NCSX
Risk Management Plan

NCSX-PLAN-RMP-00

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Concurrences:

Bob Simmons Digitally signed by Bob Simmons
DN: CN = Bob Simmons, C = US
Reason: I have reviewed this document
Date: 2004.02.04 10:33:51 -05'00'

R. Simmons, Systems Engineering Support Manager

B. Nelson, Stellarator Core Systems Project Engineer

L. Dudek, Ancillary Systems Project Engineer

E. Perry, Assembly Operations Project Engineer

A. vonHalle, Electrical Systems Project Engineer

J. Malsbury, QA Project Manger

W. Reiersen, Engineering Manager

Approved by: _____
G.H. Neilson, Project Manager

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Record of Revisions

Revision	Date	Description of Changes
Revision 0	2/2/2004	Initial Issue

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1. Background

The NCSX Project will manage risks, where "risk" refers to factors within the Project's control that threaten project performance. There are three specific areas of risk that can be controlled and managed by the NCSX Project team and these are:

- Technical risk – the possibility that the product might not meet requirements;
- Cost risk – the possibility that the cost might exceed the target value; and
- Schedule risk the possibility that the Project might take longer to complete than plan.

Control of the environment, safety, and health hazards, while part of risk management in a broader sense, are not unique to the NCSX Project and are enveloped by the Princeton Plasma Physics Laboratory (PPPL) Integrated Safety Management (ISM) program that is applicable to all PPPL projects and operations. The PPPL ISM clearly indicates that risk management is everybody's business and will be factored into every project decision throughout the life of the NCSX Project.

While any member of the NCSX Project Team can identify risks, the responsibility for risk management for the NCSX Project rests with the NCSX line management. As part of weekly technical discussion, the NCSX Engineering Manager, NCSX Project Engineers, WBS Managers, and cognizant design engineers will identify risks; assess the potential impact of the risk from a cost, schedule, and technical perspective; identify and address potential risk mitigation strategies, and report on the status of implementing these strategies. The design engineers, with the appropriate management oversight, establish the specific approaches to addressing the individual risk elements.

The System Integration Team (SIT) has an oversight responsibility to facilitate the identification of areas of risk; coordinate the development of risk mitigation plans; and monitor project performance against those plans. Accordingly, the SIT has developed and implemented a critical issue listing that identifies how near-term critical risk issues are being addressed.

The early phases of the NCSX project design process is structured to identify risks. These risks are addressed through design improvements, manufacturing studies, prototypes, schedule contingency, and cost contingency. The cost contingency methodology is outlined in the Project Execution Plan (NCSX_PLAN_PEP). In many cases the risk mitigation comprises several of the above listed mitigation elements. The

estimated costs and contingencies to mitigate these risks are incorporated in the project's baseline cost and schedule estimates. Most recently, as part of the preparations for NCSX Preliminary Design Review, the Project Team developed a comprehensive listing of the current known risk items, consequences of the impact of each risk item, and planned or current risk mitigation strategies. This listing has now evolved into the Critical Issues List utilized by the SIT. The Critical Issue List will be tracked and updated by the SIT as a living document so as to avoid overlooking important risks and to assure that the risk mitigation has adequate management oversight.

2 Risk Mitigation Approaches

2.1 Approaches to Mitigating Technical Risk

Although the NCSX Project is just completing the Preliminary Design phase for the major stellarator core systems (i.e., the vacuum vessel and modular coils), technical risk management has already been elevated to a priority in the work to date. Some specific examples are:

- Possibility of failure requiring disassembly and reassembly has been addressed by maintaining adequate margins, designing out failure modes, and increased analyses and technical assurance efforts. This includes special attention to analyses and testing, formalized technical procedures for planning and controlling work, and a very proactive program of QA and supervision of critical fabrication steps, especially the coil winding.
- Realistic performance goals and requirements have been established that permit a reasonable (~20%) margin below ~~performance~~ objectives. The extensive use of analysis and R&D addresses the major performance risks.
- Lessons-learned from the initial NCSX experience and other projects have provided guidance for identifying technical risk drivers and provided templates for adopting methods that work; e.g., coil winding design from the German W7-AS and the schedule logic from HSX.

2.2 Approaches for Mitigating Cost and Schedule Risk

Cost and schedule risk is complementary to technical risk considerations as the design progresses. To date, the following examples demonstrate the steps being taken to reduce cost and schedule risks:

- Scope creep risks the manifest themselves primarily in cost and schedule growth have been mitigated by establishing early on in the Project a set of stable and clearly documented requirements that are fully understood.
- Adequate R&D has been factored into the project to ensure that technically challenging areas with a high technical, cost, and schedule risk are properly addressed early on.
- Possibility of the supplier difficulties in building prototypes and the later production units is mitigated by increasing the on-site presence proproject personnel and DCMA to ensure that potential problems are surfaced quickly and provide a rapid NCSX Project response. In addition, the selection of multiple suppliers during the prototype phase provides increased assurance that at least one qualified supplier will emerge.
- The NCSX Project has relaxed the schedules for non-critical activities and identified sources for outside help. In addition, the PPPL-ORNL partnership provides flexibility to quickly respond to specific skill needs.
- Adequate contingencies (~28% cost contingency on work remaining and ~5.5 months schedule contingency) have been established. Use of contingency will be managed via the Configuration Control processes (ribed in the NCSX PEP and the NCSX Configuration Management Plan (NCSX_PLAN_CMP).

2.3 The NCSX Project Risk Management Approach

The NCSX Risk Management approach consists of a five step process:

- Identifying potential Project risk;
- Analyzing project risk;
- Planning risk mitigation strategies;
- Executing risk mitigation strategies; and
- Monitoring the results and revising, as necessary, the risk mitigation strategies.

2.3.1 Identifying Potential Project Risks

The NCSX Risk Management process begins with the WBS Managers evaluating potential project risk for each technical equipment and subsystem. While overall project risk should be considered, focus should be on items in excess of $200K value and/or on or near the critical path. The process for identifying these potential risk items is ongoing and is part of weekly discussions between the NCSX Engineering Managers, NCSX Project Engineers, WBS Managers, and cognizant design engineers. While some subsystems on or near the critical path are highly complex, the Vacuum Vessel (WBS 12)

and the Modular Coils (WBS 14) are obvious risk candidates. Other less critical subsystems also may have areas of risk that need to be identified and risk mitigation strategies developed. Table 2-1 below provides a generic table of common risk areas to assist the WBS Managers in this task.

Table 2-1 Common Risk Areas

Project Risk Area	High Project Risk	Moderate Project Risk	Low Project Risk
Facilities and Associated Equipment	Major development of facility or new equipment is required.	Suitable facilities exist. Minor equipment or facility modifications are required.	Suitable facilities and equipment exist and are available for use.
Design	New design, and/or significant engineering development required. Design knowledge beyond that utilized previously on other fusion devices.	Existing design is available that has been proven too meet the requirements, but needs minor design changes for this application. Design is based on a similar component or subsystem that has been successfully fabricated and tested.	Existing design is available that has previously been proven to meet all the design and performance requirements.
Hardware	Unproven technology. Highly engineered equipment. Extensive R&D and testing required to demonstrate performance.	Proven, state-of-art technology. Some engineering modification and testing required to validate performance.	Commercial, off-the-shelf technology and/or conventional manufacturing or construction.
Manufacturing	Precision manufacturing tolerances required and potential for rework likely.	Moderate tolerances with potential for rework unlikely.	Ample tolerances and potential for rework very unlikely.
Number of Suppliers and Capabilities	Few suppliers with the potential suppliers having limited related capabilities to produce items with like tolerances and complexity.	Two or more suppliers with demonstrated related capabilities to produce items with like tolerances and complexity.	Two or more suppliers with proven history of supplying similarly close tolerance and complex items.

Qualitative Probability Rating	Very likely.	Likely.	Unlikely.

2.3.2 Analyzing Project Risk

NCSX Project risks are analyzed by considering their likelihood or probability of occurring together with the consequences to the Project's cost, schedule, and technical performance baselines. Probability is assessed qualitatively as unlikely, likely, or very likely as indicated at the bottom of Table 2-1. Consequence relates to the potential impact of the threat on cost, schedule, and/or technical performance baselines. Table 2-2 provides guidelines for assessing the relative consequence of the risk threat. The consequences are addressed as marginal, significant, or critical for each area. The combination of qualitative risk probability and the consequences are meant to provide qualitative guides, not as absolute thresholds, in assisting the WBS Managers in determining the seriousness of the risk threat.

Table 2-2 Risk Consequences Matrix

Risk Area\Consequence	Marginal (M)	Significant (S)	Critical (C)
Cost: Worst Likely Impact	**≤ $25K**	**≤ $200K**	**>$200K**
Schedule: Worst Likely Impact	**< 1 week delay of critical path or DOE milestone**	**> 1 week, but < 1 month delay of critical path or DOE milestone**	**> 1 month delay of critical path or DOE milestone**
Technical: Worst Likely Impact on Scope or Performance	**Negligible, if any, degradation of scope or performance**	**Significant scope or performance degradation which has potential to impact achievement of baseline**	**Baseline scope and performance will not be achieved**

2.3.3 Planning Risk Mitigation Strategies

NCSX WBS Managers are responsible for developing and implementing appropriate risk mitigation strategies. The WBS Manager's WAF is the vehicle by which the risk mitigation strategies are planned, documented, approved by line management, and tracked. Although the SIT necessarily focuses on near-term risk issues, the WBS

Manager is responsible for identifying potential risks and developing and planning mitigation strategies for the entire scope of his or her work. Some potential risk mitigation strategies might be:

- Cost
  - Closely monitoring cost and spending
  - Consider implementing phased procurements to ensure that the supplier performance remains adequate
  - Obtain and compare cost estimates from either in-house or external sources
  - Perform value engineering
- Schedule
  - Increase lead time to reflect complexity of the procurement
  - Utilize multiple suppliers
  - Consider incentive contracts
  - Maintain an active supplier oversight function
- Technical
  - Consider whether selective or major redesign will mitigate risk
  - Invest in additional design verification techniques, such as prototyping
  - Consider pursuing simultaneous alternative technologies
  - Define and/or require interim supplier testing to demonstrate compliance with technical requirements

2.3.4 Executing Risk Mitigation Strategies

The WAF is the vehicle by which the detailed implementation work is planned and executed. Risk items should be factored into the WAFs as they are developed. The WBS Manager is then responsible for executing the work scope outlined on the WAF within the resources and time constraints shown. It is the responsibility of the WBS Manager to continually assess his work scope to identify new risk items, develop and implement effective risk mitigation strategies, and to report results to his Project Engineer and the NCSX Engineering Manager. The NCSX Engineering Manager will assimilate the risk issues identified and elevate the most critical and time-sensitive items to the SIT Critical Issues List.

2.3.5 Monitoring and Revising Risk Mitigation Strategies

Monthly the WAFs are statused as part of the NCSX Project Management System process. However, the WBS Manager is also responsible for reporting potential risk items more frequently in his or her weekly discussions with line management. As an

ongoing process, the WBS Managers will monitor performance relative to risk and evaluate the success of the risk mitigation strategies. WAFs and mitigation strategies will be adjusted continuously to take advantage of lessons learned and to maximize the probability for successful project completion.