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Flight Dynamics Support Services (FDSS) Continuous Risk Management (CRM)

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Effective Date: 02/05/2013
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Effective Date: 02/05/2013

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Submitted by:

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Date

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Date

Approved by:

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[redacted]

Date

This document supersedes and makes obsolete the following document:

- FDSS-CRM-0001 *Flight Dynamics Support Services (FDSS) Continuous Risk Management (CRM)*, Revision 2, effective: 05/02/2011 and all prior versions.

For this superseded and obsolete document discard all hard copies in accordance with Flight Dynamics (FD) Configuration Management Procedures, FDSS-CMP-0001.

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Preface

This document describes the Flight Dynamics (FD) Continuous Risk Management (CRM) support that is provided under the Flight Dynamics Support Services (FDSS) contract.

Proposed changes to this document shall be submitted to the signatories along with supportive material justifying the proposed change. Changes to this document shall be made by complete revision.

Note: There is no provision for DCNs under the GSFC Management System [MS] compliance

Comments or questions concerning this document and proposed changes shall be addressed to:

[redacted]

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Change Information Page

List of Effective Pages		
Page Number	Revision	Nature of Change
All	3	Ported document back to MS Word 2007 and updated slightly throughout to reflect current operations.

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Flight Dynamics Support Services (FDSS) Continuous Risk Management (CRM)

1. Introduction

1.1 Overview

The National Aeronautics and Space Administration (NASA) Goddard Space Flight Center's (GSFC) Navigation and Mission Design Branch (NMDB) and the Guidance, Navigation, and Control Systems Engineering Branch (GNCSEB) within the Mission Engineering and Systems Analysis (MESA) Division are responsible for providing analytic and operational expertise for orbit and attitude systems, dynamics modeling, control analyses, and estimation and simulation of space vehicles. The branches create and maintain state-of-the-art analysis tools for mission design, trajectory optimization, orbit analysis, navigation, attitude determination, and controls analysis. The branches also provide the expertise to support a wide range of flight dynamics services, such as spacecraft mission design, on-orbit sensor calibration, launch support, and orbit operations. An active technology development program is maintained, with special emphasis on developing new techniques and algorithms for autonomous orbit/attitude systems and advanced approaches for trajectory design. Specific areas of expertise resident in the branches are:

- Trajectory analysis and control design
- Mission operations
- Mission design
- Orbit estimation techniques
- Constellation analysis
- Flight dynamics model development
- Flight dynamics ground and flight system development
- Ground attitude determination

The NMDB flight dynamics support services provide for the planning, designing, implementing, conducting, enhancing, evaluating, integrating, and testing of the flight dynamics services and systems provided at GSFC. The flight dynamics disciplines include spacecraft navigation (orbit determination), trajectory control, mission design, attitude determination, attitude dynamics and attitude control. Unique mission support and network services are also provided. Flight dynamics mission support efforts involve the determination of mission flight dynamics requirements and the planning necessary to satisfy the mission/project needs. Technology development is performed in the areas of navigation, trajectory design and flight dynamics automation. Flight regimes supported include single

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satellite and satellite formations in low-Earth, high-Earth, gravity assist, libration point, non-Earth planetary and interplanetary orbit. Operational facility re-engineering planning, development, and implementation services are also provided.

To support this goal, a risk management program has been implemented to maximize NASA mission success.

1.2 Purpose

The purpose of this document is to describe the Continuous Risk Management (CRM) process tailored for the Flight Dynamics Support Services (FDSS) contract. The objective is to implement formal CRM during the entire contractual period. CRM will enable informed decision-making, optimization of resources, and coordination of design and programmatic trades against program cost, schedule, and technical performance.

1.3 Scope

This document describes the formal process for applying CRM throughout all of the tasks assigned to FDSS. CRM applies to activities performed by contractors supporting FDSS task operations, including software, analysis, and all disciplines supporting the Flight Dynamics Facility (FDF). The CRM process is designed to forecast and manage risks before they become problems. To the extent possible, FDSS will use lessons learned from other NASA and GSFC Programs in carrying out this plan. Due to the variety of tasks carried out under FDSS, different groups may tailor their CRM processes to their specific needs. However, all FDSS tasks will follow the basic approach described in this document.

1.4 Assumptions, Constraints and Policies

FDSS is being implemented with cost and schedule constraints. As a result, the Flight Dynamics Support Services (FDSS) Program Manager will be responsible for coordinating risk mitigation requiring resource allocation. All activities related to FDF risk management are under the direction of the FDF Operations Director (Code 595).

Upon approval from the FDSS Program Manager, this plan will become a controlled document. It is expected that changes and improvements will be necessary over the course of time as risk management is used by FDSS. All changes will be made in accordance with the FDF Configuration Management Procedures (CMP).

1.5 Document Organization

This document is organized into the following five major sections:

- Section 1 is an introduction and overview of the document.
- Section 2 is an overview of CRM.
- Section 3 is an overview of FDSS and FDF.

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- Section 4 is a description of FDSS risk management.
- Section 5 is a description of FDSS CRM implementation.

1.6 Related Documents and Standards

1.6.1 General

This section lists additional, related documents. The NASA Program and Project Management Processes and Requirements, NPR 7120.5E, is the controlling requirements/guideline used to prepare this plan.

1.6.2 Applicable Documents

The following are applicable documents to which this plan conforms:

- NASA Engineering and Program/Project Management Policy, NPD 7120.4D
- NASA Spaceflight Program and Project Management Requirements, NPR 7120.5E
- NASA General Safety Program Requirements, NPR 8715.3C, March 12, 2008, with change 8 dated 6/20/2012.
- Agency Risk Management Procedural Requirements, NPR 8000.4A
- Risk Management, Goddard Procedural Requirements (GPR) 7120.4D
- Management Review and Reporting for Programs and Projects, GPR 1060.2
- AS9100 Revision C Aerospace Standard

1.6.3 Reference Documents

The following are recommended reference documents for informational purposes:

- NASA Systems Engineering Handbook, NASA/SP-2007-6105 Rev1, December 2007.
- NASA Probabilistic Risk Assessment Procedures Guide for NASA Managers and Practitioners, August 2002.

2. Continuous Risk Management Overview

2.1 Overview

Risk is defined as the combination of (1) the probability that a program or project will experience an undesired event and (2) the consequences, impact, or severity of the undesired event, were it to occur. The undesired event might come from technical or programmatic sources (e.g., a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, or failure to achieve a needed scientific or technological objective or success criterion). Both the probability and consequences may have associated

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uncertainties. Continuous Risk Management is an organized, systematic risk-informed decision-making discipline that proactively identifies, analyzes, plans, tracks, controls, communicates, documents, and manages risk to increase the likelihood of achieving project goals. The Risk Management Process focuses on project objectives, bringing to bear an analytical basis for risk management decisions and the ensuing management activities, and a framework for dealing with uncertainty. The key areas of focus are:

- **Cost/Resources:** This is the risk associated with the ability of the program/project to achieve its life-cycle cost objectives and secure appropriate funding. Two risk areas bearing on cost are (1) the risk that the cost estimates and objectives are not accurate and reasonable and (2) the risk that program execution will not meet the cost objectives as a result of a failure to handle cost, schedule, and performance risks.
- **Schedule Risk:** Schedule risks are those associated with the adequacy of the time estimated and allocated for the development, production, implementation, and operation of the system. Two risk areas bearing on schedule risk are (1) the risk that the schedule estimates and objectives are not realistic and reasonable and (2) the risk that program execution will fall short of the schedule objectives as a result of failure to handle cost, schedule, or performance risks.
- **Scope/Requirements:** This is the risk associated with the evolution of the design and the production of the system of interest affecting the level of performance necessary to meet the stakeholder expectations and technical requirements. The design, test, and production processes (process risk) influence the technical risk and the nature of the product as depicted in the various levels of the PBS (product risk).

2.2 CRM Primary Activities

The CRM process includes six primary activities as depicted in Figure 2-1 and described as follows:

Figure 2-1: Continuous Risk Management Process

a. **Identify:** Identify program risk by identifying scenarios having adverse consequences (deviations from program intent). CRM addresses risk related to safety, technical performance, cost, schedule, and other risk that is specific to the program.

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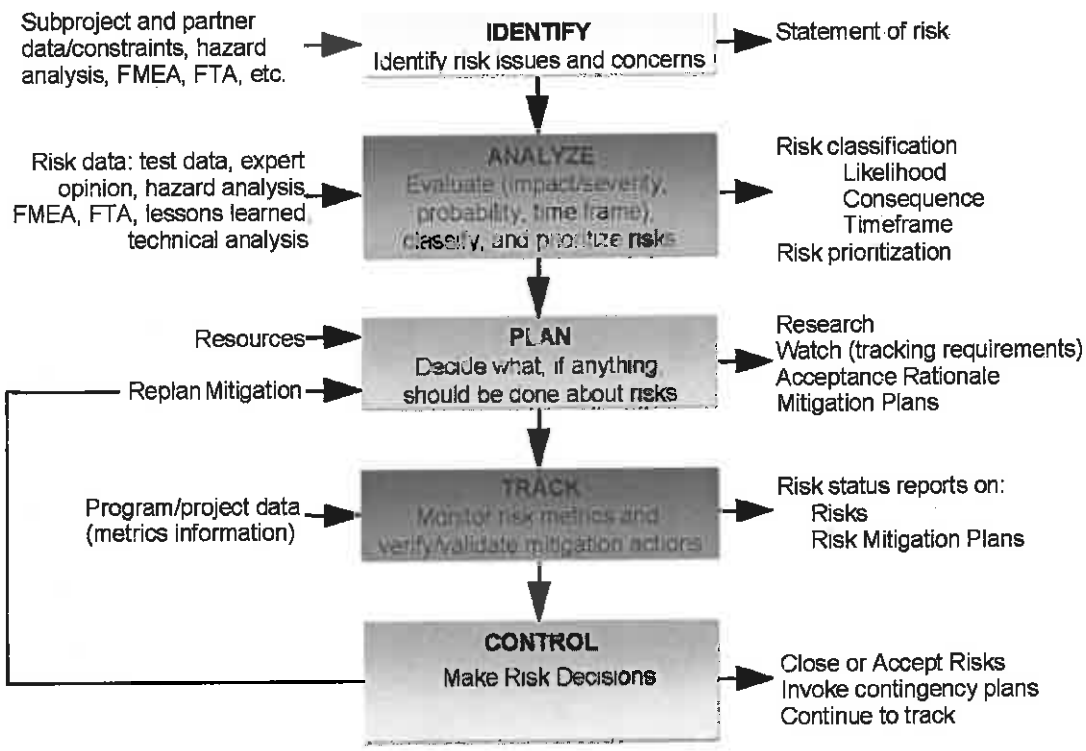
b. **Analyze:** Estimate the likelihood and consequence components of the risk through analysis, including uncertainty in the likelihoods and consequences, and the timeframes in which risk mitigation actions must be taken.

c. **Plan:** Plan the track and control actions. Decide what will be tracked, decision thresholds for corrective action, and proposed risk control actions.

d. **Track:** Track program observables relating to TPMs (performance data, schedule variances, etc.), measuring how close the program performance is compared to its plan.

e. **Control:** Given an emergent risk issue, execute the appropriate control action and verify its effectiveness.

f. **Communicate, Deliberate, and Document:** This is an element of each of the previous steps. Focus on understanding and communicating all risk information throughout each program phase. Document the risk, risk control plans, and closure/acceptance rationale. Deliberate on decisions throughout the CRM process.



FMEA – Failure Modes and Effects Analysis
FTA – Fault Tree Analysis

Figure 2-2: Continuous Risk Management Flow Process

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3. FDSS Organization

3.1 General

Figure 3 1 depicts the FDSS organization. The diagram illustrates the structure of the project team. All members of the FDSS team will participate in the implementation of this Risk Management Plan. The FDF organization is shown in Figure 3-2.

3.1.1 Terms and Definitions

The FDSS CRM process uses the following definitions:

- **Risk:** An event that may occur and will have a negative impact on the FDSS project objectives if it occurs.
- **Priority Risk:** A risk with a High severity, as described in Section 4.7.4.
- **Risk Identifier:** The person who first identifies and documents the risk.
- **Risk Owner:** The FDSS Domain Lead or staff member assigned to and responsible for analyzing, tracking, or mitigating an identified risk. The risk owner must have the appropriate knowledge and experience within the project to fully address the risk.

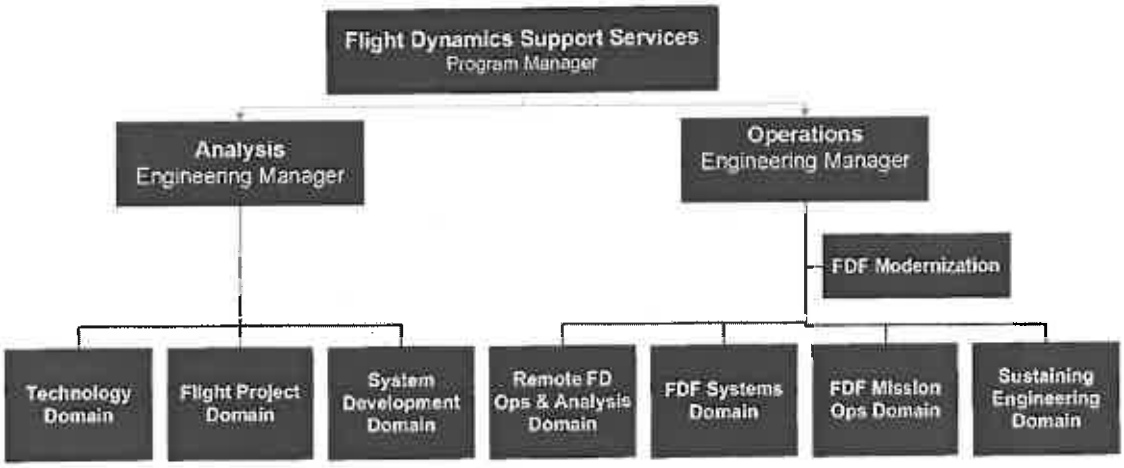

Figure 3-1: FDSS Organization

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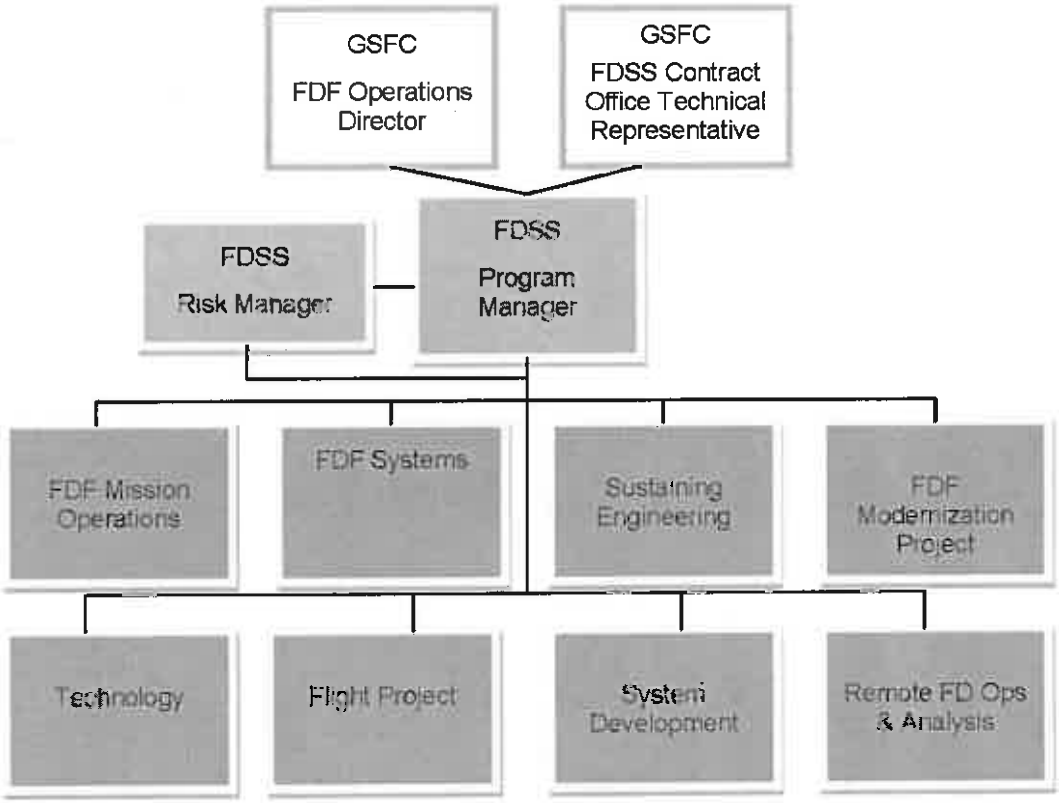

Figure 3-2: FDF Organization

3.2 FDSS Risk Board

The FDSS Risk Board is established to support the analysis and control of program risks related to the FDSS. The activities of the FDSS Risk Board include identifying and reviewing program risks. Members of the FDSS Risk Board include the Risk Manager, Program Manager, Operations and Analysis Engineering Managers, Domain/Project Leads and the Safety and Health Manager (as needed).

3.3 FDF Facility Review Board

The FRB will add items to its agenda as requested by the FDSS Risk Board. These items will include risks that have a high impact to FDF operations. These specific risks are under the direction of the FDF Operations Director. These risk items will be documented through FRB Minutes and sent to the FDSS Risk Board for tracking and mitigation. Risks not elevated to the FRB will have been tracked and mitigated at the DRB or Domain Lead level.

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4. FDSS Risk Management Process

4.1 Overview

It is understood that not all risks are identified; that there will remain some "unknowns." However, it is the intent of FDSS CRM to effectively resolve all identified risks.

4.2 FDSS Programmatic and Task Level Process

Risks that affect a specific task are managed by the Domain Lead. Risks that affect more than one domain (cross-domain) will be managed by the responsible Engineering Manager. Risks that are cross-area, (i.e., affect both the analysis and operations environments), will be managed by the PM. All programmatic risks will be collected and tracked by the FDSS Risk Manager and monitored by the FDSS Board on a quarterly basis (or as determined by the FDSS Rick Manager). Risk status will be reported to the customer as agreed upon in the Task Statement of Work.

The FDSS Program Manager manages the risks at the Program Level according to the FDSS Risk Management Process – Programmatic Level (Figure 4-1). The FDSS Program Manager ensures that risks are identified and discussed during staff meetings on a continuous basis.

FDSS Staff are responsible for communicating risks to their Task and/or Domain Lead throughout product realization.

On a continuous basis, risks should be identified and discussed during staff meetings. The FDSS Domain Lead manages the risks at the Task Level according to the FDSS Risk Management Process – Task Level (Figure 4-2). For all task level risks, the Engineering Manager is responsible for approving a risk. Tasks level risks are considered and approved at staff meetings and at Risk Review Board meetings depending on the identified risk.

4.3 FDSS Risk Management Roles and Responsibilities

FDSS risk management is a responsibility shared by the FDSS staff and FDSS Risk Board. Specific roles and responsibilities are explained in Table 4-1.

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Table 4-1: FDSS Risk Management Roles and Responsibilities

NASA/FDSS Staff	• Identify new risks. • Provide background information.
FDSS Risk Manager	• Identification, monitor and control of FDSS Programmatic Risk. • Ensure that all FDSS staff are following the risk management process. • Assist with coordinating the brainstorming process. • Chair the FDSS Risk Board. • Track risk metrics.
Risk Owner (i.e., Task Lead, Domain Lead)	• Develop/assist with creation of the risk statement. • Perform/assist risk analysis. • Contribute to the risk mitigation and contingency plan. • Track risk metrics. • Risk planning to determine a risk response plan. • Risk control.
FDSS Risk Board	• Ensure that all FDSS staff are following the risk management process. • Identify/recommend new programmatic risks for analysis. • Contribute to the risk mitigation and contingency plan. • Invited as needed to attend FDF FRB meetings. • Specialize in analysis of technical/performance risks. • Provide input related to risk classifications. • Provide recommendations for risk assignment and action strategies. • Risk control.
FDF Facility Review Board	• Responsible for managing risks that have a high impact to FDF Operations.

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4.4 FDSS Programmatic Risk CRM Flow

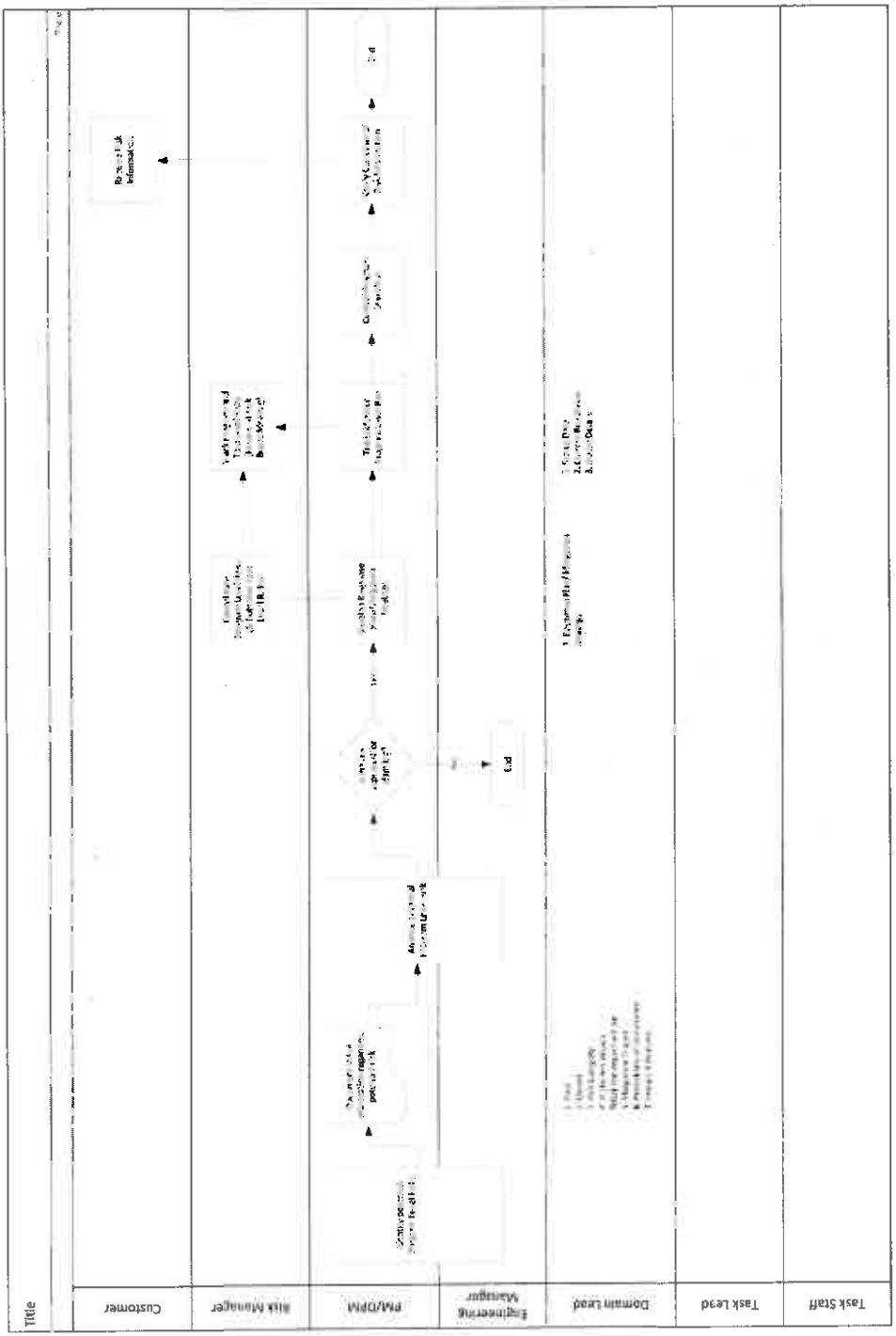

Figure 4-1: FDSS Risk Management Process – Programmatic Level

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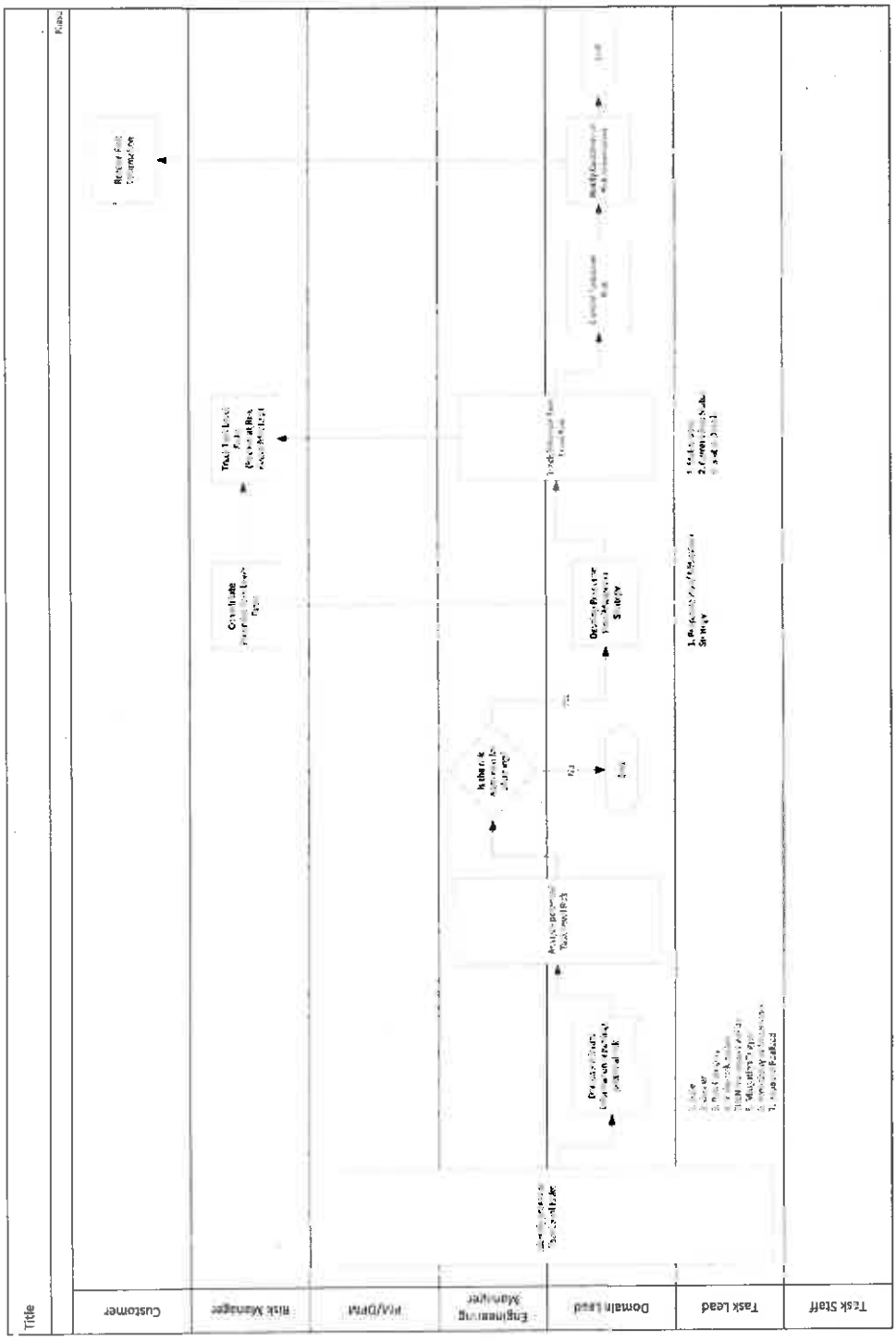

Figure 4-2: FDSS Risk Management Process - Task Level

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The FDSS Risk Management Process follows the process in Figure 4-1, but employs a local database for tracking risks rather than a program level database. The FDSS Risk Management database is maintained and controlled on a share drive at a.i. solutions headquarters.

4.5 Risk Identification

Risk identification can be initiated in several ways. Lessons learned from previous projects and experiences can provide valuable insights for identifying potential risks. The following is a list of methods or sources that may assist in the identification of risks:

a. FDSS Staff.
b. Trade Studies.
c. Lessons Learned Database.
d. Anomaly Resolution System.
e. External Reviewers/Assessors.
f. Project Team Meetings.
g. Failure Mode, Effects, and Criticality Analysis (FMECA).
h. Reliability Analysis.
i. Fault Tree Analysis.

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4.6 Hazard

Hazards must be corrected on the worst-first basis, depending on the availability of resources. If an imminent danger situation exists, the manager in charge must take immediate action to protect affected employees. The RAC presents hazard analysis data in a format which help management make decisions regarding whether hazards should be eliminated, controlled, or accepted. The priority for corrective action depends upon the risk level assigned. The risk shall be categorized in accordance with Table 4-1 and Table 4-3.

The RAC is a numerical expression (1-4) of comparative risk determined by an evaluation of both the potential severity of a condition and the likelihood of its occurrence causing an expected consequence.

Table 4-2: RAC Determination Matrix

Probability of Occurence	Hazard Categories			
	I Catastrophic	II Critical	III Moderate	IV Neglible
(A) Frequent	1A	2A	3A	4A
(B) Probable	1B	2B	3B	4B
(C) Occasional	1C	2C	3C	4C
(D) Remote	1D	2D	3D	4D
(E) Improbable	1E	2E	3E	4E

Table 4-3: RAC Assignment

Severity Probability	Risk Index	Urgency Criteria
1A, 1B, 1C, 2A, 2B, 3A	1	
1D, 2C, 2D, 3B, 3C	2	
1E, 2E, 3D, 4B, 4C, 4D, 4E	3	
4C, 4D, 4E	4	

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4.6.1 Hazard Reduction Sequence

a. **Design for minimum risk** - From the first, design to eliminate hazards. This strategy generally applies to acquisition of new equipment or expansion of existing facilities; however, it can also be applied to any change to equipment or facilities. The hazard source or the hazardous operation shall be eliminated by design without degrading the performance of the system or facility. FDSS management will ensure that hazards and associated risks are identified during the initial design process and continued through the various engineering phases. We will also review established designs and existing facilities to reduce hazards and associated risk.

b. **Design to Control Hazard** - In cases where hazards are inherent and cannot be eliminated completely, they should be controlled through design. The major safety goal during the design process is to include safety features that are fail-safe or have capabilities to handle contingencies through redundancies of critical elements. Complex features that could increase the likelihood of hazard occurrence should be avoided.

c. **Incorporate safety devices** - If identified hazards cannot be eliminated or their associated risk adequately reduced through design selection, the risk shall be reduced to a level acceptable through the use of fixed, automatic, or other protective safety design features or devices. Provisions shall be made for periodic functional checks of safety devices when applicable. Examples include: equipment guarding, system interlocks, fire detection and suppression systems, and employee isolation. We will ensure functionality of safety devices through design reviews, verification and validation, risk assessments, testing and inspection, preventive maintenance, and calibration and standardization.

d. **Provide warning devices** - When neither design nor safety devices can effectively eliminate identified hazards or adequately reduce associated risk, devices shall be used to detect the condition and to produce an adequate warning signal to alert personnel of the hazard. Warning signals and their application shall be designed to minimize the probability of incorrect personnel reaction to the signals and shall be standardized within like types of systems. Examples include chemical element detection monitors, audible alarms, flashing lights, and integrated hardware and software code warnings. a.i. solutions will provide training to employees to ensure that personnel properly react and respond to the warning device.

e. **Develop procedures and training** - Where it is impractical to eliminate hazards through design selection or adequately reduce the associated risk with safety and warning devices, procedures and training shall be used. Procedures will be developed to provide personnel with guidance and requirements in minimizing the hazard and associated risk. Establishing procedures and training may include the use of PPE such as respiratory, hearing, eye protection, and protective clothing. Training will be evaluated for effectiveness and compliance during periodic audits. Any identified residual risks will be quantified (including the basis for accepting such risks),

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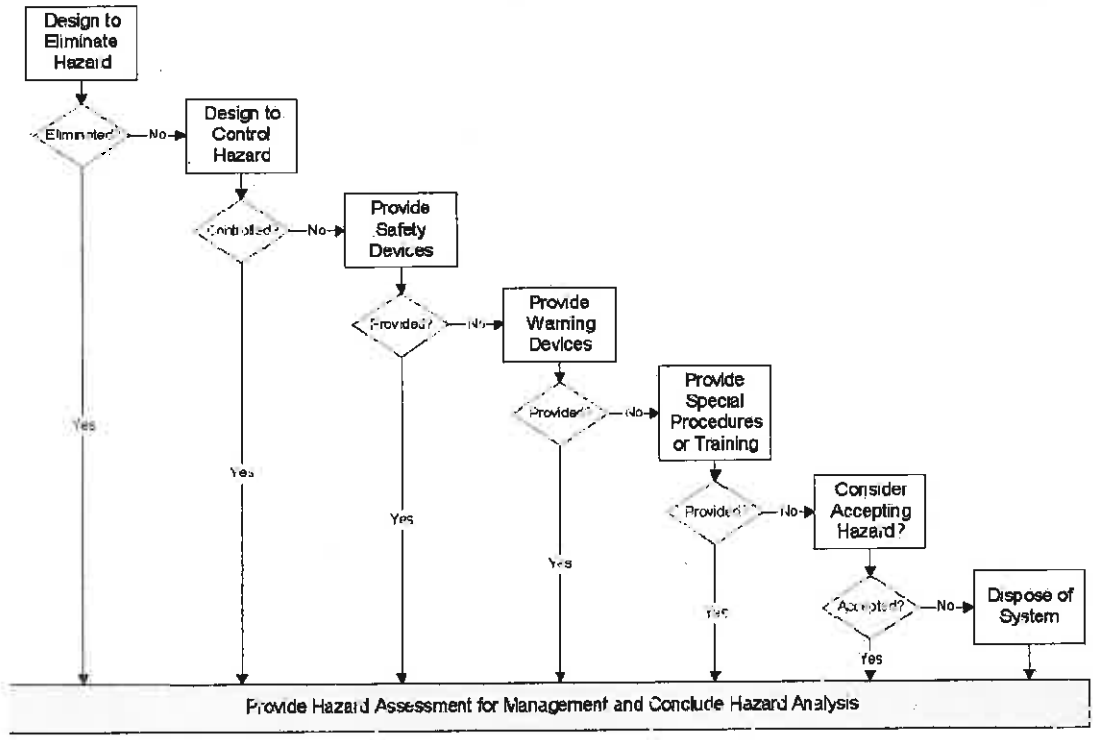
documented, and approved by the appropriate task manager. This analysis will be communicated to the COTR.

f. **Hazard Acceptance** - Where hazards cannot be reduced by any means, a decision process must be established to document the rationale for either accepting the hazard or disposal of the system.

NASA-STD-8719.7
January 1998



Hazard Reduction Precedence

Figure 4-3: Hazard Reduction Precedence

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4.7 Risk Analysis

4.7.1 General

After a risk is identified, the Risk Owner in consultation with other relevant staff members, performs analysis of the risk source/category, event description/impact to project objectives (IF/THEN statement), trigger, probability of occurrence, and impact if realized as described in the following sections.

4.7.2 Impact Assessment

Table 4-4: Risk Source/Category

Impact Category	Example Indicators
Scope/ Requirements	• Design Complexity • Failure Rate Does Not Support Design Life • Memory Utilization • Requirements Uncertainty • Design Maturity • Environmental Conditions • Physical Dimensions
Schedule	• Component Availability • Launch Windows • Delivery Schedules • Development Schedule
Cost/ Resources	• Actual Cost Beyond Budget Allocation • Replacement Impacts due to Cost • Independent Cost Estimate Inputs
Quality	• Potential problem that could cause the system to fail • Bugs exist in the system that users will encounter • Possibility that there could be unauthorized access to the system
Safety	• Personnel Related Safety (e.g., electrical shock) • Environmental considerations (e.g., the use of such materials as beryllium, volatile fuels, or water contaminates) • Refer to *Flight Dynamics Support Services (FDSS) Local Operating Procedures (LOP) for Personnel Safety, Health and Emergency Management*, FDSS-LOP-0070

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The impact categories and indicators are listed in Table 4-4; these are the categories that are used in the CRM as project objectives.

4.7.3 (IF) Event Description/ (THEN) Impact to Project Objectives

The event description and impact to project objectives is a statement that describes events in the future (at the time of identification). The event description is characterized as an "IF" statement that if it occurs, "THEN" there is a potential impact to the project objectives. Project objectives are categorized in Table 4-4.

4.7.4 Risk Trigger

Risk Triggers are indications that a risk has occurred or is about to occur and determines when a response/mitigation plan should be enacted. Triggers should be monitored by the risk owner, and any changes/ updates should be reported to the team. Triggers are sometimes called "Risk Symptoms" or "Warning Signs".

4.7.5 Probability of Occurrence

The Probability of Occurrence is the method used to determine the probability that a risk will occur. The following table is used as guide to determine the probability that a risk will occur.

Table 4-5: Probability of Occurrence

Rating		Technology	Requirements	Program	Supplier/Vendor	Hardware	Software	Testing	Productivity
5	Very Certainty (81-99%)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Likely (61-80%)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Possible (41-60%)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Unlikely (21-40%)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Very Unlikely (0-20%)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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4.7.6 Impact if Realized

Impact if Realized, also known as the severity, is determined according to the Risk Impact Chart (Refer to Figure 4-4). The purpose is to enable comparison of a set of risks to determine how they relate to each other within a given structure. It provides a means for efficiently sorting through large amounts of data and developing cost-effective mitigation plans.

Rating		Performance Impact (Cp)						Schedule Impact (Cs)	Cost Impact (Cc)
		Environmental, Safety and Health (ESH)		Programmatic	Technical			Program Slip	Program Threat
		Environmental	Safety	Programmatic	Performance	Design	Alternatives		
5	Catastrophic	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Critical	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Moderate	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Marginal	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Minimal	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure 4-4: Risk Impact Chart

4.7.7 Timeframe Assessment

A timeframe in which actions must be taken for the risk will be determined. The selected timeframe is considered when performing risk planning and better enables management to focus on actions required in the immediate future. Timeframe options include the following:

a. Near Term - Less than 6 months.
b. Mid Term - Between 6 months and 12 months.
c. Long Term - Greater than 1 year.

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4.8 Risk Planning

Once the appropriate level of risk analysis is complete, risk planning occurs to determine a risk response action to appropriately handle the risk (refer to Table 4-7). This approach is developed by the risk owner in consultation with other FDSS staff, as necessary. If a contingency plan is developed for the selected response option, a summary of the contingency plan and any determined triggers that are established to initiate the implementation of the contingency plan should be included.

The risk owner is then responsible for seeing that the response option actions are communicated and implemented, and is responsible for managing the risk.

Table 4-6: Risk Response Options

Response Option	Response Option Actions
	•
Accept	• Prepare written rationale and maintain a record of the risk in the database; development of mitigation strategies is not required.
Watch	• Monitor risk attributes; establish risk tracking parameters (triggers); develop contingency plan.
Mitigate	• Develop and execute a mitigation plan to eliminate or reduce likelihood of occurrence or impact; develop contingency plan.

4.9 Risk Tracking

4.9.1 General

Following completion of the risk analysis and the definition of the risk response option, the risk enters tracking status. Tracking activities vary based on the risk response option that is assigned to the risk.

4.9.2 Accept

Accepting is a strategy that is applicable to both Negative and Positive Risks. Accepted risks are reviewed occasionally for any changes that could affect the status of the risk. Rationale as to why the risk is acceptable will be provided for all accepted risks. No other actions are taken, and the accepted risk will be handled if it occurs.

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4.9.3 Watch

Risks with the watch response are reviewed regularly and are monitored by the risk owner per the tracking parameters established in the approach. If a trigger reached a threshold defined by the tracking parameters, then the risk owner implements the contingency plan.

4.9.4 Mitigate

The mitigation plan is implemented for risks assigned the mitigate response option. The risk owner and risk manager are responsible for monitoring the mitigation and its effectiveness. The risk owner initiates the mitigation and is responsible for notifying the FDSS Risk Manager of the mitigation status. If the mitigation is effective and eliminates the risk, rationale and justification are provided and the risk is brought before the FDSS Risk Board to consider closing it.

In the case that mitigation is not effective, the contingency plan is implemented if the metrics have reached the predetermined threshold limits. If the contingency plan does not resolve the risk, then the risk will be reassessed. The Risk Manager will review the remaining risks and consult with the risk owner. The remaining risks will be presented to the FDSS Risk Board for final closure/and or continued tracking.

4.9.5 Exploit (Opportunities)

When there is a positive risk, an opportunity, it can be exploited to ensure everything is in place to increase the probability of the occurrence of the risk.

4.9.6 Enhance (Opportunities)

When there is a positive risk, an opportunity, it can be enhanced by identifying the root cause of the positive risk to influence it for a greater likelihood of the opportunity occurring.

4.9.7 Realized

A risk that has been previously identified has been realized.

4.9.8 No longer valid

Risks that are no longer valid have been reduced to a level where the remaining risk is considered negligible.

4.9.9 Retired

Retired risks are when further risk reduction activity is deemed unnecessary. These risks will no longer be actively mitigated or monitored.

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4.10 Risk Control

During the controlling phase, informed, timely, and effective decisions are made regarding risks and their mitigation plans. Controlling risks will be integrated and coordinated in the routine management activities of all FDSS tasks.

The following are control plan decisions used during the FDSS CRM Process:

a. Replan.
b. Close the risk.
c. Invoke a contingency plan.
d. Continue tracking and executing the current plan.

The decision to proceed with mitigation plans requires current and accurate data to make the proper decision. The FDSS Program Manager will have the final decision on risk mitigation planning and use of resources.

4.11 Risk Communication and Documentation

Communicating FDSS risks provides an understanding of the overall risk posture to FDSS task personnel. FDSS risk communications have the following characteristics:

a. Open flow of information between FDSS staff and management.
b. Consistent and regular communication at formal, informal, and impromptu meetings.
c. Value of individual contributions.

Risks will be documented, regularly updated, and available for review.

5. FDSS Continuous Risk Management Implementation

5.1 General

This section identifies specific methodologies used for FDSS CRM implementation.

5.2 Continuous Risk Management Orientation

The FDSS organization is dedicated to the swift identification of risks, impacts, and the necessary course of action for all risks. All FDSS staff members are encouraged to participate in the identification of risks. FDSS staff members are immediately notified of updates or changes to the risk management process or procedures. Meetings used for risk discussion and review provide the opportunity for continuous improvement of the FDSS risk management process. The FDSS Risk Manager will track and document all process changes and make recommendations for improvement where possible.

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5.3 Risk Register

The FDSS Risk Register contains the data elements listed below. This Risk Register is used for programmatic, domain and task level risks.

a. Risk ID
b. Date Risk Identified
c. Owner/Support Resource
d. Risk Source/Category
e. Event Description/Impact to Project Objectives
f. (Mitigation) Trigger
g. Probability of Occurrence
h. Impact if Realized
i. Risk Score
j. Near Term Response Required (Y/N)
k. Response Plan/Mitigation Strategy
l. Status Date
m. Risk Status
n. Status Details

The risk register will be updated regularly, and the FDSS Risk Manager or designee will maintain configuration control and are the only persons who can modify the program risk register.

The current version of the FDSS Risk Register can be found on the PSO TPS.

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6. Records

The following records are maintained as a result of the actions described in this plan.

Title	Description
FDSS Risk List	Record of FDSS programmatic risks. Electronic copy maintained by the Risk Manager on the open shared drive at a.i. headquarters.
FDSS Risk Management Tracking	This should be maintained by each Domain Lead.
Task/Project Minutes	Minutes from Task/Project meetings; minutes should identify and discuss risks.

7. Forms

Number/Location	Title/Description
FDSS-FORM-0061, Revision 1	FDSS Risk Management Analysis Tracking Sheet.
FDSS-FORM-0062	FDSS Risk Management Tracking Sheet

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Appendix A. Abbreviations and Acronyms

Acronym	Definition
CCR	Configuration Change Request
CDL	Controlled Document Listing
CI	Configuration Item
CM	Configuration Management
CMP	Configuration Management Procedures
DRB	Domain Review Board
FD	Flight Dynamics
FDF	Flight Dynamics Facility
FDSS	Flight Dynamics Support Services
FRB	Facility Review Board
GPR	Goddard Procedural Requirement
GSFC	Goddard Space Flight Center
LOP	Local Operating Procedure
MCDL	Master Controlled Document Listing
MS	Management System
NASA	National Aeronautics and Space Administration
NMDB	Navigation and Mission Design Branch
NPR	NASA Procedural Requirements
PSO	Program Support Office
QA	Quality Assurance
TO	Task Order

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Appendix B. Change History Log

Revision	Effective Date	Description of Changes
Original	08/30/2010	FDSS-CCR-0044
1	12/06/2010	FDSS-CCR-0119
2	05/02/2011	FDSS-CCR-0150
3	02/05/2013	FDSS-CCR-0268

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