

sPHENIX Project

Risk Management Plan

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List of Acronyms

BAC	Budget at Completion
BNL	Brookhaven National Laboratory
CAM	Control Account Manager
CCB	Change Control Board
DocDB	Document Database
EAC	Estimate at Completion
ES&H	Environment, Safety and Health
EVMS	Earned Value Management System
IPT	Integrated Project Team
ISMS	Integrated Safety Management System
LHC	Large Hadron Collider
sPHENIX	sPHENIX Project
P6	Primavera P6
PD	Project Director
PM	Project Manager
PMP	Project Management Plan
PRA	Primavera Risk Analysis
RBS	Risk Breakdown Structure
RHIC	Relativistic Heavy Ion Collider
RLS	Resource Loaded Schedule
RMB	Risk Management Board
RMP	Risk Management Plan
SBMS	Standards Based Management System
WBS	Work Breakdown Structure

1.0 INTRODUCTION

1.1 sPHENIX Project Summary

The sPHENIX Major Item of Equipment (MIE) will be a major upgrade to the PHENIX experiment that will enable the precision characterization of jets produced in nucleus+nucleus (AA), proton+nucleus (pA) and proton+proton (pp) collisions at the Relativistic Heavy Ion Collider (RHIC) located at Brookhaven National Laboratory (BNL). The experiment will also collect a large sample of upsilons with a mass resolution that allows for their separation into three mass states, and the study of their behavior on different distance scales. sPHENIX provides excellent opportunities complementary to measurements being made at the Large Hadron Collider (LHC) at CERN and extends the RHIC physics program in ways that fully exploits RHIC's unique performance capabilities.

1.2 Purpose

This document describes the Risk Management Plan (RMP) for the sPHENIX project. An integral part of the Project Management Plan, the RMP outlines the risk management processes designed to help achieving project deliverables on-time and on-budget. The goal is to implement a plan to ensure:

- risk identification has the appropriate rigor;
- risk issues are made visible early;
- thorough, credible mitigation plans are prepared/implemented; and
- current EAC is maintained.

The sPHENIX RMP is the governing document for the risk management process on the project. It describes a continuous and iterative process of identifying, evaluating, mitigating, tracking and communicating project risks to increase the probability of project success. It is consistent with agency and institution requirements:

- DOE O413.3B, "Project Management for the Acquisition of Capital Assets"
- DOE G413.3-7A, "Risk Management Guide"
- BNL SBMS, "Project Management"

2.0 RESPONSIBILITIES

This section describes sPHENIX risk management organizational structure, roles and responsibilities.

The Project Director (PD) has responsibility for overall project risk management and managing contingency, consistent with the change control process and thresholds described in the Project Management Plan (PMP). The objectives are to conservatively maintain sufficient contingency, commensurate with project risks, through project completion, in order to ensure that the full project scope is achieved on schedule and on budget.

The PD is responsible for:

- Applying the continuous risk management process.
- Documenting and managing the risk management process contained within the risk management plan.
- Providing documentation and management of risks throughout the project life cycle via the project risk register.

- Identifying and analyzing global Project risks.
- Developing and executing risk mitigation strategies for the Project risks.
- Facilitating smooth risk communication process.
- Approving, modifying, or assisting in sPHENIX risk mitigation strategies.
- Chairing sPHENIX Risk Management Board (RMB).

Day-to-day management of risks will be performed by the Level 2 Managers (L2s), who serve as risk managers for sPHENIX subsystems.

The sPHENIX WBS Level 2 managers are responsible for:

- Applying the risk management approach detailed in sPHENIX RMP.
- Identifying potential risks to the technical, cost, scope and schedule success of their WBS system, determining the likelihood of occurring, and estimating the potential impact on the project. This risk analysis is performed down to the deliverable level, usually WBS Level 3 or 4.
- Developing and executing risk mitigation strategies for their Level 2 system.
- Informing the PD about the significant risks and the status of risk mitigation strategies.
- Serving as members of sPHENIX RMB.

The ES&H manager is responsible for:

- Serving as a resource to WBS managers for identifying, analyzing and reducing environmental, safety and health risks.

sPHENIX Risk Management Board is chaired by the Project Director and consists of the Project Director (PD), Project Manager (PM), the head of Project Integration office, the WBS Level 2 Managers, the Resource Coordinator, the Business Operations representative, the ES&H Manager, the Project Controls Manager and, where required, experts from the collaboration. sPHENIX Risk Management Board is responsible for:

- Reviewing and recommending new risks as needed, and/or changes to risk attributes and retirement of risks as appropriate
- Reviewing and recommending approval or modification of risk analyses and risk mitigation strategies, and
- Assisting in the development of risk mitigation strategies as needed.

The Federal Project Director attends and participates as an observer at risk meetings which are held monthly during one of the L2 meetings.

3.0 RISK MANAGEMENT PROCESS

3.1 Introduction

sPHENIX Project risk management is a continuous, iterative process that is performed throughout the project life cycle and consists of identifying and analyzing of project risks, planning mitigation strategies, communication, monitoring, reassessing and finally retiring project risks. Risk management processes are tailored to specific project phase. Risk analysis is done qualitatively before CD-1 and quantitatively after a preliminary project baseline is set before PD-2. The quantitative analysis is done using the Primavera Risk Analysis (PRA).

3.2 Risk Identification

Risk identification in sPHENIX Project is done continuously as the project evolves. It starts early in the sPHENIX lifecycle and is often a result of internal and external expert reviews. Risk identification begins with breaking the project elements into a risks breakdown structure (RBS) shown in Table A-1 and repeats with any significant changes in project plan (technology down-select, scope changes, schedule changes, etc.). The format for identified risks is risk/cause/effect and is the same for threats and opportunities. For each identified risk a risk owner is assigned. The information is captured in a risk register described in section 5.1 in details.

3.3 Qualitative Risk Analysis

Early in the project lifecycle, before a preliminary baseline is set, a qualitative risk assessment is done to provide a comprehensive understanding of all known risks to the project. For each identified risk, two fundamental risk attributes, probability and consequence, are evaluated using criteria shown in Table 1. Based on these criteria each risk is given a rank – low, medium or high. Other relevant risk attributes including risk trigger and timeframe are evaluated as well.

Since risk cost consequence is based on predefined dollar thresholds, risk owners provide detailed justifications for the risk cost impact. The resource loaded schedule serves as a basis for the risk schedule impact since it identifies activities on or close to a critical path. Risk attributes are discussed and approved during regular sPHENIX meetings. Risk owners are monitoring risks assigned to them and formally present justifications if any risk attribute requires change.

Table 1: sPHENIX Qualitative Risk Analysis Matrix

Consequence				
		Low	Moderate	High
Cost		≤ \$100K	≤\$225K	> \$225K
Schedule		Delays Level 2 milestone or Project critical path by ≤3 month	Delays Level 2 milestone or Project critical path by ≤6 months	Delays Level 2 milestone or Project critical path by >6 months
Probability	Very Likely > 50%)	Moderate	High	High
	Possible ≤ 50%	Low	Moderate	High
	Unlikely ≤ 10%	Low	Low	Moderate
	Rare ≤ 1%	Low	Low	Low

3.4 Quantitative Risk Analysis

Post CD-1 approval, after a preliminary project baseline is set and all resources required for risk mitigation are put into the baseline schedule, a quantitative analysis is done for all residual project risks. This analysis is performed by incorporating risk events into a baseline schedule and applying duration uncertainties to the critical path activities. sPHENIX is using Primavera Risk Analysis (PRA) for quantitative analysis to fully benefit from a well-developed sPHENIX P6 schedule that is loaded with burdened and escalated resources and contains hundreds of activity links. Residual Risk Register is maintained in native PRA format and is used to generate post-mitigated PRA plan. Residual risk cost and schedule impact distributions used in the analysis are developed and documented by the risk owners and approved by the RMB. Threats and opportunities are used together in the simulation model.

3.5 Risk Mitigation

sPHENIX risk owners are responsible for developing appropriate mitigation strategies to reduce the likelihood and negative impacts of risks assigned to them. They are also responsible for performing all work outlined in the approved risk mitigation plan and for keeping sPHENIX PM informed of the status of the work and any change in the risk status. After CD-1 approval sPHENIX RLS is updated to include all resources required to mitigate risks. A table of common risk areas with the appropriate mitigation strategies that serves as a tool in addressing project risks has been included in Appendix A.

3.6 Risk Monitoring

sPHENIX risk monitoring is systematic and continuous evaluation of risk status and the effectiveness of the risk handling strategy. Any changes that the risk owner makes to the risk register is brought to the attention of sPHENIX RMB to insure that the risk impacts are well understood and properly documented. Since sPHENIX WBS Level 2 are interconnected, Level 2 risks are analyzed by all L2 managers to address possible risk correlations.

sPHENIX risk monitoring is integrated with project baseline management, earned value management and contingency calculation. Project Change Requests (PCR) have links to the risk register and all realized risks will be reported monthly in EVMS variance analysis. Monte Carlo simulation of residual risks serves as a basis for the risk-based part of the project contingency.

4.0 RISK DOCUMENTATION AND COMMUNICATION

4.1 Risk Register

sPHENIX Risk Register serves as a repository for all project risks. It provides a common, uniform format to track risks and documents the following:

- Risk Identifier
- Risk Owner
- RLS Activity link

- Risk Title
- Risk Trigger
- Risk Consequences
- Probability of primary risk occurrence
- Justification for probability and impact numbers
- Primary Risk Impact for Cost, Schedule and Scope
- Primary Risk Rank (calculated)
- Probability of residual risk occurrence
- Residual Risk cost and schedule impacts for worst, likely and best-case scenarios
- Justification for residual cost and schedule impact distribution parameters
- Mitigation plan
- Status (active/retired)
- Date when retired
- Risk resolution comments
- Risk handling key data

Risk Register is used to communicate, monitor and track risks and to generate risk reports. It is updated in DocDB every time there is an approved risk change.

4.2 Risk Communication

Risk management is an integral part of many sPHENIX activities and meetings. Risk information is being shared and exchanged between sPHENIX project team, decision-makers and project stakeholders. sPHENIX status meetings regularly include risk related issues. Risk Register changes are presented by risk owners during RMB meetings, reviewed by RMB members and approved after comprehensive analysis. Risk Register line items can be referenced in project baseline change requests and EVM variance reports. Post CD-1, sPHENIX RMB convenes for risk register evaluation monthly.

5.0 CONCLUSION

The design and construction of sPHENIX project are well within the expertise and experience of the collaborations' scientific, engineering and technical staff and sPHENIX RMP will help to ensure that the project objectives are reached on time and in the most cost-effective approach possible.

This RMP will be maintained and updated throughout the life of the project to reflect tailoring risk processes to specific project phases.

APPENDIX A: Risk Management Tools

Table A-1 : Risk Breakdown Structure

	Level 1	Level 2	Level 3
Project	Project	Schedule	Schedule does not reflect realistic acquisition planning. Schedule objectives not realistic and attainable. Resources not available to meet schedule.
		Scope	Not well defined. Tied to work at other sites.
		Cost	Realistic cost objectives not established early. Use of mid-range values.
	Technical	Requirements	Operational requirements not properly established or vaguely stated. Requirements are not stable. Requirements are too restrictive — cost risk.
		Technology	Project depends on unproven technology for success with no alternatives. Project success depends on achieving advances in state-of-the-art technology. Potential advances in technology will result in less than optimal cost-effective system or make system components obsolete. Technology has not been demonstrated in required operating environment. Technology relies on complex hardware, software, or integration design.
		Design	Design relies on immature technologies or “exotic” materials to achieve performance objectives. Design not cost effective.
		Testing / Evaluation/ Simulation	Test planning not initiated early in program. Testing does not address the ultimate operating environment. Test procedures don’t address all major performance and suitability specifications. Facilities not available to accomplish specific tests, especially system-level tests. Insufficient time to test thoroughly. Project lacks proper tools and modeling and simulation capability to assess alternatives.
	External	Political	Delay in appropriation
		Funding	Contributing Universities lose funding.
		Supplier Capabilities	Inadequate supportability late in development, resulting in need for engineering changes, increased costs, and/or schedule delays. Restricted number of available vendors. Restricted production capacity.
	Internal	Human Resources	Resources not available. Proper mix (experience, skills, stability) of people not assigned to the project.
		Management	Acquisition strategy does not consider various essential elements, e.g., mission need, test and evaluation, technology, etc. Effective risk assessments not performed or results not understood and acted upon.

Table A-2 : Common Risk Mitigation Strategies

Risk Category			
Risk area	High	Moderate	Low
Cost	<p>Closely monitor cost and spending. Consider implementing phased procurements. Obtain multiple bottom-up independent cost estimates. Perform Value Engineering. Visit Vendor. Apply aggressive cost control.</p>	<p>Closely monitor cost and spending. Obtain at least two bottom-up independent cost estimates.</p>	<p>Quality controls applied as defined in the BNL Quality Management Plan.</p>
Schedule	<p>Increase lead time substantially by initiating procurements 6 – 8 weeks early. Visit Vendor. Evaluate in-house procurement. Contract incentives and/or penalties. Maintain vendor oversight.</p>	<p>Increase lead time by initiating procurements 2 – 4 weeks early. Visit Vendor. Evaluate in-house procurement. Contract incentives and/or penalties. Maintain vendor oversight. Add additional vendors.</p>	<p>Quality controls applied as defined in the BNL Quality Management Plan.</p>
Scope / Technical	<p>Perform major redesign. Increase prototype cycles. Evaluate alternate technology. Request additional process control steps during fabrication. Define extensive QA and/or acceptance testing. Increase lead time and/or increase testing cycles.</p>	<p>Moderate redesign as required. Define QA and/or acceptance testing. Increase prototype acceptance tests.</p>	<p>Quality controls applied as defined in the BNL Quality Management Plan.</p>

