Code 582

Flight Software Branch

FSW DCR Requirements

Flight Software Branch – Code 582

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FORWARD AND UPDATE HISTORY

This document defines the process to be implemented for documenting, tracking, and resolving FSW related Discrepancies or Change Requests (DCRs).

Version	Date	Description	Affected Pages
1.0	01/17/05	Original Baseline	All
1.1	04/15/05	Updated to reflect changes based on implementation by the SDO team. General formatting changes.	All
1.2	03/29/06	Updated to reflect addition of Re-use library field to the FSW DCR interface (see FSB DCR #150)	p. 6, Table 2.1.1-2

CONTENTS

1 Introduction 1
1.1 Purpose 1
1.2 Applicability 1
2 Process 2
2.1 The DCR Process 3
2.1.1 Originator Initiates a DCR 3
2.1.2. IRB Evaluates “Submitted” DCR 6
2.1.3. Assignee Upgrades DCR State to “In Work”, Starts Investigating DCR Solution 8
2.1.4. Assignee Implements DCR solution 8
2.1.5. IRB Evaluates DCR Implementation 9
2.1.6 CMO Performs Build Integration, Assignee Performs Build Integration Testing 10
2.1.7 Test Lead Promotes DCR to “Ready for Closure” or “In Test ” 11
2.1.8 Tester(s) performs DCR testing 11
2.1.9 Test Lead Evaluates DCR Tests and Results 12
2.1.10 IRB evaluates DCR for Closure 13
2.2 State Transition Diagram for the DCR Process 14
2.3 DCR Tracking and Status Reporting 15
2.4 General Metrics Generated by the DCR Tool 16
Appendix A - Rationale for the DCR states 18

TABLES AND FIGURES

Table 2.0-1 Tool-generated DCR fields 2
Table 2.1.1-1 High level product identification fields to be supplied by the originator of the DCR 4
Table 2.1.1-2 Additional fields to be supplied by the originator of the DCR 5
Table 2.1.2-1 Fields completed by the IRB Chair when assigning a DCR 7
Table 2.1.4-1 Fields completed by the assignee in the “Work Completed” state 9
Table 2.1.8-1 Fields completed by the tester when promoting a DCR to the “Test Completed” state 11
Figure 2.2-1 State Transition Diagram for the DCR Process 15
Figure 2.3-1 Example of a FSW DCR Report – DCRs by Subtype 16

1 INTRODUCTION

1.1 PURPOSE

This document defines the process to be implemented for documenting, tracking, and resolving FSW related Discrepancies or Change Requests (DCRs). The roles and responsibilities of the different groups taking part in the DCR process shall also be defined herein.

1.2 APPLICABILITY

This procedure applies to all FSW Branch teams implementing or testing systems.

2 PROCESS

All personnel involved in FSW related activities are authorized and required to document a discrepancy or a request for change in a FSW related product as soon as the problem is identified. Products subject to a DCR include all items associated with a FSW development or test activity (e.g., FSW code, simulators, tools, testbeds or documents). A DCR may be written against all applicable products but is required after the products have been baselined or successfully integrated into a FSW testbed and delivered to a test team.

The DCR process shall be implemented through the use of a tool configured to track the affected products while capturing the attributes of every documented DCR. The list of products to be tracked in the DCR tool shall be defined by the FSW Product Development Lead (PDL) and shall comprise unique product identifiers such as the examples provided in the categories listed below:

- FSW Subsystems (e.g., Main CPU C&DH, Main GN&C, PSE C&DH, Instrument Software)
- FSW Subsystems' Components (e.g., Checksum, Data Storage, Recorder Management, Bootstrap, Health & Safety
- Documentation (e.g., Flight Software Subsystem Specification, Flight Software, Requirements Documents, Interface Control Documents, User's guides)
- Receivables--H/W and S/W problems should be tracked (e.g., Simulators, Ground Systems, ETUs, Breadboards)
- Tools (e.g., CM tools, DCR systems)
- COTS (e.g., RTOS, Compilers, Optimizers)
- Test Procedures (see Note below)
- Telemetry and Command databases

Note: Because they undergo numerous changes throughout the FSW test program, test procedures and Telemetry and Command databases should be sufficiently developed before they are tracked through the DCR process. Both "Build" and "System" level test history indicates that by the time the "Acceptance Testing" phase is reached, test procedures are mature enough to be baselined. Therefore, test procedure modifications shall be tracked no later than the beginning of "Acceptance Testing".

Numerous input fields shall be configured into the DCR tool to facilitate the capture of relevant DCR data (e.g., problem definition, symptoms, impacts, etc.) and to track the DCR's evolution from the time of submittal to closure. Most of this information shall be supplied by the user, but some fields shall be automatically generated by the tool. The following table contains the list of fields to be automatically generated, and may be augmented as more fields are identified.

Table 2.0-1 Tool-generated DCR fields

Field Name	Field Description
Project Identifier	The name of the FSW project or mission against which the DCR is being submitted.
DCR ID	A sequential identification number that uniquely identifies the DCR. This number shall be set when the DCR is submitted.

Field Name	Field Description
Status	When a DCR is submitted, its initial status is automatically set to "Submitted". This is the only time where the status assignment is an automated function of the DCR tool. As the DCR goes through different states, the status shall be updated by the appropriate authority to: "Assigned", "In Work", "Work Completed", "Build Integration", "In Test", "Test Completed" "Ready for Closure", "Closed", "Closed with Defect, "On Hold", or "Rejected".
Submit Date	Date when the DCR is submitted.
Assigned Date	Date when a software developer or designated expert is assigned responsibility to investigate and resolve the DCR. This date shall be set when the IRB changes the DCR status to "Assigned".
In Work Date	Date when the assignee initiates work on the DCR.
Work Completion Date	Date when the DCR solution and all related work have been completed by the assignee. This date shall be set when the assignee updates the DCR status to "Work Completed".
Test Completion Date	Date when testing is completed.
Closed Date	Date when the DCR is closed by the IRB. This date shall be set when the IRB updates the DCR status to "Closed", "Closed with Defect" or "Cancelled".

2.1 THE DCR PROCESS

All FSW teams shall designate a DCR coordinator to assume the responsibility of controlling the DCR process. The DCR coordinator is often the CMO, or the Chair of the Internal Review Board (IRB), which is a Configuration Control Board that operates internal to an integrated FSW development team. The IRB has the responsibility to disposition each DCR written against any product associated with a FSW development, and to track each DCR status to closure. DCRs that will impact FSW team cost or schedule are raised to the Project level CCB for approval authority prior to dispositioning by the IRB.

The IRB consists of all FSW team leads and additional special expertise as necessary to facilitate decision making and ensure DCR status communications among the full set of development, test and associated team leads. The IRB "requires" the membership of all team leads associated with the development of a FSW activity. The FSW Product Development Lead (PDL) Chairs the IRB.

The IRB shall oversee all steps of the DCR process. The IRB shall determine the initial disposition of submitted DCRs and must approve all change or discrepancy resolutions before they can be applied to the configured products. As appropriate, the IRB shall consult relevant experts (e.g., systems engineers, simulation personnel) and with the concurrence of the board members shall determine the proper disposition of any given DCR.

As DCRs are processed, they shall undergo several state transitions, which occur when responsibility for the DCRs changes from one person or group to another (throughout this document, state transitions are marked in bold). These states are defined in the following subsections and represent important milestones in the process of identifying, resolving, verifying, and closing DCRs (see State Transition Diagram in section 2.2).

2.1.1 Originator Initiates a DCR

[Resulting DCR State: "Submitted"]

When someone discovers a problem or perceives a need for change in a FSW related product, this person is required to document the problem or change request via a DCR. All personnel involved in FSW related activities (developers, testers, systems engineers, I&T personnel etc.) can submit a DCR. The submitter

shall be the person who discovered the problem to ensure that the problem is accurately and completely described, reducing the potential for misinformation, which could lead to errors in assessing the DCR. This restriction is also intended to ensure that the source of the DCR is acknowledged via DCR metrics.

The DCR originator is expected to provide supporting information that describes the discrepancy or change request (DCR), identifies the affected product(s), and any other data to facilitate the assessment of the DCR. The following sequence shall occur:

- The originator shall access the DCR system to document the DCR by filling out the fields listed in Table 2.1.1-1 and 2.1.1-2. This initial documentation process is not visible to others until the originator officially "submits" the DCR information.

- The originator submits the DCR. With this action, the DCR state shall be automatically set to "Submitted", and the DCR becomes visible to others. This initial state is the only time when the submitter has the option of withdrawing the DCR.

When a DCR is "Submitted", the IRB shall be automatically notified by the DCR tool; the "DCR ID", the DCR "Status" and the "Submit Date" shall be automatically generated by the DCR system.

Table 2.1.1-1 High level product identification fields to be supplied by the originator of the DCR

Field Name	Field Description
Product Area	The general area against which the discrepancy or change request is being submitted. This includes the following: - FSW - Ground Support SW/HW - FSW tools - Documentation - Test Procedures - Simulators - Other
Subsystem[1]	The list of applicable subsystems belonging to the selected Product Area. For example, the following subsystems would be applicable to **FSW**: - COMMON FSW - EVE - GCE - MP-ACS - MP-C&DH - PSE - S-COMM - … The following would apply to **Simulators**: - GDS - Instrument Simulators - SComm - Other

[1] Different categories/sub-categories may be derived, based on the "Product Area" selected (i.e., a category other than Subsystem or "Document Type" might apply to other Product Areas).

Field Name	Field Description
Document Type[1]	If the selected Product Area is "Documentation", the document type may be one of the following: - Requirements - ICDs - Algorithms - Cmd & Tlm Definitions - Users' Guides - Other

Table 2.1.1-2 Additional fields to be supplied by the originator of the DCR

Field Name	Field Description
Product	The FSW related element in which the discrepancy was found, or for which the change request is being submitted. This category shall include the relevant FSW subsystems, ground systems, test bed hardware, simulators, tools, documentation and all other products that support FSW development or testing. Depending on the DCR, the product may be identified at a high level, as in Table 2.1.1-1, but is generally further derived from the categories listed in that table. **Refer to the PDL-defined Product List for contents (see list following second paragraph of section 2 for examples).**
Type	DCR types are **Discrepancy** and **Change**: A software "discrepancy" report formally documents an error in a controlled FSW product (i.e., a product that has been delivered and is subject to configuration control). A software "change" formally documents a request to change a controlled product (e.g., enhancement, new requirement). If the DCR is against an external product, the IRB Chair or PDL shall re-designate the type as "External DCR" and initiate a CCR (or equivalent) to the relevant external subsystem. *Unless otherwise noted, the activities defined in all the states (Figure 2.2-1) apply to both "Discrepancy" and "Change".*
Subtype	As with most other fields supplied by the DCR's originator, the subtype may be changed after evaluation by the IRB. When appropriate, more than 1 option can be selected. The following options apply to change requests 1. Enhancement 2. New Requirement 3. Deleted Requirement 4. Corrected Requirement 5. Other The following options apply to discrepancies 1. Incorrect Implementation 2. Tables (Stored Command, Telemetry Monitor, and data filter) 3. Incorrect Operation or Unexpected Behavior 4. Performance 5. Cosmetic 6. Other
Originator	Name of the person submitting the DCR.
Title	A short description of the discrepancy or change (less than 60 characters). The title should be descriptive and unique as it may be the only descriptive text displayed for each DCR in many reviews/reports.

Field Name	Field Description
Discrepancy/Change Description	A detailed explanation of the discrepancy report or requested change. Include all symptoms, observed output (i.e., event messages, system responses, test results, dumps, and/or debug output) and a detailed description of the system environment in which the discrepancy occurred. Provide enough relevant detail to assist the Internal Review Board (IRB) in their evaluation of the DCR merits and their assignment of the DCR for work.
Reuse-Library	"Yes" or "No" option field to indicate whether the affected product is from the FSW Reuse Library (e.g., cFE).
Severity	Severity is the originator's assessment of the impact of the DCR on ongoing FSW-related activities. Severity typically applies to discrepancies. The severity level can be reevaluated and modified by the IRB. Severity levels: 1 – Critical: A discrepancy that prevents test team progress or operational use of the FSW subsystem, or that has direct impact upon the FSW subsystem milestone schedules. Discrepancies that prevent the use of a build or release; no work-around is possible or practical. 2 – Moderate: A discrepancy that prohibits successful completion of one or more test variations, but is not currently affecting schedules. An operational discrepancy that can be temporarily handled procedurally, but has an adverse effect on the system. Discrepancies that are serious but that do not prevent using or testing a required capability. 3 – Minor: A discrepancy that does not prohibit successful completion of a test. This category involves minor deviations from task or project standards.
Additional Products Affected	Subsystem (and/or other components) and documentation impacted by the DCR. A pull-down menu or equivalent shall be provided..
Build Found	The software build (or iteration, or release) against which the discrepancy is discovered or during which the change request is formulated
Notes	Comments provided during the life cycle of the DCR.

2.1.2 IRB Evaluates "Submitted" DCR

[Resulting DCR State: "On Hold", "Cancelled" or "Assigned"]

Upon receipt of a Submitted DCR, the DCR coordinator/IRB Chair shall conduct a validation check to assess whether the discrepancy or change request is clearly stated and shall verify that all required information has been provided by the originator of the DCR.

The following dispositions may result from the initial IRB assessment of the DCR:

1) "On Hold"

- If the DCR is too vague or insufficiently informative, the IRB may change the DCR status to "On Hold" until further clarification has been provided.

- If the DCR resolution might have cost or schedule ramifications or significantly affect other subsystems or system resources, the DCR may be put "On Hold" and referred to the appropriate authority for further assessment (may be raised to the Project's CCB level).

- If the DCR is against an externally developed product or document, the IRB Chair shall re-designate the DCR type as "External DCR", change its status from "Submitted" to "On Hold" and

route the DCR to the responsible organization. In such cases, the DCR shall retain the "On Hold" status in the FSW DCR system until it has been addressed by the external organization and delivered to the FSW team. Upon delivery, the DCR will enter the "Ready for Closure" state of the FSW DCR cycle or any appropriate state determined by the PDL. If the DCR is eligible for testing by the FSW team and is successfully verified, it shall evolve to the "Closed" state; if the DCR fails testing, it shall be marked "Closed with Defect".

The "Submitted" state is the initial though not unique state during which a DCR may be put on hold. At the IRB's discretion, a DCR may be put on hold from any of the following DCR states: "Submitted", "Assigned", "In Work", "Work Completed", and "Build Integration".

When a DCR is assigned the "On Hold" state, the "Notes" field should be used to describe the reason(s) and, if possible, the conditions under which the DCR may be reactivated, and/or a date when the DCR should be revisited to consider reassigning or rejecting it.

An "On Hold" DCR may be re-initiated by the IRB at any time. The IRB may decide to assign the DCR for work, or may select another appropriate state for the DCR based upon its status prior to being put "On Hold".

2) "Cancelled"

- Initiated by the DCR's originator:

  The DCR's originator may decide to withdraw the DCR. This choice must be made in agreement with or after discussion with the IRB (IRB Chair). Justification for the withdrawal shall be provided in the "Notes" field and the IRB Chair shall change the DCR status to "Cancelled".

  Originator initiated cancellations are allowed only from the "Submitted" state of the DCR cycle.

- Initiated by the IRB:

  The IRB may also decide to reject the DCR if it is found to be without merit. Justification for the rejection shall be provided in the "Notes" field and the IRB Chair shall change the DCR status to "Cancelled".

The IRB may cancel DCRs for various reasons at different stages of the DCR cycle. For instance, most discrepancies due to operator errors should be rejected. IRB initiated cancellations may take place during the following states: "Submitted", "Assigned" "In Work", "Work Completed", and "Build Integration".

When a DCR is cancelled the "Notes" field should be used to describe the reason for the cancellation; the "Closed Date" shall be automatically entered by the DCR system.

3) "Assigned"

If the IRB decides to assign the DCR for work, a developer or other qualified individual shall be identified and tasked to investigate and resolve the DCR. To complete the assignment process, the IRB Chair shall fill out the fields listed in the table below.

Table 2.1.2-1 Fields completed by the IRB Chair when assigning a DCR

Field Name	Field Description
Assigned To	The name of the software developer or expert assigned to resolve the DCR.

Field Name	Field Description
Priority	The IRB's assessment of the relative importance of the DCR. Priority levels are: High, Medium, or Low. **High**- The problem should be addressed without delay. **Medium**- The problem should be addressed as soon as higher priority items have been resolved. **Low**- The problem can be addressed whenever time permits.
Related DCRs	List of any DCRs related to the current one.
Target Build	Build (or iteration, or release) by which resolution of the discrepancy or implementation of the change is required.

At the end of the assignment process, the IRB Chair shall upgrade the DCR state from "Submitted" to "Assigned". The "Assigned Date" shall be automatically set, and the assignee automatically notified by the DCR system.

Note: The IRB may update previously recorded submittal information as necessary. The IRB Chair is the only one with the authority to "Cancel", place a DCR "On Hold", or promote a DCR to closure ("Closed" or "Closed with Defect").

2.1.3 Assignee Upgrades DCR State to "In Work", Starts Investigating DCR Solution

[Resulting DCR State: "In Work"]

After receiving notification of the assignment, the assignee shall assume responsibility for the DCR by upgrading its status to "In Work". The "In Work Date" shall be automatically assigned by the DCR tool.

Case: Discrepancy – The assignee shall initiate the analysis process to determine the cause of the discrepancy and identify a solution.

Analysis of the discrepancy may yield the following results:

1. The DCR is not an actual problem but rather an operational error. The assignee shall notify the IRB and the IRB Chair may "Cancel" the DCR.

2. The DCR is not due to a FSW problem but applies to an external subsystem. The assignee shall notify the IRB and the IRB Chair shall re-categorize the DCR as an External DCR, as detailed in section 2.1.2.

3. If the assignee identifies a FSW solution, the IRB may have a review of the proposed implementation. Upon approval, the assignee shall proceed to the implementation stage, unless the IRB requests further analysis.

Case: Change Request – For a change request, the assignee will verify the feasibility of the change proposed by the DCR originator.

2.1.4 Assignee Implements DCR solution

[Resulting DCR State: "Work Completed"]

If the solution proposed by the assignee is approved by the IRB, the assignee shall do the following:

1. Implement the solution according to FSB approved guidelines.

2. Verify the implementation by performing comprehensive unit testing (if applicable).

3. Update any other affected products (e.g., subsystems and documents affected, related DCRs).

4. Complete the relevant DCR fields (listed in the table below) to quantify the effort (e.g., time, resources) that was required to fix the problem and to describe the work performed to implement the DCR solution.

Table 2.1.4-1 Fields completed by the assignee in the "Work Completed" state

Field Name	Field Description
Effort Required to Fix Problem	Assessment of the time, resources and amount of work needed to resolve the DCR.
Solution Description	Describes the work performed to resolve the DCR and of the tests to run for verification
Original Problem Source	This is the life cycle phase during which the problem was introduced into the system. At a minimum, the "Original Problem Source" list should include: • Requirements documents • System Design • Preliminary Design • Critical Design • Unit design • Unit Code • Unit Test (If the problem could have been detected during unit testing) • Build Integration Test (e.g., C&T databases, test system I/F problem) • Build Verification [Test Procedure or Testbed errors]
Description of Work-Around (if applicable)	Describes work around if the solution does not completely resolve the DCR.

5. Upgrade the DCR status from "In Work" to "Work Completed". The "Work Completion Date" shall be automatically assigned the DCR tool, and the IRB shall be automatically notified of the new DCR status.

2.1.5 IRB Evaluates DCR Implementation

[Resulting DCR State: "Ready for Closure", reversal to "In Work", or "Build Integration"]

Subsequent to the notification of the "Work Completed" status, the IRB Chair or development lead shall review the implemented solution to evaluate the readiness of the DCR to be incorporated into the current build and be submitted for test.

1. For Documentation, or requirements that have not yet been implemented (i.e., changes that would only affect a requirements document), the IRB may promote the DCR to "Ready for Closure" and shall close the DCR when a new version of the document has been issued.

2. For DCRs that required changes to the FSW code, the IRB Chair shall evaluate readiness based on the following criteria:

   a) Does the solution adequately address the problem?

   b) Is the solution complete or partial (work around required)?

   c) Do the unit tests conducted adequately verify the solution?

   Based on this evaluation, the IRB Chair shall select one of the following options (see Note):

   a). Revert the DCR to "In Work"

   If the solution of the DCR is not approved by the IRB, the DCR shall be reverted to the "In Work" state and the assignee shall be instructed to rework the implementation of the solution.

   b) Upgrade the DCR to "Build Integration"

   If the evaluation criteria are favorably answered, the IRB Chair shall promote the DCR to the "Build Integration" state.

Note- If warranted, the IRB may elect to cancel the DCR, an option that is allowable up to and including the "Work Completed" state (see State Transition Diagram in Section 2.2).

2.1.6 CMO Performs Build Integration, Assignee Performs Build Integration Testing

[Resulting DCR State: "Ready for Test"]

In the "Build Integration" state, all DCR-related information and documentation should be verified for correctness, completeness and availability for review or assessment purposes. Based on the nature of the DCR solution, the following activities shall take place:

1. FSW developer(s) completes "FSW" Build Integration Testing- For DCRs that required changes to the FSW code, the fixed code shall be committed to CM and integrated into a tagged FSW build by the CMO. Then, the responsible developer(s) shall perform all applicable Build Integration testing to ensure that the fixed code, incorporated into the tagged build, functions as intended.

   Or

2. Assignee prepares DCR for release to independent test team-For DCRs that did not result in changes to the FSW code itself but to ancillary products such as a FSW development tool, the assignee shall integrate and verify the functionality of the code change (based on the approved delivery practices for the particular tool or product), update DCR-related information as needed before the fixed component can be released for independent testing.

3. Development Lead or designee upgrades DCR to "In Test"

   Upon successful completion of build integration testing, or otherwise verifying the readiness of a DCR for independent testing (option B, above), the development lead or designee shall upgrade the DCR status to "In Test". Notification shall be automatically sent out to the IRB and the Test Lead.

After certifying that all other DCRs slated for the same build have been properly build-integrated or configured, the build (see Note) shall be released to the Test Team for independent testing.

Note: In this context, "build" refers to a release, which may also contain elements that are not integrated into a "FSW" build but are part of the FSW testbed(s).

2.1.7 Test Lead Promotes DCR to "Ready for Closure" or "In Test "

[Resulting DCR State: "Ready for Closure" or "In Test"]

When the build or release is delivered to the test team, the Test Lead shall review the release contents to determine whether to assign a DCR for test or designate the DCR for closure.

1. If a DCR is not suitable for Build Verification testing (e.g., changes that addressed a class or function name change), the Test Lead shall upgrade the DCR to "Ready for Closure" and select option 4 as the verification method used for that DCR (see Table 2.1.8-1).

   Or

2. For DCRs that are eligible for Build Verification or independent testing by the Test Team, the Test Lead shall designate an individual tester (if no tester had already been assigned). The "Tester's Name" shall be filled in by the test Lead and the responsible tester notified.

2.1.8 Tester(s) performs DCR testing

[Resulting DCR state "Test Completed"]

When a DCR has been assigned for test, the designated tester has the responsibility to verify the solution of the DCR through adequate Build verification testing. The tester shall perform the following tasks:

1. Conduct the necessary testing to verify the solution, and perform any appropriate regression testing.

2. Document the nature and outcome of the tests and produce a "Test Execution Summary" according to the "FSB Test Execution Summary" template (see FSW Test Plan document for location).

3. Upgrade the DCR state to "Test Completed"-

   Before assigning the "Test Completed" status to a DCR, the tester must ensure that sufficient details have been provided to enable the IRB to determine the final disposition of the DCR. Further information such as the location of the test reports, shall be provided by the tester by filling out the information in Table 2.1.8-1.

   When indicating test outcome, a case of failure should be documented with additional information expressing, for instance, whether a workaround may be used or whether the fix completely failed testing. In both cases, the "Closed with Defect" status shall result when the DCR goes through the final IRB evaluation. When a workaround exists, that closure state may be the final resolution for the DCR, otherwise, a new DCR shall be opened.

Table 2.1.8-1 Fields completed by the tester when promoting a DCR to the "Test Completed" state

Field Name	Field Description
Build	FSW build against which the DCR was tested.
Log Folder	Folder or directory in which the test log file is located.

Field Name	Field Description
Log File	File containing the test results.
Procedure Name(s)	Name of the procedure(s) used to test the DCR.
Verification method	Method used by the tester to verify the DCR. There are 4 possible options: 1) Demonstration 2) Analysis 3) Inspection 4) Testing not applicable at this level *When this option is selected, it indicates that verification was done by another party; details shall be provided in the "Tester's Comments" field. This option shall be selected by the Test Lead.
Test outcome	The test outcome can be any of the following 3 options: 1) DCR testing passed 2) DCR testing failed 3) DCR testing failed but a workaround can be used.
Tester's Comments	This field allows the tester to provide a summary of the tests conducted and any relevant details such as whether a work-around is required to fully address the DCR

The "Test Completed Date" shall be automatically filled in when the tester updates the DCR status to "Test Completed". Notification shall be sent out to the Test Lead and the IRB.

Note: The Test Lead shall be able to modify the fields above while in the process of verifying the test results.

2.1.9 Test Lead Evaluates DCR Tests and Results

[Resulting DCR State: Reversal to "In Test", or "Ready for Closure"]

Upon notification of a DCR promotion to "Test Completed", the Test Lead must determine whether the tests were adequate, and shall perform the following activities:

1. Assess the tests and their results, by means of one of the following 2 options:

   a) Conduct a "Test Results" review according to the "Test Peer Review" guidelines located in the "FSW Test Plan" document

   or

   b) Review the test results documented in the DCR tool, together with supporting material such as test logs.

   If necessary, the Test Lead may update related documentation (e.g., test report, User's guide modifications).

2. Revert the DCR to "In Test" - If the tests are deemed inadequate or otherwise unsatisfactory, the Test Lead shall revert the DCR to the "In Test" state and direct the tester to retest the DCR.

3. Upgrade DCR state to “Ready for Closure” - The Test Lead must verify and ascertain the validity and completeness of tests, and adequate documentation of the results before changing the DCR status to “Ready for Closure. If all the evaluation criteria are successfully met, the Test Lead shall upgrade the DCR to “Ready for Closure”. The IRB shall be automatically notified by the DCR system.

2.1.10 IRB evaluates DCR for Closure

[Resulting DCR State: “Closed” or “Closed with Defect”]

At this final state of the DCR cycle, the IRB Chair shall review the DCR to ensure that all DCR-related activities have been satisfactorily completed. The IRB Chair shall review all the fields in each DCR before selecting the “Closed “status. The IRB Chair shall verify that:

- All required DCR fields have been completed.
- The solution described by the developer is adequate to address the discrepancy report or change request.
- The test(s) described by the tester is adequate to verify the solution.
- ·Test outcome is clearly indicated.
- All documentation has been updated

The IRB evaluation shall result in one the following outcomes:

1) IRB upgrades DCR state to "Closed"

The “Closed” status shall be selected by the IRB if the DCR successfully passed testing and met all other criteria for closure. When the IRB closes the DCR, the “Closed Date” shall be automatically filled in; the “Phase Completed” field shall be entered by the IRB. This is the phase during which the discrepancy was resolved. For example:

- Requirements Analysis
- Preliminary Design
- Detailed Design
- Code
- Unit Test
- Build Integration
- Build Verification
- System Validation
- Spacecraft I&T (?)
- Maintenance (the DCR process may differ in the maintenance phase)

2) IRB upgrades DCR state to "Closed With Defect":

If the DCR was not satisfactorily resolved, the IRB Chair shall select the "Closed with Defect" status. This status may be assigned due to the following reasons:

a) The DCR failed testing

b) The DCR has been resolved, though not optimally, or a work-around is required.

c) The change corrected the problem, but introduced other problems.

DCRs with this closure state may require a waiver from the appropriate authority (e.g., the Project Office). At each project's discretion, some of these DCRs, especially those due to total failure, may result in a new DCR submission.

The "Notes" field shall be used to describe the exact reason why the DCR was assigned the "Closed With Defect" status. If a workaround is to be used, it should be clearly described.

The "Closed Date" will automatically be entered by the DCR system. Notification shall be automatically sent out to the Originator, the IRB, the Assignee, the Test and Development Leads and the CMO.

2.2 STATE TRANSITION DIAGRAM FOR THE DCR PROCESS

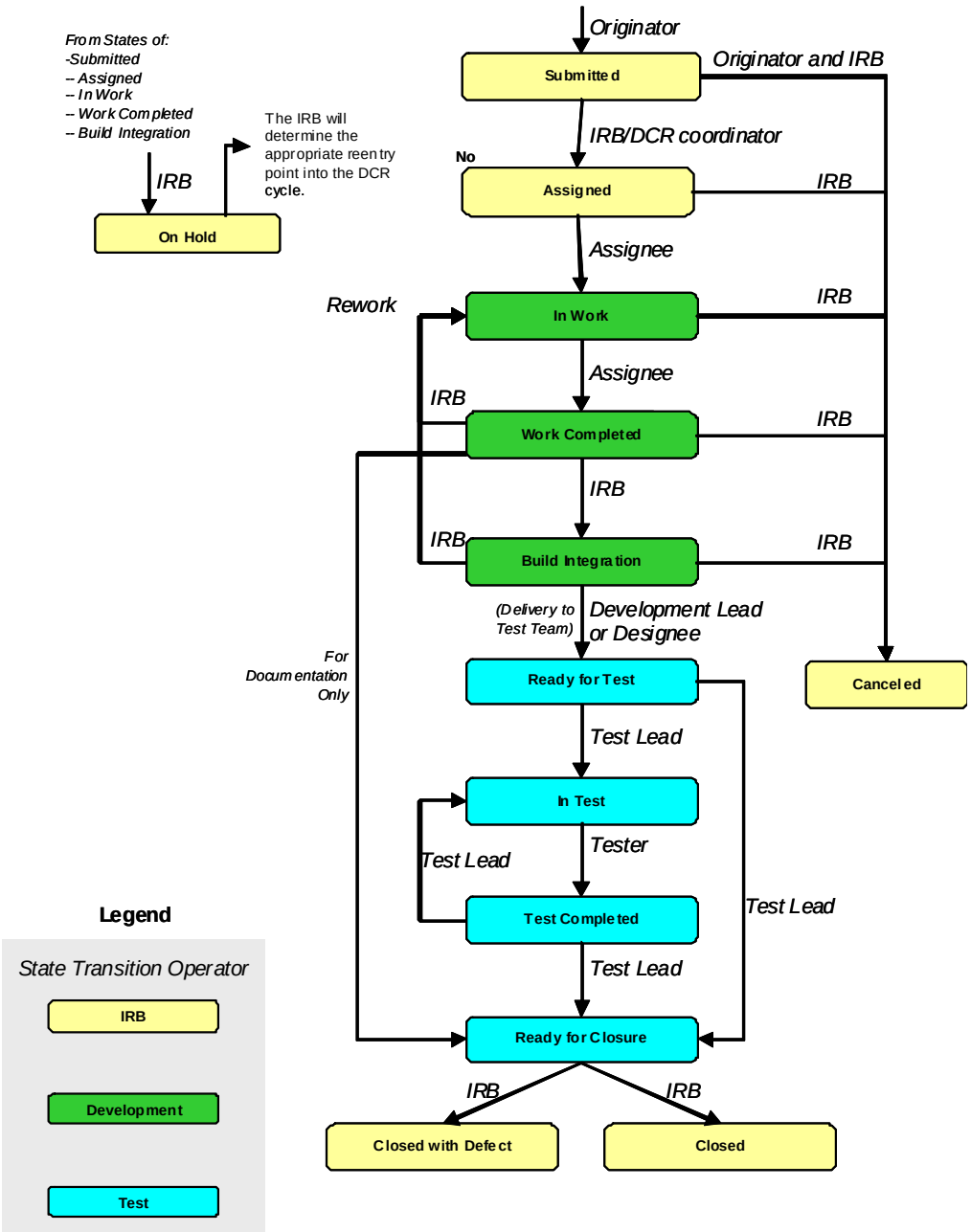

Figure 2.2-1 State Transition Diagram for the DCR Process

2.3 DCR TRACKING AND STATUS REPORTING

The DCR coordinator or some designated personnel shall maintain the official DCR status records. In addition to reporting the status of each open DCR on a periodic basis, the DCR coordinator shall maintain statistics and graphs that show the total number of DCRs recorded and the number of unresolved DCRs. These statistics can be used to detect unexpected trends and to forecast the number of DCRs to expect for later builds. The DCR tool shall support a variety of DCR tracking queries to support different aspects of

statistical reporting. The graph below depicts the number of existing DCRs reported against a given FSW system, differentiated by type.

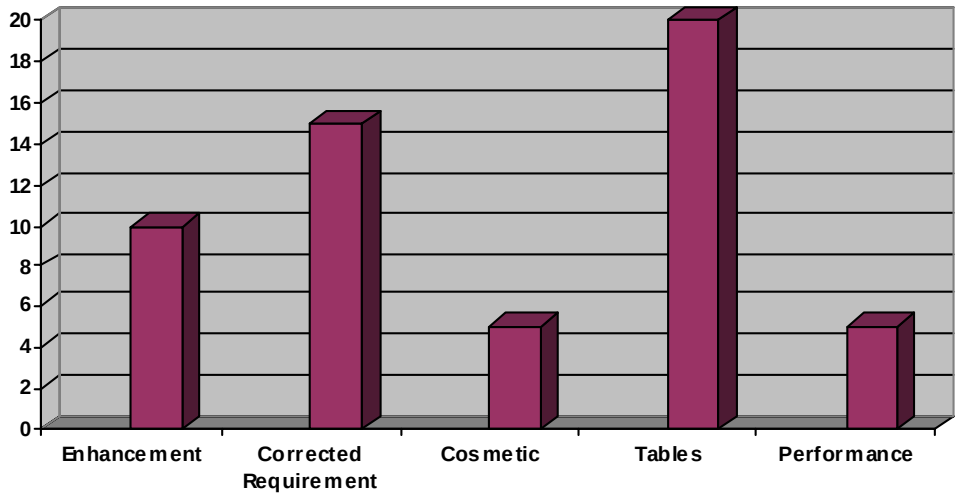

Figure 2.3-1 Example of a FSW DCR Report – DCRs by Subtype

2.4 GENERAL METRICS GENERATED BY THE DCR TOOL

The following trend indicators shall be periodically reported:

- Number of unresolved DCRs at the start of the reporting period
- Number of DCRs opened during the reporting period
- Number of DCRs closed during the reporting period
- Number of unresolved DCRs at the end of the reporting period
- Total number of DCRs
- Total number of closed DCRs
- Total number of opened DCRs
- Total number of opened DCRs by severity
- Total number of opened DCRs by state
- Total number of opened DCRs by type

The following information shall be periodically reported for each DCR:

- The DCR identifier, severity, and a summary of the discrepancy/change description

- Priority assigned to the solution effort.
- Status, including group currently assigned responsibility.
- Planned build (or iteration, or release) in which the solution will be implemented.

APPENDIX A - RATIONALE FOR THE DCR STATES

Submitted

Purpose:	This state is the initial state of the DCR when officially recorded into the system. This state serves as an initial holding state.
PDL:	The PDL uses this state to view new or unassigned DCRs. This state provides the PDL the ability to review the DCR and, with the IRB members, determine if the DCR should be accepted or rejected. The PDL should assess the schedule and staffing associated with the DCR. The PDL also needs to determine if the DCR needs to be approved by the project CCB.
Development Team:	If the problem was found by the development team, promotion to this state was achieved by a development team member after documenting the problem with sufficient details to facilitate the investigation of the DCR.
Test Team:	If the problem was found by the test team, promotion to this state was achieved by a test team member after recording the problem with sufficient details to facilitate the investigation of the DCR.

Assigned

Purpose:	This state indicates that the PDL/IRB has approved the DCR for work, who is assigned to make the change(s) and when the changes need to be resolved. It is also the state where the tester is assigned
PDL:	The PDL uses this state to indicate DCR approval or disapproval. It is also the state where the DCR is assigned to the appropriate person for resolution, the appropriate build and where the tester is assigned
Development Lead:	This state is used by the development lead as a “to do” list. No work should be done on a DCR unless it has been approved for work.
Test Lead:	The test lead does not have the details of the changes required at this point; however, this state serves as a “heads up” for future testing

In Work

Purpose:	This state is used by the assignee to start working on the DCR and ultimately resolving it. The assignee investigates the solution of the problem and, upon approval by the IRB (if applicable), implements the solution to resolve the DCR. The assignee performs all applicable unit testing to verify the solution.
PDL:	If required, the PDL may evaluate the solution proposed by the assignee and indicate whether the assignee should proceed with the implementation of the proposed solution.
Development Lead:	May serve as the PDL designee for approval of the proposed solution.
Test Lead:	N/A.

Work Completed

Purpose:	This state is used to indicate that the person assigned to fix the DCR believes he/she has completed the necessary work.
PDL	Provides the PDL with the ability to know when the work associated with a particular DCR was completed by the person assigned to resolve the DCR. The PDL needs to be able to track that all DCRs assigned to a build are completed before the build can be integrated and delivered for testing.

Development Team:	If the DCR was assigned to a developer, this state is used to indicate to the development lead/PDL that the work is complete.
Test Lead:	This state is used by the test lead since it identifies the actual changes that were made in order to resolve the DCR. At this point, the test team should evaluate the testing required to verify the DCR and create/modify the appropriate test procedures. A rough assessment should be made to ensure that the proper resources are available to test the DCR.

Build Integration

Purpose:	This state is used to integrate all the DCRs approved by the PDL/IRB for the current build. The CMO integrates all the designated DCRs, then the development team performs Build Integration testing to verify that the DCR changes were properly integrated and the associated functions work as intended in the Build tree.
PDL:	Provides the PDL/IRB and/or development lead with the ability to control the changes that are submitted. The PDL may have decided that the changes are not appropriate to include in this build and therefore, did not "promote" the DCR to this state (note that in this case, the assigned build will have to be updated).
CM:	Provides the CM person a way to make sure that only those DCRs that have been completed AND approved by the IRB/PDL are incorporated into the assigned build.
Development Lead	see PDL
Test Lead:	N/A

Ready for Test

Purpose:	This state is used to indicate that all DCRs approved the PDL/IRB and/or development lead, and incorporated into the build have been verified by the development team and have been delivered to the Test team.
PDL	N/A
CM:	N/A
Development Lead	see PDL
Test Lead:	This state is initially used by the test lead to finalize any test preparations required for the DCRs, promote DCRs not suited for Build testing to "Ready for Closure", and to make any testing assignment changes. Note that changes might have been made to a DCR between the "Work Completed" and the "Ready for Test" state (due to Build Integration findings); therefore, the test lead may need to update the tests for the DCRs.
Test Team:	Finalize preparations for testing the DCRs and making any necessary updates.

In Test

Purpose:	This state is used to indicate that the DCR(s) is being tested by the Independent Test Team.
PDL:	N/A
CM:	N/A
Development Lead:	N/A

Test Team:	The assigned tester(s) performs all necessary Build and Regression testing to verify the DCR(s).

Test Completed

Purpose:	This state is used to indicate that the changes made as a result of the DCR were tested by the person assigned to validate the DCR. Fields associated with the test results are filled in as part of the transition to this state. Note that this state alone does NOT indicate that the DCR passed or failed. Other fields are used to identify the pass/fail results.
PDL:	This state is used by the PDL/IRB to track progress made on the testing of a build. Testing of all DCRs associated with a build must be completed before a build can be considered tested. Note that there are other items that are tracked in addition to DCRs to determine when testing of a build has been completed such as requirements, commands, telemetry etc.
CM:	N/A
Development Lead:	N/A
Test Team:	This state is used to notify the PDL/IRB and/or test lead that the tester has completed the testing of the changes made as a result of the DCR. The tester then recommends to DCR for closure ("closed") or if the problem was not fixed to the tester's satisfaction, the tester recommends the DCR to be "closed with defect".

Ready for Closure

Purpose:	This state is used by the test lead to indicate their recommendation for a DCR to be "closed" or "closed with defect" based on the test results. This state gives the test lead the ability to review the test results and make a recommendation.
PDL:	This state is used by the PDL/IRB to track progress made on the testing of a build. Testing of all DCRs associated with a build must be completed before a build can be considered tested. Note that there are other items that are tracked in addition to DCRs to determine when testing of a build has been completed, such as requirements, commands, telemetry etc.
CM:	N/A
Development Team:	N/A
Test Lead:	This state is used to notify the PDL/IRB of the test lead's recommendation for closure ("closed" or "closed with defect"). Since it is the test lead's responsibility to manage the test effort, the test lead needs to have a mechanism to approve or disapprove the closure of the DCR after reviewing the test results.

Closed

Purpose:	This state is used to indicate that all items associated with this DCR have been resolved to the satisfaction of the PDL/IRB, development lead and test lead.
PDL:	This state is used as the final checkpoint for the PDL/IRB to verify that all items associated with the DCR have been completed. All of the appropriate fields of the DCR should be verified for correctness. All of the test information should be completed. This field is used by the PDL to dot all i's and cross all t's for each DCR.
CM:	N/A
Development Team:	N/A

Test Team:	N/A

Closed with Defect

Purpose:	This state is used to indicate that changes were made as a result of this DCR; however, the changes did not fully solve the problem stated in the DCR. As a result, a new DCR may be submitted and linked to the original DCR.
PDL:	This state provides the PDL a means to determine whether the solution of the DCR is valid with a workaround or whether a new one has to be opened to completely resolve the problem. Linking the original DCR with a new DCR gives the entire picture of the solution which may spread across several builds.
CM:	N/A
Development Team:	N/A
Test Team:	N/A

Cancelled

Purpose:	This state is used to indicate that no changes need to be made as a result of the DCR
PDL:	This state is used to identify all DCRs that were not approved by the IRB. Since the DCR cannot simply be eliminated from the system, this state essentially serves as a trash can for DCRs.
CM:	N/A
Development Team:	N/A
Test Team:	N/A

On Hold

Purpose:	This state is used to indicate that no changes should be made as a result of this DCR until future investigation has been completed. There are many reasons why a DCR could be in this state. A few examples include the need for project CCB approval or the inability to reproduce the problem that caused the DCR submission.
PDL:	This state is used to indicate that changes will not be made to the DCR until the PDL/IRB approves further action on the DCR. The PDL needs to track these DCRs in order to make sure that the problem posed in the DCR does progress to some sort of closure (see cancelled, closed, closed with defect).
CM:	. N/A
Development Team:	N/A
Test Team:	N/A