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New Millennium Program

Guidelines for Preparing Project Risk Management Plans

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NMP Guidelines for Preparing Project Risk Management Plans

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1 Introduction

1.1 Purpose and Scope

By validating breakthrough technology advances in space, the New Millennium Program (NMP) retires the risk of their first use by operational science missions and thereby accelerates their infusion into future science missions. Because NMP projects validate advanced technologies in space, the risks associated with these projects are greater than those acceptable to operational science missions. To contain and manage these risks, each NMP project will prepare and implement a comprehensive *Risk Management Plan* (RMP).

Risk identification and risk mitigation planning are the principal means by which projects in the New Millennium Program identify, plan, justify, and allocate financial reserves. The RMP defines the means by which a project's risks are identified, tracked, and their mitigation defined. Thus, the RMP is an essential element in reserve management.

This document provides guidelines for preparation of a project RMP for those NMP subsystem and system-level first flight validation projects selected for the Formulation Refinement Phase and, following a successful NASA Headquarters Confirmation Review (CR), for the Implementation Phase. It is intended to satisfy, in part, the requirements of NASA Procedural Requirements 7120.5C, *NASA Program and Project Management Processes and Requirements*[1] for a "continuous risk management" process within the NMP. The RMP is part of the *Project Plan*, but is issued as a separately tracked and controlled document.

Pre-project risk assessments by the NMP Office, the risks identified, and risk management process proposed in the Concept Definition Study Report, provide the initial source material from which a project RMP evolves. The project issues a preliminary RMP at the start of the Formulation Refinement Phase when responsibility for risk management transitions from the NMP Manager to the project manager. At the transition to the Implementation Phase, the formal project RMP approved by the NMP Office is released.

During the Formulation Refinement Phase, the NMP and the technology validation project will use the identified risks, risk mitigations, and the project's descope strategy to develop the project's reserve posture and its reserve allocation approach. This reserve allocation approach will be reviewed by the Governing Program Management Council (GPMC) and the Confirmation Assessment Review (CAR), which is convened by the NMP Manager. Throughout the life of an NMP project, the identified risks and risk mitigations form the basis for defining the risk exposure to the budget, establishing needed budget reserves, and for planning the deployment of those reserves.

The guidelines herein for the Project RMP conform to the *NMP Program Plan* Risk Management requirements, and the requirements in NPR 7120.5C. The format combines inputs

[1] The NMP Program Plan refers to NASA Procedures and Guidelines NPG 7120.5B with an expiration date of November 2005. In February 2004 several NPGs were converted to NASA Procedural Requirements (NPR) documents without changing classification numbers. The expiration date for NPR 7120.5B was November 21, 2007. NPR 7120.5C, which cancels NPR 7120.5B, was issued March 22, 2005 with an expiration date of March 22, 2010.

from the *NMP Program Plan*, the *Risk Management for JPL Projects* guideline document, and practices established by current NMP flight projects. Each project's risk management approach will address the unique challenges of its objectives and success criteria, specified in the NASA approved Project Level-1 Requirements (PLRs), and will accommodate the requirements of the project implementing organization.

A well-developed RMP, including a comprehensive risk list, is a useful tool in determining proper cost reserves. Projects that include significant advanced technology require much higher reserves than standard space science missions. A risk list that contains risk mitigation costs and uncertainty intervals can be effectively used in conjunction with Probabilistic Risk Analysis to determine the level of funding reserve the project requires. Many modern risk analysis computer tools also aid in allocating reserve among Work Breakdown Structure items, requirements and schedule milestones.

1.2 Applicable Documents

A baseline set of governing documents to be applied in the project RMP is listed in Table 1 below.

Table 1. Documents Governing NMP Project Risk Management Process

Document Title	Document ID & Location
NASA Program and Project Management Processes and Requirements	NPR 7120.5C http://nodis3 .gsfc.nasa.gov/displayDir.cfm?Internal_ID =N_PR_7120_005C_&page_name=main
NMP Program Plan	http://nmp.jpl.nasa.gov/program/ program-documents.html
Guideline: Risk Management for JPL Projects (JPL Risk Management Handbook)	JPL D 15951 http://rules/cgi/doc-gw.pl?DocID=35507

1.3 Definitions

1.3.1 NMP Program Plan Risk Categories

The following definitions of key risk management related terminology are taken from the *NMP Program Plan*. These definitions reflect the NMP charter and structure, but differ from the definitions for corresponding aspects of risk used on other NASA programs.

The NMP divides risks into two broad categories, *technology user risk* and *implementation risk*, each with a *primary risk* subcategory in cases where the most severe risk likelihood and/or consequence levels apply.

Technology User Risks are associated with infusing new technology into science missions. These are the perceived risks to the first user in a future Space Science flight mission.

Project Implementation Risks threaten system safety and the achievement of the NMP technology validation project's mission success criteria as established in the PLRs. Project

implementation risks are measured by the probability of their occurrence (likelihood) and the severity of their impact to the cost, schedule, technical and/or programmatic implementation plans (consequence). High-risk areas are defined to be those having high probability and high impact/severity, as defined in NPR 7120.5C.

Primary Risks, associated with all NMP technologies, are known factors threatening technology readiness schedule gates for implementation before mitigation has been applied or for which the applied mitigation was not effective. The projects shall characterize *primary risks* as either *acceptable* or *unacceptable*, based on the requirements in the risk management section of the NMP *Program Plan*.

Program Acceptable Risks are determined by the GPMC upon review of the results of the project risk management process. This determination is made after the project risk management process has been fully implemented for those NMP projects that are either in the Implementation Phase or have been recommended by the GPMC for confirmation.

1.3.2 Definition of Risk

Risk is the combination of the likelihood of an undesirable event occurring and the severity of the consequences of the occurrence, expressed as their product.

Beginning with the Formulation Refinement Phase, this definition of *risk* is applied through the use of the NASA 5x5 Risk Matrix, which defines the criteria for determining for each *technology user* and *project implementation* risk a numerical (1 through 5) likelihood level and consequence level. The results are mapped on a 5x5, color-coded, risk matrix with red, yellow, and green matrix elements. Primary risks are represented by the red zone of the matrix (refer to Figure 2).

Refer to Appendix A for additional risk terminology definitions.

2 Risk Management Plan Guidelines

Prepare the preliminary draft and for approval version of the project RMP applying the guidance provided in this section. Tailor the RMP as explained in Section 1.1 and follow the order of topics presented in the outline below.

2.1 Introduction

Introduce the RMP with sections providing: 1) statements of purpose and scope of the document, 2) a list of applicable source documents, and 3) definitions of key risk management terminology.

2.2 Risk Management Approach

2.2.1 Risk Management Objectives

List the top-level objectives of the project's risk management process, e.g.:

1. Satisfy the requirements of NPR 7120.5C and the *NMP Program Plan* as tailored (waivers in the case of 7120.5C) to the project.
2. Maximize the probability of achieving the project success criteria within the constraints of project budget and schedule requirements defined in the *Project Plan*.
3. Support project decision making by providing integrated risk and consequence assessments continuously throughout the project life cycle.
4. Proactively identify and assess project risks and associated consequences on a continuing basis throughout the project life cycle.
5. Establish identified risks and risk mitigations as the basis for determining the risk exposure of the project's budget, needed budget reserves, and the allocation of these reserves over the project life cycle.
6. Communicate risk and consequence status to all project and involved NASA and project implementing organization management personnel throughout the project life cycle.

2.2.2 Project Success Criteria

Summarize the full and minimum project success criteria presented in the PLRs document (appended to the *Program Plan*). Explain how the *Risk Management Plan* is designed to identify risks that threaten accomplishment of these success criteria and to lead to mitigation responses that reduce those risks to acceptable levels. Describe how the success criteria can be used as a metric for assessing a risk impact to the mission.

2.2.3 Project Risk Drivers

Identify the general risk threats that derive from unique characteristics and constraints of the project. Examples of such risk drivers include: engineering risks, technological risks and programmatic risks. The *engineering risks* are those that involve great difficulty in engineering design or uncertainty of engineering involved in integrating the new technology into the spacecraft. The *technological risks* are the threats to success stemming from the fact that the new technology item has never been produced before and carries design, fabrication and operation uncertainty. *Programmatic risks* can be divided into three major categories:

1. Effects of events beyond the control of the project which affect its cost or success,
2. Administrative or organizational effects which have impact on cost, and
3. Uncertainty of cost estimates.

Following are some examples of engineering, technological and programmatic risks:

- Engineering
    - Noise from the new technology items will have to be mitigated
    - Failures during vibration testing
    - Incorrect assumptions about spacecraft interfaces or vibration levels
    - Unavailability of certain parts
    - Inadequate design for radiated electromagnetic emission
    - Defects during manufacturing
    - Software performs differently on the engineering model than the flight unit
- Technological
    - New technology item cannot be packaged in a small volume
    - New technology item must be redesigned to survive launch loads
    - Performance of the new technology assembly too low
    - New electronics boards need more shielding
    - Mass of the new device is too high
- Programmatic
    - Subcontractor rates have increased
    - Launch vehicle will be delayed
    - Critical personnel not available for the project
    - Testing facility cannot support required ranges

All engineering, technological, and programmatic risks may affect the cost, schedule or performance of the project. The mitigations may include use of funding reserve, schedule reserve, descoping or restructuring of the project.

2.2.4 Risk Management Strategy

Based on the risk drivers and the relative priorities of cost control, performance and technical margins, define a risk management strategy that focuses on achieving high priority objectives. Include the requirements and milestones needed to retire unacceptable risks by the application of cost reserves, the use of schedule margin, and appropriate descoping of requirements. Discuss the project's position with respect to risk avoidance and risk acceptance; describe the differences in mitigation effort between red, yellow, and green risks, and the conditions that allow performance descoping to maintain control of project resources.

Other risk management strategy considerations include:

- Describing the project manager's use of the risk management data and process, integrated with other data (top 10 problem list, fever charts), as a basis for project decisions.
- Identifying those related and integrated risk assessment processes like schedule and budget uncertainty assessments, technical assessments like Failure Modes and Effects Criticality Analysis (FMECA), etc., that provide data for a decision.
- Coordinating partners' and contractors' contributions by sharing risk lists and risk-related decision criteria.
- Identifying and listing risk mitigation actions, their cost, and the date by which a decision to implement each action is to be made.

- Identifying and listing descope actions, their associated cost savings and reduction in capability, and the date by which a decision to implement each descope action is to be made.
- Describing the treatment and status of risk in formal reviews.

The risk and descope lists are a part of the management strategy defining risk-related reserve funding allocations and risk maturity dates.

2.2.5 Compliance with NASA Program and Project Management Requirements (NPR 7120.5C)

Describe how the project will satisfy the requirements of NPR 7120.5C. Discuss the areas where proposed tailoring (where compliance waivers are being requested) is appropriate and cost effective. Include a NPR 7120.5C risk management compliance matrix.

The GPMC at the Jet Propulsion Laboratory is the GPMC to which the project will report. Describe how risk status will be reported to the GPMC.

2.3 Risk Management Implementation

2.3.1 Responsibilities

The project manager is responsible for implementing risk management and assigning risk management responsibilities within the project organization. Describe the responsibilities of the project's risk management lead team (project manager and other members of the project staff, including risk owners, key to the identification and mitigation of risks) and provide a description of their responsibilities. Summarize the risk management functions delegated throughout the project organization in a table by function and designee (Table 2 shows an example). Other developers (Principal Investigators and Industry Partners) are responsible for implementing portions of the project risk management activity internal to their systems.

Table 2. Project Risk Management Responsibilities (Example)

Function	Designee
Owner of Risk Management Process/ Assignment of Responsibilities	Project manager
Risk Management Planning	Project element manager (PEM) with support from project system engineer (PSE) and mission assurance manager (MAM)
Risk Identification	All project personnel
Risk Assessment	Assigned risk owner (RO) with key personnel; e.g., PSE, PEM
Risk Quantification	Project staff; RO, PSE, PEM
Risk Mitigation Planning	Project staff; RO, PSE, PEM
Risk Mitigation Plan Implementation	Project staff; RO, PSE, PEM
Risk Monitoring and Control	RO with project staff
Risk Disposition	RO with project management

Describe the degree to which the project is including safety, health, mission assurance, and information technology organizations as integral parts of the risk management organizational structure. Also, describe how the project uses these capabilities including risk management review expertise, policies and practices, processes, design principles, procedures, reporting systems, tools, training, application of lessons learned, and use of reserves.

2.3.2 Schedules and Milestones

Refer to the top-level project schedule and provide a risk management schedule with milestones consistent with the project schedule. Include reviews, assessment milestones, descope decision points, the schedule for the use of reserves, and other relevant RMP time gates.

2.3.3 Resources and Facility Requirements

List the WBS elements that fund implementation of the project RMP, and other resources provided in or outside the project. Include, where appropriate, funding for workshops to involve the project team in risk management activities.

2.4 Risk Management Process Description

Describe the project's comprehensive approach to risk management considering not only flight hardware and software, ground data handling systems, flight operations, information technology security, physical security risks, and adequacy of resources and margins, but also other related factors. Examples are: getting on contracts, financial condition and capability of technology providers, security of systems (including Web sites) and facilities, export control issues, proprietary or other sensitive information, etc. Describe how the risk management process will be used to identify needed project reserves and to identify the appropriate times to deploy reserves or to implement descope options.

2.4.1 Process Flow Chart

Describe the overall flow of the project's risk management activities and any unique risk data flows, especially if driven by a tool being used. Illustrate in diagram format the information flow between risk management process elements. Figure 1 shows an overview flowchart of the project risk management process described by the guidelines herein.

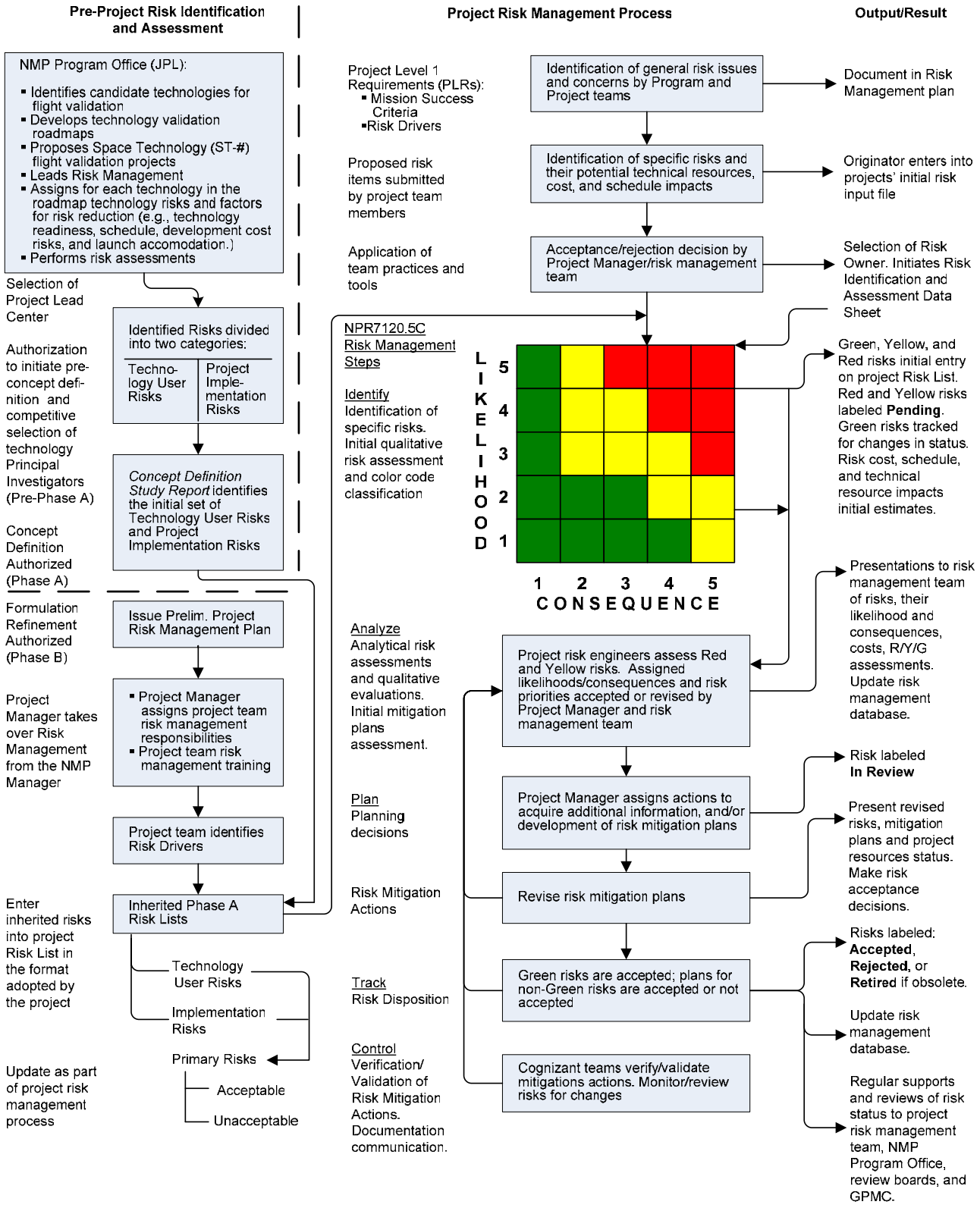

Figure 1. Risk Management Flowchart

2.4.2 Risk Identification and Assessment

The technology user and project implementation risks, and their proposed mitigations inherited from the *Concept Definition Study Report(s),* are the initial identified risk items for the technologies selected for inclusion in the flight validation project. Additional risks will be identified during the Formulation Refinement and Implementation Phases of the project. The project's risk management process is to be applied to all these risks as they are identified. Identified risks are specific and detailed. Risks are not only technical (engineering), but may well be programmatic or technological. All risk can, and most likely will, be cost, schedule or management related.

2.4.2.1 Risk Identification and Assessment Tools

Describe the project's intended use of quantitative and qualitative methods to identify risks and to assess risk probability, uncertainty of estimates, and impact/severity. Available tools include: Failure Mode and Effects Criticality Analysis, Fault Tree Analysis, Probabilistic Risk Assessment, Default Detection and Prevention, Worst Case Analysis, and Parts Stress Analysis. Other tools assisting in the identification of potential risks include the Lessons Learned database and compliance matrices against governing institutional practices and principles. Discussion at regular project tag-up meetings and monthly management reviews also serves the risk identification and assessment process.

The use of modern risk management software is encouraged. Many software applications exist that can assist in making risk management an extremely helpful tool in cost and schedule control. Some software applications allow the user to tie the risks to WBS elements, requirements and success criteria. Connectivity between the risks and WBS elements allows for effective trade studies of descope options. Tying risks to requirements and success criteria helps to establish affordable requirements.

Many risk management software applications have easy interfaces with Excel WBS, cost spreadsheets, and scheduling programs. Connecting risk lists to schedule allows analysis of schedule reserve and workforce cost involved in risk mitigation options.

2.4.2.2 Risk Identification and Categorization

Describe how risks are assigned color code classification (red, yellow, and green).

Specify the following steps for initiating reporting and identification of a new risk item (optionally illustrated in a block diagram):

1. Identification of risk (may be done by any project team member).
2. Identified new risks are reported through entry into a centralized, initial risk, input file.
3. Project risk management regularly reviews reported new entries, and those accepted are assigned a Risk Owner (RO).
4. ROs analyze risks to determine their category, likelihood and consequence levels, color code, and proposed mitigation options. All risks are documented on the Risk Identification and Assessment Data Sheet that becomes part of the project risk database. This sheet is updated throughout the risk disposition process.

5. Enter into the project Risk List (RL) all risks accepted for analysis and disposition by project management.

2.4.2.3 Project Risk List

Track and disseminate risk status through a single comprehensive RL that is regularly updated throughout the project life cycle. Identify the project individual or organizational element responsible for producing and maintaining the RL.

Describe the tool used to display the RL with its parameters. The tool should allow search by risk rank and by a reduced set of parameters, and permit display of a list of risks ordered from greatest risk to least risk for presentations to project and program management.

Upon initial entry into the RL, red and yellow risk items are labeled *Pending*. Green risks remain in the RL for routine tracking of changes in status. As additional information becomes available, red and yellow risks advance through the disposition process labeled *In Review, Accepted, Rejected,* or *Retired.* A risk item is accepted when action decisions have been made and the changes in risk assessment have been incorporated. A risk is retired if it has been overtaken by events.

2.4.2.4 Risk Likelihood and Consequence Assessment

Risk assessment is the process establishing the probability of the occurrence of an identified risk event and the consequence to the project if the event occurs. Describe the criteria for assigning analytical likelihood to a risk and the technique used to estimate its consequence. Identify responsible project risk management staff.

To complete the risk assessment process, each risk item is assigned a likelihood level and a consequence level using the definitions in Table 3 and Table 4, respectively. The associated color code for the combination of these levels is selected from the matrix in Figure 2. The consequence levels in Table 4 are based on project success and budget/schedule/technical resources effects.

Table 3. Likelihood of Risk Occurrence Definitions

Likelihood Level	Likelihood	Definition	Probability of Occurrence
5	Very High	Almost certain	> 70%
4	High	More likely than not	> 50%
3	Moderate	Significant likelihood	> 30%
2	Low	Unlikely	> 1%
1	Very Low	Very unlikely	< 1%

Table 4. Consequence of Risk Occurrence Definitions

Consequence Level	Implementation Risk	Technology User Risk
5	• Potential schedule impact would result in missing planned launch window (>100% of schedule reserve), or • Consequence of occurrence is not reparable within engineering (mass, power, memory, performance, mission return, volume) resources (>100% of resource reserve), or • All budget resources, including contingencies, would be overrun	Mission failure (L1 reqmts. or minimum mission success criteria not satisfied
4	• All launch schedule slack would be consumed (100% of schedule reserve), or • All engineering resources would be consumed (100% of resource reserve), or • All budget resources, including contingencies, would be consumed	Full mission success cannot be achieved. Minimum mission success can be partially achieved.
3	• Significant reduction in launch schedule slack (>50% of schedule reserve), or • Significant consumption of engineering resources (>50% of resource reserve), or • Significant reduction of budget contingencies	Full mission success can be partially achieved. Minimum mission success can be achieved.
2	• Small reduction in launch schedule slack (>10% of schedule reserve), or • Small consumption of engineering resources (>10% of resource reserve), or • Small reduction in budget contingencies	Small reduction in mission return (L1 requirements not at risk, or minimum mission success criteria will be met)
1	• Minimal reduction in launch schedule slack (<10% of schedule reserve), or • Minimal consumption of engineering resources (<10% of resource reserve), or • Minimal reduction of budget contingencies	Minimal (or no) impact to mission

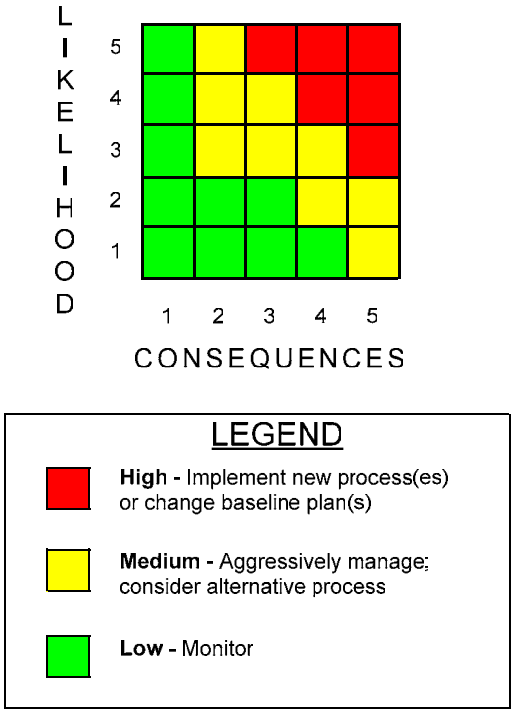

Figure 2. Consequence vs. Likelihood 5x5 Risk Matrix

2.4.2.5 Risk Consequence Aggregation and Ranking

State the project's risk handling policy for control of risks aggregated by color classification: green, yellow, and red. The policy should reflect the situation expected to govern each color, i.e.:

- Green risks represent a minimal to small threat to the project and will be monitored for future changes in severity.
- Yellow designation represents a small to moderate threat to some element of success,
- Red designation represents a high and likely threat to mission success. The project will identify mitigation actions that reduce red risks to yellow or green and will enact such mitigation on an accelerated schedule. It is prudent to incorporate mitigations of high-likelihood red risks and the costs associated with those mitigations into the project's baseline plan.

Describe the methods by which red and yellow aggregate risk consequences will be determined and tracked over time. Include quantitative analyses based on probability-weighted availability of funds, the cost of mitigation, and internal project consultations to allocate reserves and set priorities for funding liens. Explain how aggregated consequences will be held to an acceptable level. Define the risk management tools to be used to calculate total project risk and explain how the result follows from the scales used and project objectives.

2.4.3 Risk Mitigation and Disposition

2.4.3.1 Methods and Forums

Explain how management will develop risk mitigation decisions. Identify how tools will be used to support risk mitigation decisions. Link resource plans to risk management (i.e., cost risk is compared to budget reserves; schedule risk is assessed against schedule uncertainties and margins).

2.4.3.2 Risk Mitigation Plans

Describe how risk identification data is used to decide allowable mitigation actions. Identify available mitigation options: e.g., significant scope flexibility, agreed-to project objectives descopes, alternative technologies in development, multiple sources for equipment, schedule flexibilities. In the risk information files for accepted color coded risk items, collect data supporting mitigation actions and a disposition decision according to the following guidelines:

Green Risks — Accept without further mitigation. Monitor for potential increases in severity.

Yellow Risks — Investigate for most cost effective mitigation. Identify alternative strategies and conduct trade-offs to determine the mitigation required. Identify decision milestones for all risks, including those that do not require immediate action. Assess detailed cost and schedule impacts for those risks where mitigation is an option.

Red Risks — The goal is to identify mitigation actions that drive all red risks to yellow or green. Create mitigations plans on an accelerated schedule. Consider all available mitigation actions (including required waivers). Provide implementation cost and schedule data. Evaluate the following mitigation strategies:

- The causes and contributors, actions embedded in the program/project to reduce and control red risks, and the information to be collected for tracking purposes.
- Estimates of probability (qualitative or quantitative) of occurrence together with uncertainty of estimate. (The probability of occurrence to take into account the effectiveness of any already implemented risk mitigation measures.)
- Additional mitigation measures being considered, e.g., a cost comparison that addresses the probability of occurrence multiplied by cost of occurrence versus the cost of risk mitigation, additional testing, new design, new part, verification or validation plan changes, parallel path development, and capabilities descopes (with required waivers). Also consider redundancy, cross-strapping, graceful degradation, operating time before Assembly Test and Launch Operations delivery, and deviations from the project's single-point failure policy.
- Include indication of “Accepted” risk versus mitigation of “Not Accepted” risks, specifically:
  - For accepted risks describe the rationale that justifies acceptance, and contingency plans in case of occurrence.

    - For risks not accepted, describe the mitigation plan and schedule to move the risk out of the red category.
- Determine compliance with the *NMP Program Plan*, which specify the risk management requirements for *project acceptable risk*.

2.4.3.3 Project Descope Strategy

Descopes are applied by the project for specific risk mitigations to increase margins for critical resources when no other risk mitigation actions are acceptable. Identify the capability lost by applying the descope and compare it to the cost and schedule impact of implementing the descope.

The Project Descope Options List, created and maintained during the Formulation Refinement phase, is included for information in the Project Plan. Throughout the life of the project this continually updated list will contain a description of allowable descope actions, project resource savings targeted by the descope, a date by which the descope must be implemented to be useful, and other associated issues. Present the status of the Project Descope Option List at each Monthly Management Review (MMR) and other formal reviews.

2.4.4 Risk Tracking and Reporting

2.4.4.1 Risk Data Documents and Metrics

Describe the contents of the risk data documents to be prepared and maintained by the project. Describe what programmatic (cost, schedule risk) metrics will be maintained to track and report risks, and how they will be produced. The minimum required metrics include:

1. Project RL status
2. Project Top RL status
3. Number of green, yellow, and red risks vs. time
4. The evolution trends of yellow and red risks
5. Technical margins vs. time
6. Status of and liens against financial reserves
7. Project aggregate risk exposure probability weighted against funding vs. time
8. Project descope options status

2.4.4.2 Risk Status Reports

Describe what reports are planned, to whom and with what frequency. If partners are included in the project management structure, describe the reports they will generate. Discuss sharing of databases, and whether combined or separate risk lists will be maintained using common or separate criteria. Provide monthly reports in the format directed by the program office. The project manager shall, in the quarterly status report, communicate risk mitigation actions taken, the effectiveness of risk mitigation activities, and residual risks.

2.4.4.3 Risk Management Reviews

Refer to the project risk management schedule. Discuss the topics and purpose of formal reviews to be conducted, and how risks will be treated and their status described in these reviews.

2.4.5 Verification/Validation of Risk Mitigation

The verification/validation of a mitigation plan/action is the responsibility of the individual or organizational element that is responsible for the mitigation action. Mitigation plans for red risks are peer reviewed prior to and after implementation to verify the effectiveness of the mitigation actions. In addition, the project's technical management reviews and assesses the results of mitigation implementations, and verifies that the results do, in fact, mitigate the risk at which they are targeted and any consequences of the mitigation are acceptable. Store verification/validation documents in the project's risk management database files.

Appendix A. Definitions

Risk	Risk is the combination of an undesirable event occurring and the severity of the consequences of the occurrence. Conceptually, risk may be expressed mathematically as: *Risk = likelihood * consequence* (may involve integration of distributions)
Continuous Risk Management	Continuous Risk Management (CRM), as defined in NPR 7120.5C, is a software engineering practice with processes, methods, and tools for managing risks in a project.
Technology User Risk	Associated with the infusing of technology into a science mission. The perceived risk to the first user in a future mission for the Science Mission Directorate.
Implementation Risk	The probability of impact to the cost, schedule, technical and/or programmatic implementation plans, and the severity of the consequence to the project implementation plans.
Primary Risk	NMP technologies with known factors that threaten technology readiness gates for implementation before mitigation has been applied, or the applied mitigation did not lead to the desired outcome.
Problem	A problem is a risk that has been realized (even if the risk was never identified) or a risk where the decision space has been consciously limited to a single course of action, or where there is only one feasible course of action.
Risk Assessment	Risk assessment is the process of establishing the probability of the occurrence of an identified risk event and the consequence to the project if the event occurs.
Risk Based Design	Convergence of design based on risk retirement.
Risk Disposition	A process in which risks are examined in further detail to determine the extent of the risks, how they relate to each other, and which ones are the most important to deal with.
Risk Identification	A process of transforming uncertainties and issues about the project into distinct (tangible) risks that can be described and measured.
Risk Management	Risk management is an organized means to “collecting” and “controlling” the overall risk on a project. Risk management is the process by which implementation risks are identified, analyzed, and characterized to support effective and timely action by management for mitigation of these risks.
Risk Management Plan	Risk Management Plan describes the functions, responsibilities and activities necessary to accomplish effective risk management, and fulfills the requirements of NPR 7120.5C. The results of the risk planning process are documented in this Risk Management Plan.
Risk Mitigation Plan Implementation	The approach taken to deal with a risk. This can be “accept”, “research”, “watch”, or “mitigate” the risk.
Risk Mitigation Planning	An action plan for risks that are to be mitigated. It documents the strategies, actions, goals, schedule dates, tracking requirements, and all other supporting information needed to carry out the mitigation strategy.
Risk Monitoring and Control	A process that takes the tracking status reports for the watched and mitigated project risks and decides if action is needed based on new data.
Risk Planning Process	Risk planning is the process of identifying the project's overall risk policy and objectives; defining responsibilities, resources, schedules and documentation required for risk management activities; defining tools and techniques that will be used for risk identification, assessment and mitigation; and defining the relationship of the risk management activities with respect to the systems analyses, configuration control, and reviews
Risk Quantification	The process of applying values to the various aspects of a risk.

Appendix B. Abbreviations

ATLO	Assembly, Test and Launch Operations
CAR	Confirmation Assessment Review
CR	Confirmation Review
CRM	Continuous Risk Management
FMEA	Failure Modes and Effects Criticality Analysis
GPMC	Governing Program Management Council
GS	Group Supervisor
MAM	Mission Assurance Manager
MMR	Monthly Management Review
NMP	New Millennium Program
NPG	NASA Procedures and Guidelines
NPR	NASA Procedural Requirements
PCA	Program Commitment Agreement
PEM	Project Element Manager
PIP	Project Implementation Plan
PLRs	Project Level-1 Requirements
PSE	Project System Engineer
RE	Risk Engineer
RL	Risk List
RM	Risk Management
RMP	Risk Management Plan
RO	Risk Owner
TRL	Technology Readiness Level
WBS	Work Breakdown Structure