ePORT, NASA’s Computer Database Program for System Safety Risk Management Oversight (Electronic Project Online Risk Tool)

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Abstract

ePORT (electronic Project Online Risk Tool) provides a systematic approach to using an electronic database program to manage a program/project risk management processes. This presentation will briefly cover the standard risk management procedures, then thoroughly cover NASA’s Risk Management tool called ePORT. This electronic Project Online Risk Tool (ePORT) is a web-based risk management program that provides a common framework to capture and manage risks, independent of a program/projects size and budget. It is used to thoroughly cover the risk management paradigm providing standardized evaluation criterion for common management reporting. ePORT improves Product Line, Center and Corporate Management insight, simplifies program/project manager reporting, and maintains an archive of data for historical reference (ref. 1).

Introduction

Proactive fundamental managing processes are essential in preventing potentially detrimental consequences. From a program’s/project’s (P/P) conceptual phase to its disposal, it is imperative that potential negative events are identified early to ensure appropriate mitigation processes are implemented to reduce or eliminate prospective negative impacts. It is imperative that since all P/P are dynamic; the Risk management (RM) process should therefore be fluid and continuously updated as the schedule progresses.

Disciplines, be they engineering, social, academia and the like all have unique Risk associated with them and can utilize a RM approach as they see fit. Therefore, the term program/project “P/P” encompasses all disciplines and is used as such during this discussion. In addition, though this paper discusses only ePORT, the RM practices for ePORT can be utilized in other programs as well.

At no time in the history of the human race has the pace of technology increased as it has these past one hundred years. As the technology development has increased exponentially, Risks associated with this shift has increased accordingly. Fortunately, commercially available computer programs exist today that can assist with the RM processes. This paper is designed to discuss one such program developed and utilized at the United States National Aeronautics and Space Administration (NASA) George C. Marshall Space Flight Center (MSFC) in Huntsville, Alabama. It is called ePORT for electronic Project Online Risk Tool. It is used extensively at NASA and is for internal use only, not for sale or deployment. However, the program serves as an example of how others might employ a similar tool in their RM work.

History

By early 2001, several independent studies were reporting insufficient RM practices at NASA (e.g., Faster, Better, Cheaper Task Force; Mars Climate Orbiter Mishap Investigation Board; NASA Integrated Action Team). MSFC Systems Management Office (SMO) reacted to the Agency’s and Center’s refocus on RM by meeting with SMO Safety and Mission Assurance (S&MA) and P/P Risk managers across MSFC and at other NASA Centers to assess available RM tools. This assessment highlighted a general conclusion that no cost-effective, robust, cross-platform tools were available that fully met P/P needs. Because of this condition, larger initiatives would build their own database systems from scratch at significant cost while smaller initiatives struggled to effectively manage Risks due to the lack of funds. Since one of SMO’s chartered functions was to “Direct the development of standard processes, tools, and guidelines for P/P management...” it was decided to add the RM Module to the ePORT requirements.
From July 2001 to November 2002, SMO worked with NASA Headquarters (HQ) and other NASA Centers to develop recommendations for the Agency Project Management Council (PMC) to establish a common approach for health status and Risk management reporting. In February 2002, SMO completed successful Operational Readiness Review of ePORT Core and made version 1.0 available to MSFC P/P (ref. 2).

Some key tenets to ePORT development were that the P/P Managers should own their assessments and be maintained at least one level lower than required by management to improve accuracy in reporting. Any common reporting criteria should be used where established.

ePORT allows the users to download reports in formats that can be easily incorporated into standard applications [portable document format (.PDF) or Microsoft Excel (.xls)]. The tool provides benefits to P/P, not just upper management, and allows managers as much flexibility as possible for data organization and access control, see Figure – 1 (ref. 3).

Risk Management Flow

Figure – 1, ePORT Risk Management Flow

Continuous Risk Management Process
Before describing the ePORT program, a brief explanation of the RM process is in order. Continuous Risk Management (CRM) is a practice with processes, methods, and tools for managing Risks in a P/P. CRM as discussed in this paper for ePORT is based largely on the CRM process developed by the Carnegie Mellon University Software Engineering Institute (ref. 4) and provides a disciplined environment for proactive decision-making to access continuously what could go wrong (Risks), determine what Risks are important to deal with, and implement strategies to deal with those Risks. A simple RM paradigm is shown in Figure – 2. A thorough and more informative breakdown of the Continuous Risk Management Process Flow is seen in Figure – 3 (ref. 5).

**Figure – 2, Risk Management Paradigm**

As indicated in the CRM Process Flow chart above, the six steps to a thorough CRM process begins with Identify and progresses through Analyze, Plan, Track, Control, and Communicate and Document:

**Identify:** Beginning with Identify, where the P/P considers Risks before they become a Problem. Anyone in a P/P can Identify Risks because each individual has particular knowledge about various parts of a P/P. During Identify, uncertainties and issues about the P/P are transformed into distinct (tangible) Risks that can be described and measured. The aim for the Risk statement is that it be clear, concise, and sufficiently informative so that the Risk is easily understood. The Risk statement should follow the following standard two part format:
Risk Statement: given the <condition> there is a possibility that <consequence> will occur (ref. 6)

Analyze: The purpose of Analyze is to convert the data into decision-making information. Analyze is a process of examining the Risks in detail to determine the extent of the Risks, how they relate to each other, and which ones are the most important. Analyzing Risks has three basic activities: Evaluating the attributes of the Risks (impact, probability, and timeframe), Classifying the Risks, and Prioritizing (-ranking) the Risks.

Evaluating: The first step provides better understanding of the Risk by qualifying the expected impact, probability, and timeframe of a Risk. This involves establishing values for: Probability: The likelihood the Risk will occur; Impact: The loss or negative affect (consequence) on the P/P should the Risk occur; and Timeframe: The period when you must take action in order to mitigate the Risk.

Classifying: The second step allow placing each Risk in decision making corresponding fields. This enables the P/P to group identified Risks in specified disciplines so the Risk is assigned to the appropriate personnel.

Prioritizing: In Prioritizing Risks, the P/P can evaluate the Risks that pose the highest concern. Here the amount of effort and/or time when to begin actions to work on the Risk is decided.

Figure – 4 demonstrates Sample Attribute Values that might be used to evaluate Risks (ref. 7).

Figure – 4, Sample Attribute Values

Plan: Planning is the function of deciding what, if anything should be done about a Risk or set of related Risks. In this function, decisions and mitigation strategies are developed based on current knowledge of P/P Risks.
The purpose of Plan is to: Make sure the consequences and the sources of the Risk are known; Develop effective Plans; Plan efficiently (only as much as needed or will be of benefit); produce, over time, the correct set of actions that minimize the impacts of Risks (cost and schedule) while maximizing opportunity and value; and, Plan important Risks first.

Figure – 5 indicates the potential approaches to Risk Planning.

There are four options to consider when planning for Risks: (1) Research: establish a plan to research the Risk(s); (2) Accept: decide to "accept" the Risk(s) and document the rationale behind the decision; (3) Watch: monitor Risk conditions for any indications of change in probability or impact (tracking metrics must be established and documented); and (4) Mitigate: allocate resources and assign actions in order to reduce the probability or potential impact of Risks. This can range from simple tasking to sweeping activities: (a) Action Items: a series of discrete tasks to mitigate Risk and (b) Task Plan: formal, well-documented and larger in scope (ref. 8).

Track: Tracking is the process by which Risk status data are acquired, compiled, and reported. The purpose of Track is to collect accurate, timely, and relevant Risk information and to present it in a clear and easily understood manner to the appropriate people/group. Tracking is done by the Risk owner who is responsible for monitoring "watched" or "mitigated" Risks. Tracking status information become critical to performing the next function in the Continuous Risk Management paradigm, i.e. Control. Supporting information, such as schedule and budget variances, critical path changes, and project/performance indicators can be used as triggers, thresholds, and Risk - or plan-specific measures where appropriate.

Example-1: A program metric might look at the rate of module completion. If this metric indicates that the rate of completion is lower than expected, then a schedule Risk should be identified (ref. 9).

Example-2: A program may set upper and lower boundaries as the limiting factors which can establish a false sense that all is going well when it actually may not be. For example, if the trends are stabilized near the upper boundary and they begin to fall, concern that a Problem might occur may not be flagged until the lower boundary is passed. At this point it may be too late. However, by monitoring the rate of change and understanding why the rapidly increasing rate of change is occurring the P/P can take appropriate action to prevent a problem from taking place.

Control: The purpose of the Control function is to make informed, timely, and effective decisions regarding Risks and their mitigation plans. It is the process that takes in tracking status information and decides exactly what to do based on the reported data. Controlling Risks involves analyzing the status reports, deciding how to proceed, and then implementing those decisions.

Decision makers need to know: (1) when or whether there is a significant change in Risk attributes and (2) the effectiveness of mitigation plans within the context of P/P needs and constraints.
The goal is to obtain a clear understanding of the current status of each Risk and mitigation plan relative to the P/P and then to make decisions based on that understanding. Tracking data is used to ensure that P/P Risks continue to be managed effectively and to determine how to proceed with P/P Risks. Options include: Replan, Close the Risk, Invoke a Contingency Plan, and Continue Tracking and Executing the Current Plan:

Replan: A new or modified plan is required when the threshold value has been exceeded, analysis of the indicators shows that the action plan is not working, or an unexpected adverse trend is discovered.

Close the Risk: A Closed Risk is one that no longer exists, has been overcome by events, or the Risk has become a Problem. When it becomes a Problem the event has occurred and it is now placed in a different category and is now tracked (see Problem section below).

Invoke a Contingency Plan: A Contingency Plan is invoked when a trigger has been exceeded or some other related action needs to be taken.

Continue tracking and executing the current plan: No additional action is taken when analysis of the tracking data indicates that all is going as expected or P/P personnel decide to continue tracking the Risk or mitigation plan as before. However, don’t forget about the rate of change example mentioned earlier (ref. 10).

Communication and Documentation: The purpose of Communicate and Document is for ALL personnel to understand the P/P Risks, mitigation alternatives as well as Risk data and to make effective choices within the constraints of the P/P. Communication and Documentation are essential to the success of all other functions within the paradigm and are critical for managing Risks.

For effective Risk management, an organization must have open Communication and formal Documentation. Communication of Risk information is often difficult because the concept of Risk comprises two subjects that people don’t normally deal well with: probability and negative consequences. Documentation allows for the necessary paper (electronic) tracking capability for current P/P actions, simplifies P/P manager reporting, and maintains an archive of data for historical reference.

Not only is effective Continuous Risk Management in jeopardy, but the P/P as a whole is in jeopardy when the environment is not based on open Communication. No one has better insight into Risks than P/P personnel, and management needs that input. Experienced managers know that the free flow of information can make or break any P/P. Open Communication requires: Encouraging free-flowing information at all between all P/P levels; enabling formal, informal and impromptu communication; and using consensus-based processes that value the individual voice, bringing unique knowledge and insight to identifying and managing Risks (ref. 11).

Phase-1: Where to begin

In an ideal case study, before a P/P initiates an electronic RM system such as in this case ePORT, it is imperative that the essential P/P disciplines have been identified and personnel manning these disciplines are in place. Equally important is that the P/P be in its early stages of development. This will ensure the P/P will be heading in the most efficient direction from the beginning. Once the team is in place, the P/P manager would need to set aside a mandatory two day (minimum) off-site stand down for RM training for ALL personnel assigned to the P/P. This effort will ensure all team members are properly and thoroughly educated in the RM process equally and to relay any P/P updates prior to identifying P/P Risks. In addition, since ePORT will be utilized throughout the training, it is imperative that all team members attend regardless if they are familiar with the RM processes because they will be creating their personal accounts, taught how to navigate through ePORT, and learn how to input Risks. For efficiency purposes, an ePORT administrator should also be identified, present at the training session, be well trained in ePORT beforehand, and be the designated P/P ePORT central point of contact. Each team member will begin to use the RM paradigm and correctly identify and state Risks as they are imputed into the ePORT system. The beauty of this process is three fold, at the end of the training all team members are equally knowledgeable of the RM process, they will know how to independently submit Risks in their areas of expertise at any stage in the P/P life cycle (thus the term “Continuous” RM), and the P/P has established a team building event in the process.
Phase-2: Using ePORT

Once the P/P team members complete the training course they will become experts in the RM process. Access to ePORT is limited to the P/P Manager or personnel designated as their representatives for either data entry or review. Each initiative is partitioned from the others to only allow access to approved members of the team or upper management. It is best that the users and Risk managers initiate access based on their P/P responsibilities. Clicking on the system requirements link takes the user to a new page detailing ePORT's system requirements and provides access to the latest version of software needed to view ePORT as well as some optional plug-ins.

ePORT System Requirements: ePORT was developed so that users would not be required to acquire special proprietary software except for normal freeware multimedia plug-ins in order to use the tool. The development team has a continuous objective to ensure the tool is platform independent. ePORT is designed to work consistently on PC and Macintosh platforms using Internet Explorer or Safari. While ePORT may work with older or newer versions of the software specified, it was designed and tested using the versions listed (ref. 12).

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<tr>
<td>Additional Plug-ins</td>
<td>Adobe Reader</td>
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The home page for ePORT has a primary main menu that is divided into seven major sections: Message Center, Profile, Risk, Problems, Reports, Help, Setup and Sign out. When selecting any one of these sections, sublinks are generated for specific areas of CRM operations for the P/P team members to use and are described below.

**Message Center:** Returns the user to the initial main screen to view administrative messages pertaining to ePORT for the P/P users. As the P/P progresses, noted RM information that needs to be disseminated to the team is shown here.

**Profile:** Links to a one-screen synopsis of the P/P containing Initiative Name (P/P name), the NASA Center for the P/P, Initiative Hierarchy of the P/P, and points of contact (names, phone numbers, email addresses) which are listed alphabetically.

**Risks:** Contains tools for managing the initiative on a continual basis. By selecting [Risks], users gain access to a complete RM database to plan strategies for recognizing and mitigating potential threats to the initiative's success. Sub links include Add, Index, Status, 5x5 Grid, and Definitions:

- **Add:** Contains the necessary blank fields for filling in each Risk. Red asterisk areas are mandatory fields before submitting and include Likelihood, Consequence (Cost, Schedule, Performance and Safety) all 1 to 5, Title, Statement, Team, Owner, Timeframe (Near Mid and Far), Approach (Research, Mitigation, Watch, Accept). Additional blank fields include Planned Closure Date, Context, Research Plan, Mitigation Plan, Watch Plan/Tracking Requirements, Management Plan and Status. One note here is to be careful when referencing web links, without any notice the link itself or sub-links within it could be deleted or worst case the information is outdated, incorrect and may lead you down the wrong path. It is best to refrain from using web links in any Risk statements, subsequent data, or in documentation.

- **Index:** Is the page where the user can identify specific areas when performing selected criteria. It is basically a bean counter for the P/P. Here displays of the summary of all Risks by criticality are shown and it allows for P/P Risk integration and multiple ways to sort specific Risks. The user can draft Risks tailored reports from Approved Risks and Proposed Modifications (Mods) and automatically flag identity when proposed Mods exist. For example, if management wishes to have listed only Status (Open), Criticality (Medium), Timeframe, (Near), Approach (Accept, Research and Mitigate) only Risks, they only need to choose the said criteria and select [Search]. One can even choose the specified Risks via Owner, Teams, Category, Group and sort the list via Descending, Ascending or RID (Risk Identification Number).

- **Status:** After selecting [Search] from the Index page, a list of the requested Risk appears. By selecting [Status], this list will now appear in criticality hierarchy previously selected in the Index page with each Risk having its designated Risk Plan and Approach shown.
5x5 Grid: Shows where all approved Risks previously identified in the Likelihood versus Consequences 5x5 matrix grid, see Figure – 6 (ref. 13). After all the Risks have been accepted by the Risk board or management board they are formally entered into the ePORT. At this time a Risk 5x5 Summary Matrix can be generated. The data from this matrix allows the severity of the Risk of an event occurring to be determined. Here the P/P can designate which list to monitor (i.e. top 10) and prioritize the immediate effort to work the more severe Risks first or Risks that can be mitigated the quickest, however the P/P chooses. ePORT uses the following criteria to rank Risks: (1) by criticality (High, Med, and Low); (2) by worst-case LxC (Likelihood x Consequence) product; (3) by composite LxC (sum of each LxC product for cost, schedule, technical and safety consequence); (4) by timeframe (near, mid, far); (5) by approach (mitigate, research, watch, and accept); and (6) by Risk identification number.

Definitions: Through a pop-up page, the P/P selected Risk Definitions are defined (Timeframe – Near, Mid and Far) (Likelihood and Consequences – Cost, Schedule, Performance, Safety, etc.) (Risk Values – 5, 4, 3, 2 and 1). These definitions are also shown in Figure – 4 above.

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**ePORT Risk 5x5 Summary**

![Image of ePORT Risk 5x5 Summary Grid]

**Problems:** Contains tools for managing the Problems that are associated with an initiative on a continual basis. By selecting [Problems], users gain access to a complete Problems management database to plan strategies for handling the initiative’s ongoing Problems. A special note here is that when a Risk becomes a Problem, the event has occurred and is therefore moved within ePORT and tracked separately. As with the Risks link noted above, Problems also has Add, Index, Status, and Definitions. However, in addition Problems has Summary and Issues links.

**Summary:** Lists the Impact Summary in a 3x3 grid relative to the noted Problem’s impact in Red (high Criticality), Yellow (Medium Criticality) and Green (Low Criticality) versus the timeframes Near, Mid and Far.
Issues: Lists both the noted 3x3 grid in Summary and the 5x5 (Likelihood versus Consequences) Grids for Problems.

Reports: Allow the user to select specific data and templates to create tailored reports for the accepted Risks, Problems and General where the user can select the ability to download the information in either portable document format (.PDF) or Microsoft Excel (.xls).

Help: Contains immediate resources to aid the user in using ePORT. By selecting [User Guide], a new web browser window will open and provide access to a web based help guide. By selecting [FAQ], the user can view comments and responses entered to date and submit comments, questions or bugs to the administrator.

Setup: Houses all user-defined preferences that are available to task manager, Risk manager or the general users. Users have access to their own user preferences by selecting [My Preferences]. The [Risk Admin] section allows the Risk manager to establish the Risk settings for their initiative.

Sign out: It is a must to always [Sign Out] of ePORT after each session to maintain integrity of the user’s initiatives data. If the user’s browser stays idle for more than 20 minutes the user’s session will time out and the user will be automatically asked to log back in (ref. 14).

Conclusion

In any system the RM process works in maintaining a P/P ability to stay on schedule and within budget. The difficulty lies in actually implementing a thorough RM process. Often a P/P Risk Management Plan (RMP) is hastily written and then thrown in a corner to gather dust until a Problem occurs. Having a thoroughly trained staff and a computer based centralized RM program in place is not only essential but imperative for any P/P. In addition to the RM course, one of the steps NASA has taken is to establish a Risk management web site that contains sample Risk management plans and a schedule of classes. A significant amount of time was spent discussing with managers the benefits of taking a formal training course where the costs and time spent is more than recovered by a P/P when all team members are working toward common goals in a coordinated manner. In doing so ePORT has proven itself over and over as a P/P viable and necessary tool by improving the product line, Center and Corporate management insight, simplifying P/P manager reporting processes, and maintaining an archive of data for historical reference.

With the current United States space initiative directive, completing the International Space Station and traveling back to the Moon and then to Mars, new technical challenges are being encountered each day. NASA has been a leader in the aerospace industry; however, this industry is rapidly changing. High tech private adventures are cropping up every day and with the proper tools in place they can succeed. There are several commercially available RM tools on the market. A proactive manager of any P/P should ensure their teams master these tools. The positive result will show when they deliver products and or services that are on time, safe, reliable and profitable.

References

(refs. 2 – 3) Risk Management with ePORT (electronic Project Online Risk Tool), MSFC Office of Strategic Analysis and Communication presentation, August 1, 2007.

Biography

George C. Marshall Space Flight Center
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MSFC, AL 35812 U.S.A.
Paul Johnson is an Aerospace Engineer with the United States National Aeronautics and Space Administration (NASA) located at the George C. Marshall Space Flight Center (MSFC) in Huntsville, Alabama. He began his career as a cooperative intern in the early 1980's working within the Ground Support Equipment (GSE) Office. Upon graduating from the University of Louisville in Louisville, Kentucky, with a Bachelor's degree in Applied Science in Mechanical Engineering, he returned to NASA/MSFC assigned to the Propulsion Controls Office working on the Space Shuttle Main Engine Valves and Actuators. After working full time for only one year, he took a six year leave of absence to join the United States Navy and flew various jet aircraft. Upon returning to NASA in 1991 he was assigned to the Liquid Propulsion Office working various Environmental Control and Life Support Systems (ECLSS) for the International Space Station (ISS). However, within two years while still working for NASA, he was assigned as a Diplomat working at the American/NASA Liaison Office in Moscow, Russia, working the joint United States/Russian space effort. Since his return to MSFC he has been working in the Safety and Mission Assurance (S&MA) Office ensuring Safety, Reliability, and Quality Assurance requirements are being met on flight hardware. He returned to graduate school and has earned a graduate degree in Engineering Management.

Abbreviations and Acronyms

Admin Administration
CRM Continuous Risk Management
ECLSS Environmental Control and Life Support Systems
EPA Environmental Protection Agency
ePORT Electronic Project Online Risk Tool
F Far-term
FAQ Frequently Asked Questions
GSE Ground Support Equipment
H High
HQ Headquarters
ISS International Space Station
L Low
LxC Likelihood x Consequence
M Medium
M Mid-term
Mod Modification
MSFC Marshall Space Flight Center
N Near-term
NASA National Aeronautics and Space Administration
OSHA Occupational Safety and Health Act
.PDF Portable Document Format®
P/P Program and/or Project
FMC Program Management Council
RID Risk Identification Number
RM Risk Management
S&MA Safety and Mission Assurance
SMO Systems Management Office
UAF User Access Form
.xls Microsoft Excel®
Paul Johnson
National Aeronautics and Space Administration
George C. Marshall Space Flight Center

NASA’s Computer Database Program for System Safety Risk Management Oversight
HANDBOUTS

- CRM Process Flow
- CRM Summary Card
- CRM Paradigm
- CRM Program/Project Risk Definitions
- CRM Training Processes and Solutions tri-fold
Apollo Launch Escape System (LES)  Aries I Launch Abort System (LAS)
Orion
Launch Abort System (LAS)
Jettison Motor (JM) Static Firing Test
27 Mar 08
AGENDA

- Quote
- ePORT History
- Continuous Risk Management Process
- ePORT - Project: PILOT
- Things To Think About
- Q&A
"Proactive fundamental managing processes are essential in preventing potentially detrimental consequences."
ePORT HISTORY

- Independent Studies showed insufficient Risk Management (RM) practices at NASA for Programs/Projects (P/P).
- No cost-effective, robust, cross-platform RM tools were available that fully met P/P needs:
  - to each his own.
- Direction to develop standard processes, tools and guidelines for P/P management.
- ePORT – electronic Project Online Risk Tool
DEFINITIONS

♦ What is Continuous Risk Management:
  • It is a **continuous** iterative process to manage risks in order to achieve mission success.

♦ What is a RISK:
  • It is characterized by the **combination** of the "probability" that the Program/Project will experience an undesired event (cost, schedule, safety or technical) and the "consequences, impact, or severity" of the undesired event, were to occur.
My customer doesn't want to hear that he/she is a source of risk!

This is development... why should we worry about supportability and maintainability risks!

No one on the staff knows how to do risk management!

Our job is to develop software, not fill out bureaucratic forms!

We are using a proven method, so it's not a risk. The conference speaker said so!

We have no cost/schedule risk because new technology will increase our productivity by 5-to-10 times!

Our customer goes ballistic whenever he/she hears of a potential problem!

Making our risks public will kill the project!

Give us an hour and we'll tell you our top 10 risks!

We have no risk!

Using that tool is not a risk. The vendor said so!

The project is too small to do risk management!

New technology we've never used before will mitigate the risk!

https://www.goldpractices.com/practices/frm/
CONTINUOUS RISK MANAGEMENT
PROCESS SUPPORT STRUCTURE
NOT ALL INCLUSIVE!

- Development, Level of Technology Readiness, Work Breakdown Structure (WBS), Funding Profile, Manpower Availability, etc.

Cost

- Initial Design Review (IDR), Preliminary Design Review (PDR), Material Readiness Review (MRR), Critical Design Review (CDR), Manufacturing Due Dates, Delivery Dates, etc.

Schedule

- Hazard Analysis, Failure Modes and Effects Analysis (FMEA), Critical Item List (CIL), Reliability Requirements, Redundancy Requirements (Redundancy Tolerance), Industrial Safety, etc.

Safety

- Anomalies, Testing, Manufacturing, Quality Control, Design, Material Availability, Personnel Expertise, etc.

Technical
Cost | Schedule | Safety | Technical

Development, Level of Technology Readiness,
Work Breakdown Structure (WBS), Refunding Profile, Manpower
Availability Initial Design Review (IDR), Preliminary Design Review (PDR),
Material Readiness Review (MRR), Critical Design Review (CDR),
Manufacturing Due Dates, Delivery Dates, - Hazard Analysis, Failure Modes
and Effects Analysis (FMEA), Critical Item List (CIL), Reliability
Requirements, Redundancy Requirements (Fault Tolerance) Industrial
Safety, Anomalies (Testing, Manufacturing, Quality Control), Design,
Material Availability, Personnel Expertise, etc...
International System Safety Regional Conference 2008

Cost  Schedule  Safety  Technical

Development, Level of Technology Readiness, Work Breakdown Structure (WBS), Refunding Profile, Manpower Availability Initial Design Review (IDR), Preliminary Design Review (PDR), Material Readiness Review (MRR), Critical Design Review (CDR), Manufacturing Due Dates, Delivery Dates, - Hazard Analysis, Failure Modes and Effects Analysis (FMEA), Critical Item List (CIL), Reliability Requirements, Redundancy Requirements (Fault Tolerance) Industrial Safety, Anomalies (Testing, Manufacturing, Quality Control), Design, Material Availability, Personnel Expertise, etc...
Groups, Teams And Categories for PILOT

Groups

 gibt additive

Teams

 gibt additive

Categories

 gibt additive

Click on the Group, Team or Category Name to delete it from the initiative.

Everyone  Engineering  Drawings
Management  Electrical  Materials
S&MA  Quality  Reliability
Testing  Risk Manager  Safety

Member Access for PILOT

1) Select User to add to your team

   Select User to add to your Initiative

2) Click on name to update the access level of the team member and to see the delete option.

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<td>Wrigley, Tracy</td>
<td>Team Member</td>
<td>No eMAIL</td>
<td>Everyone</td>
</tr>
</tbody>
</table>
Continuous Risk Management Summary Card

**Definitions**

**Continuous Risk Management (CRM)** - A management practice with processes, methods, and tools for managing risks in a program or project.

**RISK** - is characterized by the combination of the Likelihood/Probability that a program or project will experience an undesired event (some examples include a cost overrun, schedule slippage, safety mishap, health problem, malicious activities, environmental impact, failure to achieve a needed scientific or technical breakthrough or mission success criteria) and the consequences, impact, or severity of the undesired event, over it to occur.

**Likelihood** - the probability that the risk will occur.

**Consequence** - the loss or effect on the program/project if the risk occurs.

**Timeframe** - the period when action must be taken to handle the risk mitigation plan.

**Cost** - a program/project cost issue that directly/indirectly impacts the program/project budget.

**Schedule** - a program/project schedule issue that directly impacts the program/project.

**Technical** - a program/project technical issue that directly impacts the program/project.

**Timeline**

- **Near** - within the next 3 months
- **Mid-Term** - between 4 - 8 months
- **Far** - beyond 8 months

**Likelihood**

<table>
<thead>
<tr>
<th>Level</th>
<th>Probability</th>
<th>...or the current process...</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Very High</td>
<td>cannot prevent this event, no alternative approaches or processes are available.</td>
</tr>
<tr>
<td>4</td>
<td>High</td>
<td>cannot prevent this event, but a different approach or process might.</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
<td>may prevent this event, but additional actions will be required.</td>
</tr>
<tr>
<td>2</td>
<td>Low</td>
<td>is usually sufficient to prevent this type of event.</td>
</tr>
<tr>
<td>1</td>
<td>Very Low</td>
<td>is sufficient to prevent this event.</td>
</tr>
</tbody>
</table>

**RISK MATRIX**

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Sample data - What is the Consequence (Cost, Schedule, Safety, or Technical) of this Risk? - Sample data**

<table>
<thead>
<tr>
<th>Level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Minimal or no Impact</td>
<td>Budget Increase &lt; 5%</td>
<td>Budget Increase &gt; 5%</td>
<td>Budget Increase &gt;10%</td>
<td>Budget Increase &gt;15%</td>
</tr>
<tr>
<td>Schedule</td>
<td>Minimal or no Impact</td>
<td>Additional activities required. Able to meet date.</td>
<td>Key Program Milestone Slip&lt;=1 Month</td>
<td>Key Program Milestone Slip&gt;1 Month, Program Critical Path impacted</td>
<td>Cannot achieve Major Program milestone</td>
</tr>
<tr>
<td>Technical</td>
<td>Minimal or no Impact</td>
<td>Moderate reduction, same approached retained</td>
<td>Moderate reduction but alternatives available</td>
<td>Major reduction but alternatives available</td>
<td>Unacceptable, no alternatives exist</td>
</tr>
<tr>
<td>Safety</td>
<td>No Safety and Health Plan Violation</td>
<td>No adverse hazard or reliability change</td>
<td>Full regulatory compliance</td>
<td>Documented CIL</td>
<td>CIL without acceptance rationale</td>
</tr>
<tr>
<td></td>
<td>Change in hazard controls but no increase in PRA</td>
<td>Minor violation of Federal or State regulations</td>
<td>&lt;10% decrease in reliability</td>
<td>Change in hazard controls but with increase in PRA</td>
<td>Violation of Federal or State regulations</td>
</tr>
<tr>
<td></td>
<td>Violation of Federal or State regulations</td>
<td>10-20% decrease in reliability</td>
<td>Major but temporary injury</td>
<td>Potential damage to assets</td>
<td>Multiple violations of Federal or State regulations</td>
</tr>
<tr>
<td></td>
<td>&lt;20% decrease in reliability</td>
<td>Unacceptable, no alternatives exist</td>
<td>Loss of Critical assets</td>
<td>Willful or major violations of Federal or State regulations</td>
<td>Potential for permanent injury or death</td>
</tr>
</tbody>
</table>
Good Afternoon, Paul!

**Risk Definitions for PILOT**

**Commercially available CRM programs may charge extra for this process!**

### Time Frame Definitions

**Near**

The project must take action on the identified risk or the project will be impacted by the risk in the next 90 days.

**Mid**

The project must take action on the identified risk or the project will be impacted by the risk in the next 90-180 days.

**Far**

The project need not take action for at least the next 180 days - any impact will occur in > 180 days.

### Likelihood and Consequences Definitions

**Likelihood**

- All Types

**Risk Value**

- Your team's current process...

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Cost</th>
<th>Schedule</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualitative: Occurrence improbable. Quantitative: P &lt;= 10% for risks with primary</td>
<td>&lt;= 2 percent Negligible impact to budget</td>
<td>Negligible Schedule Impact</td>
<td>Negligible impact to requirements, mission objections or technical snags</td>
</tr>
</tbody>
</table>
**Near**

The project must take action on the identified risk or the project will be impacted by the risk in the next 90-180 days.

**Mid**

The project need not take action for at least the next 180 days - any impact will occur in > 180 days.

**Far**

The project need not take action for at least the next 180 days - any impact will occur in > 180 days.

---

### Likelihood and Consequences Definitions

**Likelihood Definitions**

| Risk Value | Your team's current process... | Qualitative: Occurrence | Quantitative: P <= 10^-6 for risks with primary impact on Human Safety Class I | Human Safety - A condition that could cause the need for minor first aid treatment though would not otherwise affect.
|---|---|---|---|---
| 1 | <= 2 percent Negligible impact to budget | Negligible impact to schedule. | Requirements, mission objectives or technical goals. | Human Safety - A condition that could cause the need for minor first aid treatment though would not otherwise affect.
| 2 | > 2 percent but <= 5 percent Minor impact to budget | Minor Overall Schedule Impact Accommodate with reserve, no impact to critical path | Minor Impact to requirements, mission objectives or technical goals | Human Safety - A condition that may cause minor injury or occupational illness.
| 3 | > 5 percent but <= 10 percent Moderate impact to budget | <= 1 month impact to critical path / milestones | Moderate impact to requirements, mission objectives or technical goals | Human Safety - A condition that may cause severe injury or occupational illness.
| 4 | > 10 percent but <= 15 percent Major impact to budget | > 1 and <= 6 month impact to critical path / milestones | Major impact to requirements, mission objectives or technical goals | Human Safety - A condition that may cause permanently disabling injury.
| 5 | > 15 percent Possible program cancellation | > 6 month impact to critical path / milestones or possible program/project cancellation | Performance goals not achievable with existing engineering capabilities / technology. | Human Safety - A condition that may cause death or loss of crew.

### Consequences Definitions

**Consequences Definitions**

| Risk Value | Your team's current process... | Qualitative: Occurrence | Quantitative: P <= 10^-6 for risks with primary impact on Human Safety Class I | Human Safety - A condition that could cause the need for minor first aid treatment though would not otherwise affect.
|---|---|---|---|---
| 1 | <= 2 percent Negligible impact to budget | Negligible impact to schedule. | Requirements, mission objectives or technical goals. | Human Safety - A condition that could cause the need for minor first aid treatment though would not otherwise affect.
| 2 | > 2 percent but <= 5 percent Minor impact to budget | Minor Overall Schedule Impact Accommodate with reserve, no impact to critical path | Minor Impact to requirements, mission objectives or technical goals | Human Safety - A condition that may cause minor injury or occupational illness.
| 3 | > 5 percent but <= 10 percent Moderate impact to budget | <= 1 month impact to critical path / milestones | Moderate impact to requirements, mission objectives or technical goals | Human Safety - A condition that may cause severe injury or occupational illness.
| 4 | > 10 percent but <= 15 percent Major impact to budget | > 1 and <= 6 month impact to critical path / milestones | Major impact to requirements, mission objectives or technical goals | Human Safety - A condition that may cause permanently disabling injury.
| 5 | > 15 percent Possible program cancellation | > 6 month impact to critical path / milestones or possible program/project cancellation | Performance goals not achievable with existing engineering capabilities / technology. | Human Safety - A condition that may cause death or loss of crew.

**All Types**

- **Cost:**
  - <= 2 percent Negligible impact to budget
- **Schedule:**
  - Minor Overall Schedule Impact
  - <= 1 month impact to critical path / milestones
- **Performance:**
  - Moderate impact to requirements, mission objectives or technical goals
- **Safety:**
  - Human Safety - A condition that could cause the need for minor first aid treatment though would not otherwise affect.

**Given the event occurs, what magnitude (consequence level) of the impact to your team?**

- **Human Safety - A condition that could cause the need for minor first aid treatment though would not otherwise affect.**
- **Human Safety - A condition that may cause minor injury or occupational illness.**
- **Human Safety - A condition that may cause severe injury or occupational illness.**
- **Human Safety - A condition that may cause permanently disabling injury.**
- **Human Safety - A condition that may cause death or loss of crew.**
The project must take action on the identified risk or the project will be impacted by the risk in the next 90 days.

- Near
  - The project must take action on the identified risk or the project will be impacted by the risk in the next 90-180 days.

- Mid
  - The project need not take action for at least the next 180 days (any impact will occur in greater than 180 days).

- Far

<table>
<thead>
<tr>
<th>Value</th>
<th>Cost</th>
<th>Schedule</th>
<th>Performance</th>
<th>Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Negligible impact to budget</td>
<td>Negligible Schedule Impact</td>
<td>Negligible impact to requirements, mission objectives or technical goals</td>
<td>Human Safety - A condition that could cause the need for minor first aid treatment though mold, dust, chemicals, etc.</td>
</tr>
<tr>
<td>&gt;2% but ≤5% (Minor impact to budget)</td>
<td>Minor Overall Schedule Impact</td>
<td>Minor Impact to requirements, mission objectives or technical goals</td>
<td>Human Safety - A condition</td>
<td></td>
</tr>
</tbody>
</table>

Impact Definitions

**Value**
- 1
- >2% but ≤5%

**Cost**
- Negligible impact to budget
- Minor Overall Schedule Impact

**Schedule**
- Negligible Schedule Impact

**Performance**
- Negligible impact to requirements, mission objectives or technical goals
- Minor Impact to requirements

**Safety**
- Human Safety - A condition that could cause the need for minor first aid treatment through mold, dust, chemicals, etc.
- Human Safety - A condition
Risk Manager must add Teams before risks can be added!

<table>
<thead>
<tr>
<th>Risk Information Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Likelihood</strong></td>
</tr>
<tr>
<td>1</td>
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<tr>
<td><strong>Consequences</strong></td>
</tr>
<tr>
<td><strong>Cost</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td><strong>Schedule</strong></td>
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<tr>
<td><strong>Performance</strong></td>
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<tr>
<td><strong>Safety</strong></td>
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<tr>
<td><strong>Title</strong></td>
</tr>
<tr>
<td><strong>Statement</strong></td>
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<tr>
<td><strong>Team</strong></td>
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<tr>
<td><strong>Owner</strong></td>
</tr>
<tr>
<td><strong>Timeframe</strong></td>
</tr>
<tr>
<td><strong>Context</strong></td>
</tr>
</tbody>
</table>

* Indicates mandatory fields

Select an Team

Select an Owner

Near | Mid | Far

Risk Manager must add Teams before risks can be added!
RISK STATEMENT

Given the <condition>, there is a possibility that this <consequence> will occur.
RISK STATEMENT

Given the <failure of turbine blades at high RPMs can lead to turbine fragmentation>, there is a possibility <loss of containment> will occur.
Risk Information Sheet
PILOT-5

Title *
High Pressure Oxygen Tubopump Turbine Blade Failure

Planned Closure Date 2/15/2009

Schedule
Given the failure of a turbine blade at high RPMs can lead to turbine fragmentation, there is a possibility of loss of containment will occur.

Owner *
Spurgeon, Jennifer

Category
Setup

Timeframe *
Near  Mid  Far

Context
containment will occur.

Research Plan

Turbine airfoil durability analyses needs be conducted to verify that the airfoils have infinite life.
**Risks For PILOT**

1. **Select Initiative(s):**
   - PILOT

2. **Select the Criteria:**
   - **Status:**
     - Open
     - Closed
   - **Criticality:**
     - High
     - Medium
     - Low
   - **Timeframe:**
     - Near
     - Mid
     - Far
   - **Approach:**
     - Accept
     - Research
     - Mitigate
     - Watch

3. **Sort Risks:**
   - Descending
   - Ascending
   - RID

### Risk Counts

<table>
<thead>
<tr>
<th></th>
<th>Approved</th>
<th>Draft</th>
<th>Modified</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Search Total</td>
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<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Approved Risks (Click on risk title to view/modify risk details)**

<table>
<thead>
<tr>
<th>Risk ID - Title-</th>
<th>Owner</th>
<th>Status</th>
<th>Category</th>
<th>Timeframe</th>
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</thead>
<tbody>
<tr>
<td>Risk Total</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk ID</td>
<td>Title</td>
<td>Risk Statement</td>
<td>Owner</td>
<td>Status</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
<td>----------------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>H</td>
<td>PILOT-1-<em>Distress due to Internal Contamination</em></td>
<td>Given that objects (contamination) may impact the inducer/impeller, there is a possibility that leading edge turbine fractures damage thus reducing the pump margin and cavitations will occur.</td>
<td>Moore-Hartley, Pat</td>
<td>Open</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>PILOT-2-<em>High Cycle Fatigue</em></td>
<td>Given the vibrations from various sources, there is a possibility that induced high cycle fatigue in the bearing races, rolling elements, and cage will occur.</td>
<td>Coker, Cynthia Setup</td>
<td>Open</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>PILOT-3-<em>Premature Engine Shutdown</em></td>
<td>Given the several conditions exist which could lead to a premature shutdown of a main engine, there is a possibility where an unsuccessful recoverable abort will occur.</td>
<td>Mullane, Dan Reliability</td>
<td>Open</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>PILOT-4-<em>High Pressure Fuel Turbopump (HPFTP) housing external leak/rupture</em></td>
<td>Given the result that defects introduced through manufacturing or handling damage may occur, there is a possibility that reduced rotor part strength or life will occur.</td>
<td>Powell, William Quality</td>
<td>Open</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk ID</td>
<td>Title</td>
<td>Owner</td>
<td>Status</td>
<td>Timeframe</td>
</tr>
<tr>
<td>--------</td>
<td>-------</td>
<td>-------</td>
<td>--------</td>
<td>-----------</td>
</tr>
<tr>
<td>PILOT-5</td>
<td>High Pressure Oxygen Turbopump Turbine Blade Failure</td>
<td>Spurgeon, Jennifer</td>
<td>Open</td>
<td>Far</td>
</tr>
<tr>
<td>PILOT-6</td>
<td>Loss of Thrust</td>
<td>Suttle, Madelyn</td>
<td>Open</td>
<td>Near</td>
</tr>
<tr>
<td>PILOT-7</td>
<td>Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire</td>
<td>Grubbs, Rodney</td>
<td>Open</td>
<td>Drawings</td>
</tr>
<tr>
<td>Draft Risks (Click on risk title to view/modify risk details)</td>
<td></td>
<td></td>
<td></td>
<td>Engineering</td>
</tr>
<tr>
<td>Risk ID - Title</td>
<td>Owner</td>
<td>Status</td>
<td>Category</td>
<td>Team</td>
</tr>
</tbody>
</table>

**PILOT-5 - High Pressure Oxygen Turbopump Turbine Blade Failure**
Given the failure of a turbine blade at high RPMs can lead to turbine fragmentation, there is a possibility of loss of containment will occur.

**PILOT-6 - Loss of Thrust**
Given the cryogenic temperature of Hydrogen (~ -420 F) in the fuel ducts and pumps, there is a possibility that they can condense and liquefy the Nitrogen in the aft compartment on the uninsulated components or on other components where there are faults in their insulation will occur.

**PILOT-7 - Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire**
Given that miscalculations in the engine balance or turbopump performance, there is a possibility that an incorrect installation (before flight or during refurbishments) of an oversized discharge coolant orifice and overspeeding of the LPFTP will occur.
PILOT-7 - Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire
Given that miscalculations in the engine balance or
turbopump performance, there is a possibility that an
incorrect installation (before flight or during
refurbishments) of an oversized discharge coolant orifice
and overspeeding of the LPFTP will occur.
Grubbs, Rodney Open

Draft Risks (Click on risk title to view/modify risk details)

<table>
<thead>
<tr>
<th>Risk ID - Title -</th>
<th>Owner</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Statement</td>
<td></td>
<td></td>
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<tr>
<td>Risk Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L/C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PILOT-D-1 - Minimum time between arrival and departure flights.
Given that there is minimum time between arrival and
departure flights, there is a possibility that any delay in
an arrival flight a missed connection flight will occur.
Johnson, Paul Open

Modified Risks (Click on risk title to view/modify risk details)

<table>
<thead>
<tr>
<th>Risk ID - Title -</th>
<th>Owner</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Statement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L/C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PILOT-M-8-(1) - Failure to complete ISSRC 2008 presentation on time.
Given that current work load tasks are increasing, there
is a possibility that not completing the ISSRC 2008 on
time will occur.
Johnson, Paul Open
**Risks For PILOT**

<table>
<thead>
<tr>
<th>Criticality</th>
<th>Risk ID - Title</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>PILOT-1-Distress due to Internal Contamination</td>
<td>Watch</td>
</tr>
<tr>
<td>5/4</td>
<td>The use of materials, design configurations, etc., which generate contamination shall be minimized. Cored passages where either the coring material or the casting material can generate or become contamination sources, will be verified as free from contamination by suitable NDT techniques. All drilled or bored passes shall be deburred. A Contamination Control Plan will be provided.</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>PILOT-2-High Cycle Fatigue</td>
<td>Research</td>
</tr>
<tr>
<td>4/4</td>
<td>Control Provisions / References Verification: - Turbine airfoil durability analyses have been conducted to verify that the airfoils have infinite HCF life (REF: DVS-30, Para. 4.1.2.5). - The design will comply with additional specific vibratory criteria given in the ICD (REF: CP11372, Para 6.3.1). - Computational Fluid Dynamics (CFD) analyses will be performed to reduce flowpath perturbations. These analyses will be verified through water flow visualization and air flow substantiation tests (REF: DVS-30, Para's. 4.1.2.4, 4.1.2.6, 4.1.2.11, 4.1.3.2.5.1 and 4.1.3.2.5.2). - Rotor Dynamics Analysis verification shall be considered complete when the specified analyses have been completed, when it has been established that the worst operating conditions have been considered, and when the verifications tests listed in tables on pages 41 and 42 of DVS-30 have been met (REF: DVS-30, Para. 4.1.2.10). - Analyses will be verified through detail part and subassembly tests (REF: DVS-30, Para’s 4.1.4.18.2 and 4.1.4.24.1).</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>PILOT-3-Premature Engine Shutdown</td>
<td>Research</td>
</tr>
<tr>
<td>3/4</td>
<td>- Redline limit inhibit is documented in the integration hazard analysis. - Engines and major components are green run accepted at a thrust profile which incudes 50 seconds at 100%. Develop a test plan to accept all...</td>
<td></td>
</tr>
</tbody>
</table>

---

**PILOT·3·Premature Engine Shutdown**

- Redline limit inhibit is documented in the integration hazard analysis. - Engines and major components are green run accepted at a thrust profile which includes 50 seconds at 100%. Develop a test plan to accept all...
4.1.3.2.5.2) - Rotor Dynamics Analysis verification shall be considered complete when the specified analyses have been completed, when it has been established that the worst operating conditions have been considered, and when the verifications tests listed in tables on pages 41 and 42 of DVS-30 have been met (REF: DVS-30, Para. 4.1.2.10). - Analyses will be verified through detail part and subassembly tests (REF: DVS-30, Para's 4.1.4.1.8.2 and 4.1.4.2.4.1).

<table>
<thead>
<tr>
<th>PILOT</th>
<th>Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>PILOT-3</td>
<td>Premature Engine Shutdown</td>
</tr>
<tr>
<td>3/4</td>
<td>Redline limit inhibit is documented in the integration hazard analysis. - Engines and major components are green run accepted at a thrust profile which includes 50 seconds at 109%. - Develop a test plan to assess all command input failure scenarios.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PILOT</th>
<th>Mitigate</th>
</tr>
</thead>
<tbody>
<tr>
<td>PILOT-4</td>
<td>High Pressure Fuel Turbopump (HPFTP) housing external leak/rupture</td>
</tr>
<tr>
<td>4/3</td>
<td>P&amp;W Engineering Source Approval for manufacturing processes &amp; materials in manned rocket programs is a system established by Engineering for the control of certain parts, materials and processes where characteristics vital to the performance or integrity of the parts, materials or processes cannot be completely defined in a manner suitable for inspection purposes and must therefore be assured by procurement from sources which have demonstrated, to the satisfaction of Engineering and QA, the ability to produce the necessary characteristics. REF: PWA 371 Engineering Source Approval for Manufacturing Processes &amp; Materials in Manned Rocket Programs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PILOT</th>
<th>Research</th>
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<tr>
<td>PILOT-5</td>
<td>High Pressure Oxygen Turbopump Turbine Blade Failure</td>
</tr>
<tr>
<td>2/4</td>
<td>Turbine airfoil durability analyses needs be be conducted to verify that the airfoils have infinite life.</td>
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<table>
<thead>
<tr>
<th>PILOT</th>
<th>Mitigate</th>
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<tbody>
<tr>
<td>PILOT-6</td>
<td>Loss of Thrust</td>
</tr>
<tr>
<td>2/4</td>
<td>No research plan provided.</td>
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<tr>
<td>PILOT-8</td>
<td>Failure to complete ISSRC 2008 presentation on time.</td>
</tr>
<tr>
<td>2/4</td>
<td>Work diligently to ensure ISSRC 2008 presentation is completed and submitted to management for final approval.</td>
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</tbody>
</table>

<table>
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<tr>
<td>PILOT-7</td>
<td>Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire</td>
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<tr>
<td>2/3</td>
<td>Review drawings and sizing and installations of the F7 orifice and adjust per specifications.</td>
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### Consequences

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<td>R-</td>
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<td>High Pressure Fuel Turbopump (HPFTP) housing external leak/rupture.</td>
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<td>PILOT-8</td>
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<td>Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire</td>
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**Risks For PILOT**

**Select report template then select the criteria.**

**Select Report Template: Index**

<table>
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<tr>
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<td>Closed</td>
<td>Medium</td>
<td>Mid</td>
<td>Research</td>
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<td>Far</td>
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</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>Watch</td>
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**Owner**

- All Owners

**Team**

- All Teams

**As Of Date:** 3/26/2008

**Format:** PDF, Excel

**Sort Risks:** Descending, Ascending, RID

[Search]
Cost  Schedule  Safety  Technical

Development, Level of Technology Readiness, Work Breakdown Structure (WBS), Refunding Profile, Manpower Availability Initial Design Review (IDR), Preliminary Design Review (PDR), Material Readiness Review (MRR), Critical Design Review (CDR), Manufacturing Due Dates, Delivery Dates, - Hazard Analysis, Failure Modes and Effects Analysis (FMEA), Critical Item List (CIL), Reliability Requirements, Redundancy Requirements (Fault Tolerance) Industrial Safety, Anomalies (Testing, Manufacturing, Quality Control), Design, Material Availability, Personnel Expertise, etc...
Development, Level of Technology Readiness, Work Breakdown Structure (WBS), Refunding Profile, Manpower Availability Initial Design Review (IDR), Preliminary Design Review (PDR), Material Readiness Review (MRR), Critical Design Review (CDR), Manufacturing Due Dates, Delivery Dates, - Hazard Analysis, Failure Modes and Effects Analysis (FMEA), Critical Item List (CIL), Reliability Requirements, Redundancy Requirements (Fault Tolerance) Industrial Safety, Anomalies (Testing, Manufacturing, Quality Control), Design, Material Availability, Personnel Expertise, etc...
## Propulsion Inflight Liquid Oxygen Test

### Risk Index Report

<table>
<thead>
<tr>
<th>Criticality</th>
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<th>Risk Statement</th>
<th>Owner</th>
<th>Status</th>
<th>Timeframe</th>
<th>Approach</th>
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</thead>
<tbody>
<tr>
<td><strong>H</strong></td>
<td>PILOT-1 - Distress due to Internal Contamination</td>
<td>Given that objects (contamination) may impact the inducer/impeller, there is a possibility that leading edge turbine fractures damage thus reducing the pump margin and cavitations will occur.</td>
<td>Moore-Hartley, Pat</td>
<td>Open</td>
<td>Engineering</td>
<td>Watch</td>
</tr>
<tr>
<td><strong>H</strong></td>
<td>PILOT-2 - High Cycle Fatigue</td>
<td>Given the vibrations from various sources, there is a possibility that induced high cycle fatigue in the bearing races, rolling elements, and cage will occur.</td>
<td>Coker, Cynthia</td>
<td>Open</td>
<td>Setup</td>
<td>Mid</td>
</tr>
<tr>
<td><strong>M</strong></td>
<td>PILOT-3 - Premature Engine Shutdown</td>
<td>Given the several conditions exist which could lead to a premature shutdown of a main engine, there is a possibility where an unsuccessful recoverable abort will occur.</td>
<td>Mullane, Dan</td>
<td>Open</td>
<td>Reliability</td>
<td>Far</td>
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<td>L/C: 5/4</td>
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<td>PILOT-6 - Loss of Thrust</td>
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<td>Near</td>
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<td></td>
<td>Given the cryogenic temperature of Hydrogen (~ -420 F) in the fuel ducts and pumps, there is a possibility that they can condense and liquify the Nitrogen in the aft compartment on the uninsulated components or on other components where there are faults in their insulation will occur.</td>
<td>S&amp;MA</td>
<td>Research</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PILOT-8 - Failure to complete ISSRC 2008 presentation on time.</td>
<td>Johnson, Paul</td>
<td>Open</td>
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</tr>
<tr>
<td>L/C: 2/4</td>
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<td>Schedule</td>
<td>Near</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>Given that current work load tasks are increasing, there is a possibility that not completing the ISSRC 2008 on time will occur.</td>
<td>Management</td>
<td>Mitigate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PILOT-7 - Low Pressure Fuel Turbopump (LPFTP) Rupture/Fire</td>
<td>Grubbs, Rodney</td>
<td>Open</td>
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<td></td>
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<tr>
<td>L/C: 2/3</td>
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<td>Drawings</td>
<td>Near</td>
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<tr>
<td></td>
<td>Given that miscalculations in the engine balance or turbopump performance, there is a possibility that an incorrect installation (before flight or during refurbishments) of an oversized discharge coolant orifice and overspeeding of the LPFTP will occur.</td>
<td>Engineering</td>
<td>Mitigate</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Owner</td>
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<tr>
<td>Coker, Cynthia</td>
<td>Engineering</td>
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<tr>
<td>Grubbs, Rodney</td>
<td>Management</td>
<td>Materials</td>
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</tr>
<tr>
<td>Johnson, Paul</td>
<td>S&amp;MA</td>
<td>Quality</td>
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As Of Date: 4/14/2008  Format: ○ PDF  ○ Excel  ○ Descending  ○ Ascending  ○ RID  

Select report template then select the criteria.

Select Report Template: Index

1) Select Initiative(s):
   - PILOT

2) Select the Criteria:
   - Status: Open, Closed
   - Criticality: High, Medium, Low
   - Timeframe: Near, Mid, Far
   - Approach: Accept, Research, Mitigate, Watch

3) Sort Risks: ○ Descending  ○ Ascending  ○ RID

Search
# Risk Index Report

## Approved Risks

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<th>Owner</th>
<th>Category</th>
<th>Status</th>
<th>Timeframe</th>
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</tr>
</thead>
<tbody>
<tr>
<td>PILOT-1 - Distress due to Internal Contamination</td>
<td>Given that objects (contamination) may impact the inducer/impeller, there is a</td>
<td>Moore-Hartley, Pat</td>
<td>Materials</td>
<td>Open</td>
<td>Far</td>
<td></td>
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<td>PILOT-2 - High Cycle Fatigue</td>
<td>Given the vibrations from various sources, there is a possibility that induced high</td>
<td>Coker, Cynthia</td>
<td>Setup</td>
<td>Open</td>
<td>Mid</td>
<td></td>
</tr>
<tr>
<td>PILOT-3 - Premature Engine Shutdown</td>
<td>Given the several conditions exist which could lead to a premature shutdown of a</td>
<td>Mullane, Dan</td>
<td>Reliability</td>
<td>Open</td>
<td>Far</td>
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</tr>
<tr>
<td>PILOT-4 - High Pressure Fuel Turbopump (HPFTP) housing external leak/rupture</td>
<td>Given the result that defects introduced through manufacturing or handling damage</td>
<td>Powell, William</td>
<td>Quality</td>
<td>Open</td>
<td>Near</td>
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</tr>
<tr>
<td>PILOT-5 - High Pressure Oxygen Tubopump Turbine Blade Failure</td>
<td>Given the failure of a turbine blade at high RPMs can lead to turbine fragmentation,</td>
<td>Spurgeon, Jennifer</td>
<td>Setup</td>
<td>Open</td>
<td>Far</td>
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</tr>
<tr>
<td>PILOT-6 - High Pressure Oxygen Tubopump Turbine Blade Failure</td>
<td>Given the failure of a turbine blade at high RPMs can lead to turbine fragmentation,</td>
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<td>Given the cryogenic temperature of Hydrogen (~-420 F) in the fuel ducts and</td>
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<td>S&amp;MA</td>
<td>Research</td>
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<tr>
<td>PILOT-7</td>
<td>Failure to complete ISSRC 2008 presentation on time.</td>
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<td>Given that current work load tasks are increasing, there is a possibility</td>
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<td>Given that miscalculations in the engine balance or turbopump performance,</td>
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Select report template then select the criteria.

Select Report Template: Index

1) Select Initiative(s): PILOT

2) Select the Criteria:
- Status: Open, Closed
- Criticality: High, Medium, Low
- Timeframe: Near, Mid, Far

Owner: All Owners
Team: All Teams
As Of Date: 3/26/2008
Format: PDF, Excel
Sort Problems: Descending, Ascending, PID
Select report template then select the criteria.

Select Report Template: Team Contact List

1) Select Initiative(s):
   - PILOT

2) Select the Criteria:
   - Format: PDF, Excel
   - Search
ePORT Help Guide
- ePORT Overview
- Logging into ePORT
- Menus
- Profile
- Risk Management
- Problem Management
- Reports
- Risk / Problem Admin

National Aeronautics and Space Administration

George C Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

electronic Project Online Risk Tool

Version 6.0
Release 2

User’s Guide
Initiative Manager Quick Look

Risk Counts
- High:
- Med:
- Low:

Problems Counts
- High:
- Med:
- Low:
Risk Transfer for PILOT

NOTE: Transferring a risk should only be done after much consideration. This step is not reversible. The source risk will be closed and will not be able to be modified after the transfer. If the risk must be transferred follow the steps below.

Step 1) Select source initiative

Select a Source Initiative
NOTE: Transferring a risk should only be done after much consideration. This step is not reversible. The source risk will be closed and will not be able to be modified after the transfer. If the risk must be transferred follow the steps below.

Step 1) Select source initiative

PILOT

Step 2) Select target initiative

Sample Proj

Step 3) Select the risk to be transferred.

PILOT-6-Loss of Thrust

Step 4) Select a new owner, new category and new team for the risk

Current Risk Owner: Suttle, Madelyn
Current Risk Category: Reliability
Current Risk Team: S&MA

Target Initiative Owners:
Select a Owner

Target Initiative Categories:
Select a Category

Target Initiative Teams:
Select a Team
NOTE: Risk Managers can add initiatives to a level directly below the current assigned initiative. Only an initiative created by a Risk Manager and that does not have any approved risks can be deleted.

<table>
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<tr>
<th>Initiative Hierarchy</th>
<th>Add Initiative Form</th>
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<tr>
<td>Initiative Information</td>
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<td>Center: Select Center</td>
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<td>Initiative Name:</td>
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Delete Initiative

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<th>Initiative: PILOT</th>
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Communicate
Document

Control
Identify
Plan
Analyze
Track
RESPONSIBILITY

Manager

SR&QA

Engineering
Manufacturing
Procurement
Schedule
Testing
Finance
COMMUNICATION
THINGS TO THINK ABOUT
INDICATORS
(What to look for)

- **Trend Analysis**
  - Setting Upper / Lower Trigger Indicators
  - [http://www.itl.nist.gov/div898/handbook/pmc/section3/pmc32.htm](http://www.itl.nist.gov/div898/handbook/pmc/section3/pmc32.htm)

- **Statistical Process Control (SPC)**
  - Out of Control Processes / Out of Control Indicators
  - [http://www.cheresources.com/spczz.shtml](http://www.cheresources.com/spczz.shtml)

- **Learning from Past Mistakes**
  - Record but not read and understand

- **SSME**
  - In Family / Out of Family

- **Private Mig Pilot**
  - By the book he was right.

![Figure 1: Process data from Hexane process from 2/25/99 to 2/28/99](image)
Continuous Risk Management Process Flow

1. Identify
   - Individual Uncertainties
   - Group/Team Uncertainties
   - Program/Project Data

2. Analyze
   - A. Risk Attributes
     * Likelihood
     * Consequence
     * Timeframe as determined by Program/Project
   - Risk Database
   - B. Program/Project Risks Lists
   - C. Classify & Prioritize Risks Lists

3. Plan
   - Resources
   - Program/Project Goals & Constraints
   - A. Assign Responsibility & Plan Approach
     * Watch
     * Accept
     * Mitigate
     * Set Scope & Success Metrics
   - B. Develop Action Plans
   - C. Risk & Mitigation Plan Metric

4. Track
   - Program/Project Data
   - Resources
   - A. Status Reports Risk & Mitigation Plans
   - B. Collect Metrics
     * Set Triggers
     * Strategic Mitigation
     * Set Thresholds
     * Create Mitigation Plans
     * Watch Trends
     * Track Mitigation Plans
     * Track Risk Attributes
     * Report Risk Status

5. Control
   - Program/Project Data
   - A. Analyze Risk Reports and determine the next step:
     * Continue current plan
     * Update/Correct Current Plan
     * Close the risk
     * Invoke a risk Contingency Plan
     * Then make risk decisions known
   - B. Inform Decision Makers by:
     * Updating risk list/database
     * Keep Program/Project members informed

6. Communicate & Document
   - Program/Project Data
   - Risk Database
   - A. Create/Update Risk List
   - B. Create/Update Risk Matrix
   - C. Create/Update Risk Metrics
Continuous Risk Management Summary Card

**Definitions**

**CONTINUOUS RISK MANAGEMENT (CRM)** - An engineering practice with processes, methods, and tools for managing risks in a program or project.

**LIKELIHOOD** - The probability that the risk will occur.

**CONSEQUENCE** - The loss or effect on the program/project if the risk occurs.

**TIMEFRAME** - The period when action must be taken to handle the risk mitigation plan.

**COST** - A program/project cost item that directly/indirectly impacts the program/project budget.

**SAFETY** - A program/project safety item that directly impacts the program/project.

**TECHNICAL** - A program/project technical item that directly impacts the program/project.

**LEGEND**

- High - Implement new processes or change baseline plans
- Moderate - Aggressively manage; consider alternative processes
- Low - Track and Monitor

**LIKELIHOOD**

- High
- Mid Term - between 4 - 8 months
- Near - within the next 3 months
- Far - beyond 8 months

**WHAT IS THE LIKELIHOOD THE SITUATION OR CIRCUMSTANCE WILL HAPPEN?**

- **Level**
  - 5 Very High
  - 4 High
  - 3 Moderate
  - 2 Low
  - 1 Very Low

- **Probability**
  - cannot prevent this event, no alternative approaches or processes are available.
  - cannot prevent this event, but a different approach or process might.
  - may prevent this event, but additional actions will be required.
  - is usually sufficient to prevent this type of event.
  - is sufficient to prevent this event.

**Sample data - WHAT IS THE CONSEQUENCE (COST, SCHEDULE, SAFETY, OR TECHNICAL) OF THIS RISK? - Sample data**

**CONSEQUENCE**

<table>
<thead>
<tr>
<th>Level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td>Minimal or no impact</td>
<td>Budget Increase &lt; 5%</td>
<td>Budget Increase &gt; 5%</td>
<td>Budget Increase &gt;10%</td>
<td>Budget Increase &gt;15%</td>
</tr>
<tr>
<td><strong>Schedule</strong></td>
<td>Minimal or no impact</td>
<td>Additional activities required. Able to meet date.</td>
<td>Key Program Milestone Slip&lt;1 Month</td>
<td>Key Program Milestone Slip&gt;1 Month, or Program Critical Path impacted</td>
<td>Cannot achieve Major Program milestone</td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td>Minimal or no impact</td>
<td>Moderate reduction, same approach retained</td>
<td>Moderate reduction but alternatives available</td>
<td>Major reduction but alternatives available</td>
<td>Unacceptable, no alternatives exist</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td><em>No Safety and Health Plan Violation</em></td>
<td><em>Documented CIL</em></td>
<td><em>CIL without acceptance rationale</em></td>
<td><em>Major but temporary injury</em></td>
<td><em>Potential for permanent injury or death</em></td>
</tr>
<tr>
<td></td>
<td><em>No adverse hazard or reliability change</em></td>
<td><em>Change in hazard controls but no increase in FRA</em></td>
<td><em>Change in hazard controls but with increase in PRA</em></td>
<td><em>Potential damage to assets</em></td>
<td><em>Loss of Critical assets</em></td>
</tr>
<tr>
<td></td>
<td><em>Full regulatory compliance</em></td>
<td><em>Minor violation of Federal or State regulations</em></td>
<td><em>Violation of Federal or State regulations</em></td>
<td><em>Multiple violations of Federal or State regulations</em></td>
<td><em>Willful or major violations of Federal or State regulations</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>&lt;10% decrease in reliability</em></td>
<td><em>&lt;0% decrease in reliability</em></td>
<td><em>&gt;30% decrease in reliability</em></td>
<td></td>
</tr>
</tbody>
</table>
Program/Project Risk Definitions

RISK: A risk is characterized by the combination of the "probability" that the Program/Project will experience an undesired event (cost, schedule, safety or technical) and the "consequences," impact or severity of the undesired event, were it to occur. All risks must be actionable.

RISK MANAGEMENT: Risk Management (RM) is a continuous, iterative process to manage risk in order to achieve mission success. RM uses a structured team and with all stakeholders, should be a key element and an integral part of normal Program/Project management and engineering processes.

1 IDENTIFY
   A. Early identification and management techniques include: budget or schedule, schedule, safety or technical analysis or analysis of market, competition, /feasibility and planning. Project/Programs report on risks and major and engineering and project sure.
   B. Key areas to assess include: budget, requirements, technology, management, engineering, opportunities, logistics, and maintenance, operations, safety, and public safety, contractors, and authorities.
   C. Information Sources: system, historical data, resources, suppliers, plans, proposed changes, technical risks to consider given to the management of risk.

2 ANALYZE
   A. Determine the likelihood of the event.
   B. Determine the impact of the event.
   C. Determine the risk's consequences:
      1. Safety issues (e.g., loss of life or property).
      2. Performance (e.g., cost, schedule, specification).
      3. Cost of mitigation (e.g., cost savings).
      4. Schedule issues (e.g., cost or schedule impact).
   D. Need to integrate the risk with the other risks (e.g., "find similar threads").
   E. Need to identify all groups affected by the risk or affected parties.
   F. Plot the risk on a risk matrix.
   G. Enter the risk and analysis data into the risk database.

3 PLAN
   A. Analyze the risk to identify the best risk mitigation plan.
   B. Develop the risk mitigation plan to reduce risk (i.e., occurrence and impact). Consistency with other risk mitigation plans is necessary. Modify the risk assessment.
   C. Determine the risk assessment on the project plan.
   D. Develop the risk plan.
   E. Document the risk plan.
   F. Develop the risk plan to reduce risks.
   G. Implement the risk plan.
   H. Communicate the risk plan.

4 TRACK
   A. Track and assess the risk to the mitigation plans. Are the plans being performed in a timely manner and is the mitigation plan working or do you need to go back to the mitigation plan? Are the data acquired, analyzed, and reported?
   B. Use tracking reports to communicate to improve quantification and/ or quality required for effective control decisions.
   C. Risk tracking should include on-time tracking.

5 CONTROL
   A. Use processes to which decisions are made based on the data presented in the tracking reports. This ensures that the risks are continually and effectively managed.
   B. Decisions are based on correct information as well as experience and must adapt to any changing condition.
   C. Risk decisions and current conditions should be updated with Program/Project management practices.
   D. Update tracking data to determine how to proceed with risk analysis, contingency planning, and execution of the current plan, plan, or involve a new program.
   E. Update tracking data to ensure that risk data is up to date.

6 COMMUNICATE AND DOCUMENT
   A. Provide in progress and final risk to the Program/Project Risk or benefits, risk controls, and potential new risks.
   B. Share the documentation and visibility of risk information for better management and execution.
   C. Clear all risks in the risk management plan and 2000-plan.
MARSHALL SPACE FLIGHT CENTER
Continuous Risk Management (CRM) Training Processes and Solutions

Control
Identify
Communicate
Document
Track
Analyze
Plan
Additional NASA/Contractor CRM Programs In Use

- **IRMA – Integrated Risk Management Application**
  - International Space Station (ISS)
  - Constellation Program (CxP)
  - SIRMA – Shuttle Integrated Risk Management Application

- **ARM – Active Risk Manager**
  - NASA Headquarters (HQ)

- **EVM/RM – Earned Value Management and Risk Management**
  - Facilitates the CRM process

- **Risk Control – Rocketdyne**

- Many more...
WRAP-UP

- Quote
- ePORT History
- Continuous Risk Management Process
- ePORT - Project: PILOT
- Things To Think About
- Q&A
THANK YOU