GIDEP Alerts and Problem Advisories incorporated in Section 2.3

ATTACHMENT L

List of Fees for Non-Government Use of Facilities

The following facilities and property are hereby authorized for non-Government use under the conditions set forth in this contract. The Monthly Rental charges are as listed.

The Maintenance charge is fixed @ 14% of the total contractor use cost before Center Overhead (unless noted otherwise)

Center Overhead is currently a 6% charge, based on the TOTAL contractor use (including maintenance).

Facility	Description	Monthly Rental
290	27'x 40' Thermal Vacuum Chamber	$47,511.00
403	Modal Test Facility, shaker & control room	$1,493.00
406	High Capacity Centrifuge Facility	$14,726.00
418	Acoustic Test Chamber & Control Room	$3,971.00
225	10'x15' Thermal Vacuum Chamber	$8,599.00
232	4'x4'x4' Temperature and Humidity Chamber	$1,477.00
234	Solar Calibration Unit	$1,477.00
237	7'x8' Thermal Vacuum Chamber	$3,015.00
238	12'x15' Thermal Vacuum Chamber	$3,015.00
239	7'x8' Thermal Vacuum Chamber	$3,015.00
240	3'x3' Thermal Vacuum Chamber	$1,477.00
241	3'x3' Thermal Vacuum Chamber	$1,477.00
245	2'x3' Vacuum Bake Out Chamber	$1,477.00
400	Mass Properties Measurement Facility	$4,073.00
402	Static Load Test Facility	$4,073.00
404	Load Test Machine- 60k Tinius Olson	$871.00
405	Load Test Machine- 120k Tinius Olson	$871.00
409	C220-1 Vibration Test Cell	$15,657.00
410	UD Vibration Test Cell	$24,657.00
411	B335-1 Vlbration Test Cell	$15,657.00
412	B335-2 Vibration Test Cell	$15,657.00
413	6 Degree Of Freedom Hydraulic Shaker	$15,657.00
416	Data Acquisition System	$1,500.00
417	Data Reduction Lab	$1,500.00
420	Small EMC Test Facility	$7,137.00
421	Large EMC Test Facility	$7,137.00
426	40 Ft Spacecraft Magnetic Test Facility	$1,645.00
Floor	Floor Space in Bldg 7/10/15/29 complex 1 square ft	$1.92

ATTACHMENT M

PERSONAL IDENTITY VERIFICATION (PIV) CARD ISSUANCE PROCEDURES

PIV Card Issuance Procedures in accordance with FAR clause 52.204-9, Personal Identity Verification of Contractor Personnel. FIPS 201 Appendix A graphically displays the following procedure for the issuance of a PIV credential.

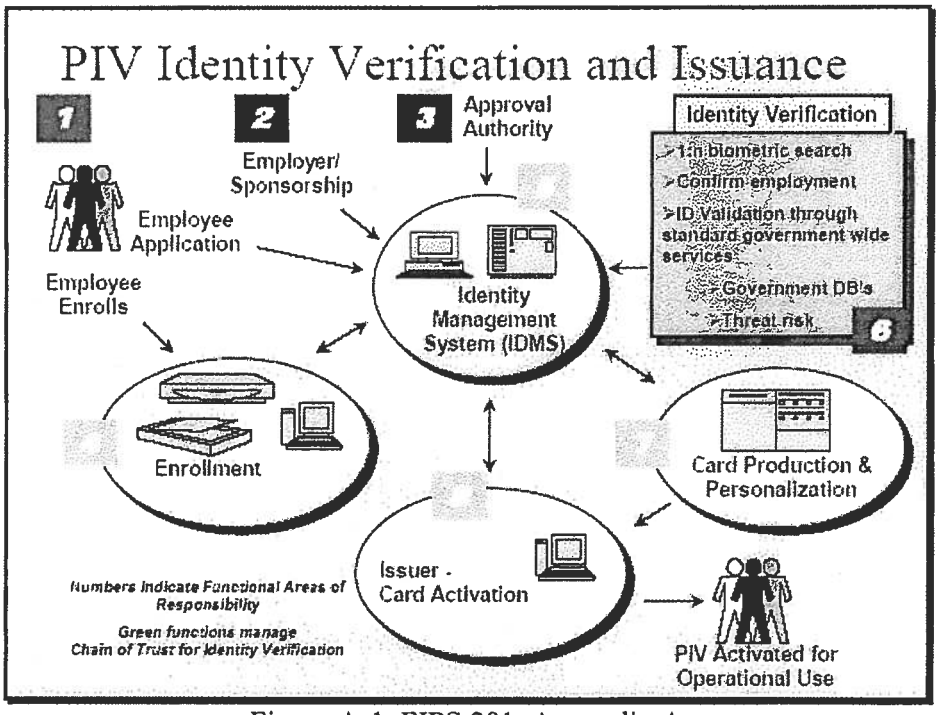

Figure A-1, FIPS 201, Appendix A

The following steps describe the procedures for the NASA Personal Identity Verification Card Issuance (PCI) of a PIV credential:

Step 1:
The Contractor's Corporate Security Officer (CSO), Program Manager (PM), or Facility Security Officer (FSO) submits a formal letter that provides a list of contract employees (applicant) names requesting access to the NASA Contracting Officer's Technical Representative (COTR). In the case of a foreign national applicant, approval through the NASA Foreign National Management System (NFNMS) must be obtained for the visit or assignment before any processing for a PIV credential can take place. Further, if the foreign national is not under a contract where a COTR has been officially designated, the foreign national will provide the information directly to their visit/assignment host, and the host sponsor will fulfill the duties of the COTR mentioned herein. In each case, the letter shall provide notification of the contract or foreign national employee's (hereafter the "applicant") full name (first, middle and last), social security number (SSN) or NASA Foreign National Management System Visitor Number if the foreign national does not have a SSN, and date of birth. If the contract employee has a current satisfactorily completed National Agency Check with Inquiries (NACI) or an equivalent or higher degree of background investigation, the letter shall indicate the type of investigation, the agency completing the investigation, and date the investigation was completed. Also, the letter must specify the

risk/sensitivity level associated with the position in which each applicant will be working (NPR 1600.1, §4.5 is germane) Further, the letter shall also acknowledge that contract employees may be denied access to NASA information or information systems based on an unsatisfactory background investigation/adjudication. .

After reviewing the letter for completeness and concurring with the risk/sensitivity levels, the COTR/host must forward the letter to the Center Chief of Security (CCS). The CCS shall review the OPM databases (e.g., DCII, PIP, et al.), and take appropriate steps to validate the applicant's investigation status. Requirements for a NACI or other investigation shall be initiated only if necessary.

Applicants who do not currently possess the required level of background investigation shall be directed to the e-QIP web site to complete the necessary background investigation forms online. The CCS shall provide to the COTR/host information and instructions on how to access the e-QIP for each contract or foreign national employee requiring access

Step 2:
Upon acceptance of the letter/background information, the applicant will be advised that in order to complete the investigative process, he or she must appear in-person before the authorized PIV registrar and submit two forms of identity source documents in original form. The identity source documents must come from the list of acceptable documents included in Form I-9, Employment Eligibility Verification, one which must be a Federal[1] or State issued picture identification. Fingerprints will be taken at this time. The applicant must appear **no later than** the entry on duty date.

When the applicant appears, the registrar will electronically scan the submitted documents; any document that appears invalid will be rejected by the registrar. The registrar will capture electronically both a facial image and fingerprints of the applicant. The information submitted by the applicant will be used to create or update the applicant identity record in the Identity Management System (IDMS).

Step 3:
Upon the applicant's completion of the investigative document, the CCS reviews the information, and resolves discrepancies with the applicant as necessary. When the applicant has appeared in person and completed fingerprints, the package is electronically submitted to initiate the NACI. The CCS includes a request for feedback on the NAC portion of the NACI at the time the request is submitted.

Step 4:
Prior to authorizing physical access of a contractor employee to a federally-controlled facility or access to a Federal information system, the CCS will a National Crime Information Center (NCIC) with an Interstate Identification Index check is/has been performed. In the case of a foreign national, a national check of the Bureau of Immigration and Customs Enforcement (BICE) database will be performed for each applicant. If this process yields negative information, the CCS will immediately notify the COTR/host of the determination regarding access made by the CCS.

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[1] A non-PIV government identification badge, including the NASA Photo Identification Badge, MAY NOT BE USED for the original issuance of a PIV vetted credential

Step 5:
Upon receipt of the completed NAC, the CCS will update IDMS from the NAC portion of the NACI and indicate the result of the suitability determination. If an unsatisfactory suitability determination is rendered, the COTR will advise the contractor that the employee is being denied physical access to all federally-controlled facilities and Federal information systems.

Based on a favorable NAC and NCIC/III or BICE check, the CCS will authorize the issuance of a PIV federal credential in the Physical Access Control System (PACS) database. The CCS, based on information provided by the COTR/host, will determine what physical access the applicant should be granted once the PIV issues the credential.

Step 6:
Using the information provided by the applicant during his or her in-person appearance, the PIV card production facility creates and instantiates the approved PIV card for the applicant with an activation date commensurate with the applicant's start date.

Step 7:
The applicant proceeds to the credential issuance facility to begin processing for receipt of his/her federal credential.

The applicant provides to the credential issuing operator proof of identity with documentation that meets the requirements of FIPS 201 (DHS Employment Eligibility Verification (Form I-9) documents. These documents **must** be the same documents submitted for registration.

The credential issuing operator will verify that the facial image, and optionally reference finger print, matches the enrollment data used to produce the card. Upon verification of identity, the operator will locate the employee's record in the PACS database, and modify the record to indicate the PIV card has been issued. The applicant will select a PIN for use with his or her new PIV card. Although root data is inaccessible to the operator, certain fields (hair color, eye color, et al.) may be modified to more accurately record the employee's information.

The applicant proceeds to a kiosk or other workstation to complete activation of the PIV card using the initial PIN entered at card issuance.

ALTERNATIVE FOR APPLICANTS WHO DO NOT HAVE A COMPLETED AND ADJUDICATED NAC AT THE TIME OF ENTRANCE ON DUTY

Steps 1 through 4 shall be accomplished for all applicants in accordance with the process described above. If the applicant is unable to appear in person until the time of entry on duty, or does not, for any other reason, have a completed and adjudicated NAC portion of the NACI at the time of entrance on duty, the following interim procedures shall apply.

1. If the documents required to submit the NACI have not been completed prior to EOD, the applicant will be instructed to complete all remaining requirements for submission of the investigation request. This includes presentation of I-9 documents and completion of fingerprints, if not already accomplished. If the applicant fails to complete these activities as prescribed in NPR 1600.1 (Chapters 3 & 4), it may be considered as failure to meet the conditions required for physical access to a federally-controlled facility or access to a Federal information system, and result in denial of such access.

2. Based on favorable results of the NCIC, the applicant shall be issued a temporary NASA identification card for a period not-to-exceed six months. If at the end of the six month period the NAC results have not been returned, the agency will at that time make a determination if an additional extension will be granted for the temporary identification card.

3. Upon return of the completed NAC, the process will continue from Step 5.