DRAFT
RESEARCH SUPPORT BUILDING AND INFRASTRUCTURE MODERNIZATION

RISK MANAGEMENT PLAN

April 2009
SLAC-I-050-07010-002

Contents

Revision History

Rev. No.	Date	Revision Description	Pages Modified
Rev. 0	04.15.09	Initial Issue; Risk Management Plan for CD-1	Not Applicable

1.0 Introduction

1.1 Scope

This document, the Risk Management Plan (RMP), describes the management processes used on the project to plan, identify, assess, categorize, quantify, handle and report/track risks associated with the achievement of the project requirements and goals for the Research Support Building and Infrastructure Modernization (RSB) Project, which is being established at SLAC National Accelerator Laboratory. The RSB RMP is consistent with DOE O 413.3A, *Project Management for the Acquisition of Capital Assests,* and strives to incorporate "best practices" from other large scale construction projects around DOE complex.

RSB management team believe that the risk is an inherent in all activities of any large scale construction project. To be successful, a risk management process is needed such that risk can be continually evaluated and managed in order to minimize the consequences of adverse events.

The ultimate goal of risk management is to increase the probability of project and activity success by focusing attention on problem areas early and reducing the amount of costly rework in the future. For each and every risk, there is the potential impact of cost overruns, schedule delays and compromises in quality and safety if the risk occurs. Hence, risk management will be applied continuously throughout the RSB project life cycle and will evolve and adapt to accommodate the various project phases.

A "risk" is an event that has the potential to cause an unwanted change in the project. A risk is as follow:

- A definable event;
- With a probability of occurrence; and
- With a consequence or "impact" if it occurs.

A measure of the severity of risk is:

- Severity = Probability x Impact.

For risks, we have a "mitigation plan." A mitigation plan either lowers the probability and/or the impact to reduce the severity to an acceptable level.

Managing risk is a key element of the project management process for both the planning and the performance phases of the RSB project. As such, this RMP develops a methodology to identify and quantify specific risks to the project, determine their consequence and associated probability, and develop mitigation strategies.

2.0 Management Approach

2.1 Responsibilities

RSB project management has established specific roles and responsibilities to support project risk management processes and control over the life cycle of the project. The specific responsibilities relating to the RSB RMP are as follows:

- RSB Project Manager – The RSB Project Manager is responsibility for managing cost and schedule contingency, consistent with the change control process and thresholds described in the PEP. The objectives are to maintain contingency commensurate with project risk through project completion and to ensure that the full project scope is achieved on schedule and on budget.
- RSB Project Risk Manager – The RSB Project Risk Manager is assigned responsibility for implementing the overall Risk Management Program and ensuring that it meets the intent of DOE Order 413.3A and is assigned responsibility for working with risks, quality and safety subject matter experts to execute the risk management process. The Project Risk Manager is also the Risk Manager Points-Of-Contact (POCs) of the project. RSB Project Risk Manager is responsible, but not limited to, for the following:
  - Eliciting risks, logging risks in the risk register.
  - Performing analyses, reporting on risk exposure to Project Manager.
  - Identifying abatement strategies, abatement actions and tracking their effectiveness at reducing risk exposure.
  - Reporting abatement results to the Project Manager.

2.2 Risk Management Process

RSB project risk management process is summarized in the following steps.

- Risk Management Planning – Prior to the initiation of risk management, activities in the proposed baseline (scope, schedule, and cost) are evaluated to determine their potential for risk. This evaluation (or risk screening) assesses all activities against a set of screening categories typically in the areas of construction, interface control, safety, regulatory and environmental, security, design, resources, space migration etc. Activities which are identified as project risks will be tracked within the RSB RMP.
- Risk Identification – Identify risks that may impact the successful completion of the project. Risks are identified for the entire life cycle of the project. Risk associated with project work scope, cost, and schedule are identified by systematically challenging the assumptions,

logic, and scope of the project and examining the identified uncertainties associated with each stage of the project.

- Risk Assessment – Assess the risks to determine their likelihood and impact on the project's cost, schedule, and/or work scope. This includes a qualitative and quantitative assessment of the consequences (impact) of the risks as well as the risks probability of occurring.
- Risk Handling – Determine the risk-handling strategy, whether (in order of preference) it is to eliminate, transfer, prevent, mitigate, or assume (accept the risk).
- Risk Management Impact and Control Actions – Assesses the risk impact on the project and the effect of the risk handling strategies. Risk handling strategies will be reflected in the project's baseline, whereas residual risks will be reflected in the project contingency.
- Risk Reporting and Tracking – Risk reporting and tracking is the documentation of the risk management process.

Risk management is an iterative process in which the effectiveness of control actions is constantly evaluated, new risks are discovered, and existing risks are reassessed. New or revised control actions are implemented as needed. By managing risks, the process helps minimize cost impact, schedule delays, or the impact of other issue that could impede a project's progress. The iterative process continues until all the risks are closed or the project is completed.

3.0 Risk identification and Assessment

3.1 Risk Identification

Risk identification requires a methodical process to ensure that the list of identified risks is comprehensive. In this process, the Risk Project Manager, Project Manager, Integrated Project Team, Safety Subject Matter Experts, and Control Account Manager are asked to identify project risks in their area of responsibility. The risk identification process is using a graded approach, the Risk Management process begins with the team evaluating potential risk for each technical equipment item and subsystem that exceeds $100K, is on or near the critical path, or that poses a particular technical challenge. Common risk areas have been developed as a tool to assist the team in identifying areas of project risk. In addition, the Project Risk Manager can identify project risks that may not have been identified in any of the subproject risk analyses. The common risk areas are shown in table 1:

Table 1 - Common Risk Areas

Project Risk Areas	Significant risks
Facilities and Equipment	• Major equipment development • Inadequate planning for long lead items and vendor support.
Design	• Design relies on immature technologies or "exotic" materials to achieve performance objectives. • Design not cost effective.
Requirements	• Operational requirements not properly established or vaguely stated. • Requirements are not stable.
Testing/Evaluation/ Simulation	• Test planning not initiated early in program (Initiation Phase). • Testing does not address the ultimate operating environment. • Test procedures don't address all major performance 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.
Schedule	• Funding profile not stable from budget cycle to budget cycle. • Schedule does not reflect realistic acquisition planning. • Schedule objectives not realistic and attainable. • Resources not available to meet schedule.
Supplier Capabilities	• Restricted number of available vendors.
Cost	• Realistic cost objectives not established early. • Funding profile does not match acquisition strategy. • Fluctuations in cost of raw materials.
Technology	• Technology has not been demonstrated in required operating environment. • Technology relies on complex hardware, software, or integration design.
Management	• Acquisition strategy does not give adequate consideration to various essential elements, e.g., mission need, test and evaluation, technology, etc. • Subordinate strategies and plans are not developed in a timely manner or based on the acquisition strategy. • Proper mix (experience, skills, stability) of people not assigned to the project. • Effective risk assessments not performed or results not understood and acted upon.

3.2 Risk Categories

Risks to the RSB project are identified according to the following categories:

- Management
  - Configuration Processes
  - Interface Management
  - Procurements and Procurement Process
  - Programmatic
- Technical
  - Design Functional Requirements

  - Design Maturity/Complexity
  - Design and Equipment Complexity.
  - Installation and Integration Complexity
- Environment, Safety & Health (ES&H).
  - Regulatory and Environmental Controls
  - Safeguards and Security
- Schedule
- Cost (includes currency and inflation)
  - Resources (Funding and Staffing)

ES&H hazards associated with the RSB Project are well within the range of normal SLAC operations. The project management will apply SLAC's Integrated Safety & Environmental Management (ISEMS) System for handling all the ES&H risks entailed in the RSB Project. However, ES&H impacts that increase the risk severity level of technical parameters or facilities will be included in the project's Risk Management Registry.

3.3 Risk Assessment and Quantification

Risk level assessment is done by determining the probability of the occurrence and cost and schedule consequence of each risk. Consequence must consider foreseeable cumulative impact on project scope, cost and schedule.

In terms of risk consequences, each risk category has three assessment levels:

2.3.1 Technical Consequence Level

If the risk occurs:

- Level 0 negligible or no impact on fulfillment of mission need
- Level 1 low level of impact on fulfillment of mission need
- Level 2 moderate impact on fulfillment of mission need
- Level 3 considerable impact on fulfillment of mission need

2.3.2 Schedule Consequence Level

If the risk occurs:

- Level 0 potential delay to milestone of up to 1 month
- Level 1 potential delay to milestone of up to 2 months
- Level 2 potential delay to milestone of up to 3 months
- Level 3 potential delay to milestone of greater than 3 months

2.3.3 Cost Consequence Level

If the risk occurs:

- Level 0 estimated cost of impact consequence is < $10K
- Level 1 estimated cost of impact consequence is < $100K
- Level 2 estimated cost of impact consequence is < $500K
- Level 3 estimated cost of impact consequence is > $500K

2.3.4 Overall Consequence Level

An overall consequence level is derived using the greatest of the technical, schedule and cost consequence levels.

Table 2 – Overall Consequence Level

Overall Level / Risk Area	Level 0 (Negligible)	Level 1 (Low)	Level 2 (Moderate)	Level 3 (High)
Technical	Negligible	Low degradation.	Significant technical degradation.	Technical performance effectively useless for attaining physics objectives.
Schedule	Negligible potential for delay	Delays milestone or Project critical path by up to 1 month	Delays milestone or Project critical path by up to 3 months	Delays milestone or Project critical path by > 3 months
Cost	≤ $10K	≤ $100K	≤$500K	>$500K

3.4 Risk Probabilities

The following risk probability levels are assessed for each risk category.

Risk Probability Level:

- Level P0 < 1% probability that the consequences of the risk will be realized
- Level P1 < 10% probability that the consequences of the risk will be realized
- Level P2 < 25% probability that the consequences of the risk will be realized
- Level P3 > 25% probability that the consequences of the risk will be realized

3.5 Risk Severities

Finally, a risk severity matrix determined from the Overall Consequence Level and the Risk Probability Level provides the overall assessment of each identified risk to the RSB project, as shown below:

Table 3 – Risk Severity Matrix

Risk Severity Levels in colored boxes		Consequence Level			
		0	1	2	3
Probability Level	P0	0	0	0	0
	P1	0	1	2	3
	P2	0	2	2	3
	P3	0	3	3	3

Items with risk severity level of 2 or greater must be entered in the RSB Project Contingency Analysis.

4.0 Risk Management Impact and Control Action

4.1 Risk Handling

Risk management is the process used to identify risks and implement actions to reduce the likelihood of a risk materializing and/or to reduce or eliminate the potential consequences of identified project risks. Risk mitigation strategies generally fall into one of four categories: 1) risk avoidance, 2) risk transfer, 3) risk reduction or mitigation, and 4) risk acceptance. Each of these strategies is described in table 4, as are general methods used to manage identified risks.

A management strategy of risk handling is selected for each identified risks. Control actions are specified for each identified project risk based on the management strategy selected, unless the risk is accepted. Also specified for each identified risk is the date by which the control action is to be completed, the responsible-action POC, probability and consequence of the risk (pre and post handling), a cost estimate of implementing the control actions, the status of each control action, and indication as to whether or not the risk is closed.

The management strategy and control actions selected for each identified risk are tracked in the risk register. The baseline budget includes the funding required to implement the mitigation actions for the risks to achieve the confidence level set by the project.

Table 4 - General Methods to Manage Identified Risks

MANAGEMENT METHOD	OBJECTIVE	FEATURES
Avoidance	Risk is eliminated or avoided by changing the parameters of the project	* May change the project plan to eliminate conditions creating the risk (risky requirement, work scope, technology, or contractor) or eliminate the risk entirely. * May trade one risk for another lesser risk. * If a lower risk option is available, revise baseline to favor it. * Check that the lower risk is the better choice considering the project as a whole.
Transfer	Risk remains viable but is shifted to another project or organization. Often called risk allocation.	* If full transfer is not possible, consider a partial shift e.g., insurances, performance bond, PI, warranty, or contract guarantee. * Often, results in risk being shared between project and others. * Often best with funding risks. * Must consider costs and benefits of transfer. Must ensure recipient is best equipped and prepared to assume the risk in whole or in part. * Risk is not avoided. Recipient Must be willing to assume the risk, in whole or in part.
Mitigation	Reduced likelihood and/or consequences of a risk (preferably both) by series of control actions.	* Most common form of risk management. * Must systematically and carefully identify and attack root causes of the risk. * Control actions are comprehensive and feasible. * Early actions Often required for success. * Actions can affect cost, scope, and schedule. * cost/benefit analysis can be useful in selecting best Control action from a list of alternatives * Confidence levels for Control actions derived from Monte Carlo, Crystal Ball, or other analysis can be useful, but are not mandatory
Assumption	Risk is recognized and simply taken on by the project	* "Last option" for controlling a risk. No feasible means to mitigate or otherwise control the risk is available. * Benefit is that no changes in project plans are required to address the risk. * Sometimes used when a compellingly large reward could be gained by taking the risk. * Typically used for obdurate, distant, or least-predictable risk e.g. funding levels. * Residual (remaining) risk is always accepted. * Requires special diligence in monitoring, because nothing was done to reduce the risk. * Alternative or acceptable "fall-back" positions are especially crucial if the risk is critical to project success. * Worst case is "passive" acceptance, when no fall-back plans are considered.

4.2 Risk Impact Determination

Risk impact determination is the process of evaluating and quantifying the effect of risks on the project. Risk impacts a project into two difference ways:

- Handling strategy implementation. If the risk is "handled" using a risk reduction or mitigation strategy, there may be a cost and schedule impact associated with the implementation of that strategy. The implementation cost and schedule impacts of the "handling" strategy must be included in the baseline project cost and schedule.
- Residual risk. Even after risk-handling strategies have been implemented, there may be remaining risk impacts (residual risks). The cost and schedule impact of residual risks must be included in the contingency calculations. This is accomplished by determining a cost and schedule impact probability distribution for each residual risk. These probability distributions are then combined statistically through a Monte Carlo process to produce the contingency estimate. At all times, the project's available cost contingency should be greater than the statistical calculation of residual cost risk.

4.3 Abatement

The Risk Manager is responsible for developing appropriate risk abatement strategies to accept or mitigate project risk.

During risk elicitation, the Risk Manager will determine the abatement strategy for each of the identified risks. The abatement strategy is the general approach that project management will take with regard to a risk. For risk that are deemed mitigate, abatement actions are developed. Abatement actions are the specific activities that will be executed to reduce the impact of the risk.

The date by which the abatement action is to be completed, the Risk Manager uses the information to ensure that abatement actions are completed in a timely manner and are effective in reducing the risk. Additionally, the likelihood and consequence of the residual risk after abatement, and the likelihood of the success of the abatement actions are reduced in the Risk Register.

Table 5 common risk areas and abatement strategies has been included below as a tool to assist in addressing project risks.

The three identified Risk types, Cost, Schedule, and Technical, all have different mitigation strategies that can be used to reduce or eliminate their impact or probability of occurrence.

Preparation of clear and concise specifications and construction drawings, judicious determination of subcontractor responsibility and approval of proposed lower tier sub-subcontractors, and implementation of QA provisions will minimize technical risk.

Use of fixed-price subcontracts and competition will be maximized to reduce cost risk.

In addition, the Project will be tracked monthly, with schedule changes carefully monitored and approved through a change control process overseen by a combination of the Project Manager and the DOE.

Table 5 - Common Risk Abatement Strategies

Project Risk Category			
Project Impact	High	Moderate	Low
Cost	• Closely monitor cost and spending • Obtain Multiple bottoms-up independent cost estimates • Perform Value Management Vendor visits	• Closely monitor cost and spending • Obtain at least two bottoms-up independent cost estimates	• Monitor cost, schedule and spending
Schedule	• Increase lead time substantially by initiating procurements 6-8 weeks early • Vendor visits and oversight	• Increase lead time by initiating procurements 2-4 weeks early • Vendor visits and oversight	• Monitor cost, schedule and spending
Performance	• Perform major redesign • Evaluate alternate technology • QA/acceptance testing	• Moderate redesign as required • QA/acceptance testing	• QA/acceptance testing.

4.4 Cost and Schedule Impact – Monte Carlo Simulation

The "Crystal Ball" software package will be used to model probability simulations to determine the most likely risk expenditure and schedule delay. The model will use simulation ranges taken from the "Optimistic", "Pessimistic", and "Most Likely" risk estimates, using a triangular linear model.

The 80% Monte Carlo Simulated Risk Cost will be used to validate the experts' analysis of risk cost for the project, and projected level of project contingency.

The 80% Monte Carlo Simulated Schedule Delay will be used in the Master Project Schedule to aid in tracking the overall critical path delay.

The methods and results as determined by the "Crystal Ball" Monte Carlo Simulation are included in the RSB Project Contingency Analysis Report.

5.0 Risk Tracking and Documentation

5.1 Risk Registry

The RSB Risk Registry tracks and monitors the status of all project risks including each risk POC, probability and consequence of each risk (pre and post-mitigation) and details on the risk control actions. The Risk Manager is responsible for identifying and assessing of risks. This responsibility includes providing regular re-evaluation and a status update of risk entries via the RSB Project Risk Registry. The Risk Registry is a living document used throughout the life of the project.

Project risks and the management actions to control them are reviewed and updated monthly by RSB Risk Manager, RSB Project Manager and the Integrated Project Team. New and imminent risks are added into the registry when identified. Risks are closed when the risk is no longer credible or when the risk has been realized and no residual risk remains.

The Risk Manager is responsible for maintenance of the Risk registry for ensuring that RSB Project team members are monitoring and reassessing risks regularly, and that the Risk Handling Plans are being implemented in a timely and effective manner.

Items with risk severity level of 2 or greater must be entered in the RSB Contingency Analysis, which is the product of the impact and the risk probability. This is to provide a roughly quantitative assessment of the relative risks identified by the project

5.2 Risk Documentation

Each identified risk shall be documented using the Risk Assessment Worksheet. Consequences and probabilities will be described as detailed as possible to support the level of assessment. The approach to each identified risk shall be documented using the Risk Management Worksheet.

Appendix A: Risk Registry Report