Jupiter
Icy
Moons
Orbiter

Problem/Failure Reporting (PFR) Requirements

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PROBLEM/FAILURE REPORTING (PFR) REQUIREMENTS FOR THE JUPITER ICY MOONS ORBITER (JIMO) PROJECT

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DOCUMENT CHANGE LOG

Revision	Date	Affected Pages	Reason for Change
-	1/30/04	All	Initial Draft

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1 INTRODUCTION

1.1 PURPOSE

This document establishes the requirements for reporting, analysis, corrective action, review, and closure of problem/failures documented for the JIMO Project in compliance with the JPL Flight Project Practices (Doc ID 58032).

1.2 SCOPE

This problem/failure reporting, analysis, and corrective action program covers all JIMO hardware, software, and support equipment and associated software. The requirements of this document apply to hardware during all activities involved in design, development, integration, test, and launch, until 30 days after launch.

1.3 APPLICABILITY AND RESPONSIBILITIES

This document applies to all Space System flight hardware and software, instruments and non-flight test and ground support hardware and software necessary to accomplish the mission. Primary responsibility for the implementation of the requirements of this document belongs to the cognizant design organization, partners, contractors and their respective subcontractors. These requirements shall be extended to subcontractors and suppliers through appropriate contractual documentation by all hardware and software developers.

2 APPLICABLE DOCUMENTS

The following documents, of the issue in effect on the date of invitation for bids, or request for proposal, form a part of this document to the extent specified herein. In case of conflict between the referenced document and this document, the conflict shall be presented to the Mission Assurance Manager for resolution.

2.1 JPL DOCUMENTS

D-8091	JPL Anomaly Resolution Standard
D-58032	JPL Flight Project Practices
D-560	JPL Standard for Flight Systems Safety
D-11119	Closed Loop Alert System
D-1926	JPL Spacecraft Significant Event File (SSEF)
D-53052	Category B Waiver Request/Approval process

3 PROBLEM/FAILURE REPORTING (P/FR) REQUIREMENTS

3.1 GENERAL REQUIREMENTS

The P/FR requirements shall apply to design, development, and testing of flight-like and flight hardware, firmware, and software. The comprehensive problem/failure reporting program will assure the following (in accordance with D-8091):

(a) Complete coverage of reportable incidents
(b) Timeliness, completeness, and depth of reporting
(c) Adequacy, completeness, and depth of analysis
(d) Adequacy and verification of corrective action
(e) Completeness of close out report documentation
(f) Assignment of P/FR risk ratings
(g) Assessment of P/FRs with significant residual mission risk (Red Flag P/FRs).

Two types of problem/failure reports will be utilized during flight hardware or software design, development, integration, test, and launch.

1. Developmental Problem/Failure Reports (DP/FR) for all non-flight and pre-qual hardware and software.
2. Formal Problem Failure Reports (P/FR) for qual, proto-flight, and flight hardware and software.

3.2 PROBLEM/FAILURE REPORTING REQUIREMENTS

The types of equipment and incidents covered by the problem/failure reporting system, as well as the starting point for generating each of the two types of reports (DP/FR and P/FR), are described below:

3.2.1 Items Covered by Reporting

The items listed below shall be covered by the problem/failure reporting system for incidents listed in paragraph 3.2.3, starting at the point defined in paragraph 3.2.2.

(a) Developmental Problem/Failure Reports (DP/FR) shall be utilized for reportable incidents involving the items listed below. DP/FRs may also be used during breadboard activities.
    a. Non-flight-like Hardware (e.g., breadboards and non-qual EM)
    b. Developmental Flight Software
    c. Support equipment (hardware and software) when not connected to flight hardware and for which a cause is determined.
    d. Test software

(b) Formal Problem/Failure Reports (P/FR) shall be utilized for all reportable incidents involving the following:
    a. Flight-like and Flight (FLT) hardware
    b. Flight software
    c. Support equipment (hardware and software) when connected to or in preparation for connecting to flight-like hardware.
    d. Facility equipment (hardware and software) when utilized or in preparation for use in test of flight-like hardware.
    e. Safety violations
    f. Test software

3.2.2 DP/FR and P/FR Starting Points

The required starting points for DP/FRs and P/FRs are defined below. Reporting requirements continue during all subsequent phases of testing, integration and launch.

DP/FRs are initiated to document incidents in:

(a) Non-flight-like Hardware beginning at first application of power of each non-flight like assembly.
(b) Developmental Flight Software beginning at software integration and testing.
(c) Support equipment hardware and software (including test and facility equipment) during GSE acceptance testing.
(d) Test software beginning at testing of non-flight like hardware.

PFRs are initiated to document incidents in:

(a) Flight-like and Flight Hardware beginning at first application of power.
(b) Flight Software beginning at acceptance testing and all subsequent testing and when testing with flight-like hardware.
(c) Support equipment hardware and software (including test and facility equipment) in acceptance test or while testing the items listed in (a) or (b).
(d) Facility equipment when used with items (a) or (b).
(e) Hardware damage or safety violations to flight-like or flight hardware, facilities, or personnel.
(f) Test software while testing items (a) or (b).

3.2.3 Incidents Requiring Reports

Incidents defined below require the initiation of a DP/FR or P/FR:

All hardware failures, damage, problems, malfunctions, anomalies, nonstandard or unexpected results, and incidents of performance outside specification limits, also incidents of anomalous dynamic performance such as glitches, drifts, transients, stepping, oscillations, etc. within specification limits.

All software and procedure problems, errors, ambiguities encountered with the software while utilized with project hardware or while being checked in preparation for operation with project hardware or while in the workstation environment.

All support equipment, test equipment, or test facilities problems, failures, and anomalous performance, including procedures and operator actions, while being utilized in conjunction with project hardware or while being checked in preparation for operation with project hardware.

All incidents involving actual or potential damage to hardware, software, or injury to personnel, from testing, handling, shipping, or storage.

3.2.4 Timeliness of Reporting and Release

All reportable incidents shall be documented and reported within two working days of incident/observation. The reports shall be released without delay, regardless of the incident's apparent magnitude, any initial assessment of criticality, or the existence of possible explanations.

3.2.5 Responsibility of Reporting

The individual in charge of the activity, the project hardware, software, test equipment, or support equipment at the time when a reportable incident occurs has

the primary responsibility to originate the DP/FR or P/FR, however, if not reported, any individual observing a reportable incident has a responsibility to originate a DP/FR or P/FR.

3.2.6 Form for Reporting

All problem/failure incidents shall be entered electronically into the JPL Unified Problem Reporting System (UPRS). For partners, contractors, or sub-contractors that are not using the UPRS, this requires transfer of information from their reporting system to the UPRS concurrently with the investigation to enable timely coordination and communication of the results of investigation and analyses.

3.2.7 Analysis Requirements

Analyses of the DP/FR or P/FR will be conducted to the extent necessary to define the problem, determine the failure mechanism, identify whether parts may have been overstressed as a result of the failure, address the effect of the incident on associated elements of the subsystem and the system (including near and long term effects on desired functional performance) and determine the necessary corrective action. The proposed corrective action will be analyzed to ensure that the implementation will address both the problem and any interactions with other elements of the subsystem and the system.

3.2.8 Corrective Action Requirements

The appropriate corrective action shall provide a solution to the problem with no adverse interactions with other elements of the subsystem and system. The corrective action shall be implemented, documented, and verified.

When corrective action is implemented, all documents defining changes in design configuration or document revisions shall be processed in accordance with configuration control requirements and referenced on the DP/FR or P/FR prior to closeout review and approval.

Verification of corrective action shall involve appropriate analyses, breadboard or prototype tests, rerun of qualification, protoflight or acceptance tests, regression testing, or the completion of special tests to ensure that correction has been accomplished. After completion of the corrective action, the item must again be subjected to the conditions under which the problem/failure occurred and must perform successfully under those conditions.

3.2.9 Failure Effects and Cause/Corrective Action Ratings

Each DP/FR or P/FR shall be assigned to a two-factored rating describing the assessment of the effects of the failure and the certainty of the corrective action.

3.2.9.1 Failure Effects Rating

The Failure Effects Rating is an assessment of the consequence or the impact of the problem or failure if it had occurred at that point in time that yields the greatest effect on the mission. Assume the failure occurs at the worst possible time, during ground test, in flight, or during any other mission phase. It shall not be an assessment of the adequacy of the corrective action. Redundancy shall not be considered in making this assessment. The assessment shall be 1,2, or 3 based on the criteria listed below:

Rating 1: Negligible effect on mission performance and system safety.
- (a) No appreciable change in functional capability
- (b) Minor degradation of engineering or science capability
- (c) Support equipment or test equipment problem/failure
- (d) SE, TE, or operator induced failure
- (e) Workmanship failures found at initial test opportunity
- (f) Causes negligible operational difficulties or constraints
- (g) Negligible or no reduction in lifetime
- (h) Cannot occur in flight
- (i) Minor safety violation

Rating 2: Significant effect on mission performance or system safety.
- (a) Appreciable change/degradation in functional capability
- (b) Appreciable degradation of engineering or science capability
- (c) Causes significant operational difficulties or constraints
- (d) Significant reduction in lifetime
- (e) Significant safety violation

Rating 3: Major or catastrophic effect on mission performance or system safety.
- (a) Major change/degradation in functional capability
- (b) Major degradation of engineering or science capability
- (c) Causes major operational difficulties or constraints
- (d) Major reduction in lifetime
- (e) Major safety violation

3.2.9.2 Cause and Corrective Action Rating

The Cause and Corrective Action Rating is an assessment of the certainty that the exact failure cause has been determined and that the corrective action will eliminate any known possibility of recurrence of the problem/failure in flight.

The assessment shall be 1, 2, 3, or 4 based on the criteria listed below:

Rating 1: Known Cause/Certainty in corrective action.
Analysis, corrective action and verification of correction are considered to have determined the root cause and have defined an effective corrective action that has

been implemented and verified by test or other demonstration. No known possibility of recurrence in flight.

Rating 2: Unknown Cause/Certainty in corrective action.
The cause could not be completely determined, but an effective corrective action has been implemented and verified by test or other demonstration; or the problem/failure (observed incident) could not be repeated in tests or checkouts. No known possibility of recurrence in flight.

Rating 3: Known Cause/Uncertainty in corrective action.
Analysis, corrective action and verification of correction are considered to have determined the cause, but effective corrective action has not been implemented and verified by test or other demonstration. Some possibility of recurrence in flight.

Rating 4: Unknown Cause/Uncertainty in corrective action.
The cause could not be completely determined and no effective corrective action has been implemented and verified by test or other demonstration. Some possibility of recurrence in flight.

3.2.9.3 Risk Assessment

3.2.9.3.1 Red Flag PFRs

All DP/FRs and P/FRs having a Failure Effect Rating of 2 or 3 coupled with a Failure Cause/Corrective Action rating of 3 or 4 are defined as "Red Flag" DP/FRs and P/FRs.

(a) Each DP/FR that is a potential Red Flag or a DP/FR with impact on flight hardware or software shall be converted to a P/FR and be subjected to the P/FR review/approval process.
(b) Each Red Flag P/FR must include a Red Flag Summary regarding the rationale for accepting the residual risk.
(c) The JPL Project Manager and the Contractor Project Manager (if applicable) shall review, approve and sign Red Flag P/FR closures to acknowledge understanding and acceptance of the defined residual mission risk.
(d) All Red Flag P/FRs shall be discussed at subsequent formal reviews as described in Project Review Plan.

Table 3-1 P/FR ratings

Failure Effect		Failure Cause/Corrective Action	
Negligible	1	1	Known cause/Certainty in corrective action
Significant	2	2	Unknown cause/Certainty in corrective action
Major	3	3	Known cause/Uncertainty in corrective action.
		4	Unknown cause/ Uncertainty in corrective action

3.2.9.3.1 Preliminary Rating of P/FRs

A preliminary rating in accordance with Table 3-1 above shall be assigned within 10 working days from date of incident to determine if there are potential Red Flag issues.

3.2.10 Safety Rating and Assessment

Each DP/FR and P/FR shall be reviewed by System Safety to determine if there is any potential adverse effect on personnel safety or hardware safety associated with the problem/failure. It is the responsibility of each DP/FR and P/FR reviewer to determine that the assigned safety ratings are appropriate.

All DP/FRs and P/FRs with a hardware or personnel safety issue shall have a safety risk assessment made by the JPL Systems Safety office and shall be reviewed and approved by the JPL Systems Safety engineer and the Contractor Safety Engineer (if applicable).

Guidelines of JPL D-560 shall be used for the safety assessment.

3.2.11 Spacecraft Significant Event File (SSEF) and Alert/Concern Assessment

Each DP/FR and P/FR shall be reviewed to determine if it meets the criteria for an SSEF issue as defined in D-1926 and/or if it meets the criteria for a JPL alert/concern issue (reference D-11119).

3.2.12 P/FR and DP/FR Review, Approval, and Closure

3.2.12.1 Formal P/FR Review, Approval, and Closure

Each P/FR requires the following signatures for review, approval, and closure:

(a) The cognizant engineer and reliability engineer will perform a preliminary review and sign-off of each P/FR. Each P/FR shall be assessed and rated for safety concerns, assigned a cause code, and a cause/corrective action rating.
(b) Closure of a P/FR requires that all appropriate signatures are on the P/FR as follows:

1) Cognizant Engineer and Project Element Manager (PEM) for all P/FRs.
2) Hardware Reliability Engineer for all P/FRs.
3) Flight System Engineer for P/FRs which:
    i. Result in an Engineering Change Request (ECR) to project hardware or software
    ii. Result in a waiver to level 4 or higher functional requirements.
    iii. Have a cause/corrective action rating of 2 or 4.

   In addition, the cognizant engineer or reliability engineer can decide that any other P/FR should be reviewed by the System Engineer.
4) Safety Engineer will review all P/FRs to assess for hardware or personnel safety issues.
5) Mission Assurance Manager for all P/FRs.
6) Flight System Manager and Project Engineer for P/FRs which result in an ECR or waiver to level 2 or higher requirements.
7) Project Manager and Flight System Manager for Red Flag P/FRs.

3.2.12.2 DP/FR Review, Approvals and Closure

Each DP/FR shall be subjected to the same process as the P/FRs; however, closure of a DP/FR only requires the Cognizant Engineer's and Project Element Manager (PEM) signature.

3.3 CONTRACTOR PROBLEM/FAILURE REPORTING REQUIREMENTS

3.3.1 General

Each Contractor organization external to JPL that is providing project hardware or software shall establish a system for controlling and monitoring the status of problem/failure reports prepared under its cognizance. The requirements for such a system shall be in accordance with this document. The use of a contractor's problem/failure reporting program requires the approval of the JPL Mission Assurance Manager. Contractors shall pass these requirements down to subcontractors/supplier.

3.3.2 Liaison and Submittals to JPL

1. The initial submittal to JPL shall consist of the contractor's report with (at least) initial reporting data sections completed. The submittal shall be sent electronically to the JPL UPRS or entered directly into the web-based UPRS system within 2 working days of the incident. The UPRS will then electronically inform the Contract Technical Manager and JPL Cognizant Engineer that the report is in the JPL UPRS automated system. The Monthly Technical Progress Reports will include a summary of DP/FRs and P/FRs generated during the reporting period.

2. Submittals of interim reports consisting of updated releases of the contractors' report and copies of referenced supplemental data and documents shall be sent to (or entered into) the JPL UPRS.

3. The final submittal to JPL shall consist of the contractor's signed P/FR with copies of referenced supplemental data and documents not previously submitted. The verification, analysis, and corrective action shall be reviewed and approved by both the contractor's Project Engineer and the Contractor's Product Assurance Manager prior to submittal of a Contractor signed P/FR to JPL. Also, in the case of Red Flag P/FR's, the Contractor's Project Manager must review and approve the P/FR. Submittals shall be sent to the JPL UPRS.

The P/FR shall not be considered closed by the contractor until it has been closed at JPL with approvals as described in paragraph 3.2.12.1.