Preliminary Risk Management Plan

Core Facility Revitalization (CFR) Project
Brookhaven National Laboratory

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Prepared for:
The Department of Energy

by:
Brookhaven Science Associates

Preliminary Risk Management Plan

Core Facility Revitalization (CFR) Project

Approval:

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Date: 8-5-16

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CHANGE LOG

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Rev. 0	7/19/2016	Issued to support CD-1	N/A

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1.0 OVERVIEW

Risk Management (RM) is an overarching process that encompasses identification, analysis, mitigation planning, mitigation implementation and tracking. RM is critical to acquisition success and an integral part of project management and engineering activities. Risk is a measure of future uncertainties in achieving project performance goals and objectives within defined cost, schedule and performance constraints. Risks are therefore associated with all aspects of a project and how these aspects relate across the Work Breakdown Structure (WBS) and Integrated Master Schedule.

Risks have three components:

1. A future root cause, which, if eliminated or corrected, would prevent a potential consequence from occurring.
2. A probability (or likelihood) of the root cause occurring, assessed at the present time.
3. The consequence (or effect) of that future occurrence.

Risk addresses the potential variation in the planned approach and its expected outcome. Risk assessment and identification is performed as early as possible in the life cycle to ensure that critical technical, scope, schedule, and cost risks are identified and/or addressed as part of the program and project planning, execution, and budget activities.

The risks anticipated for the Core Facility Revitalization (CFR) Project will be analyzed and managed in accordance with the methods identified in the DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets* and DOE G 413.3-7, *Risk Management Guide.*

This Preliminary Risk Management Plan was developed to support approval of Critical Decision 1 (CD-1) and will be updated throughout the life of the project.

2.0 PURPOSE AND SCOPE

The objective of a well-managed risk management plan is to provide a repeatable process for balancing cost, schedule and performance goals with project funding, especially on projects with tightly constrained or optimistic cost, schedule and performance goals.

Risk events are determined by examining each WBS element and process for possible root causes. These sources can generally be grouped as scope, cost, and schedule risk. Prevention and management of environment, safety, and health hazards, while part of risk management, are enveloped by the Integrated Safety Management System (ISMS) that is applicable to all activities and/or projects performed at Department of Energy Laboratories. The ISMS clearly specifies that risk management is everybody's responsibility and will be factored into every project decision throughout the life of the CFR Project.

A project-wide risk registry is developed listing the various risks with their classification, probability, impact on cost and schedule and mitigation strategies. Risk assessments and mitigation plans will be continuously managed, updated, and tracked as the project evolves.

The estimated costs and contingencies to mitigate these risks are incorporated in the project's preliminary baseline cost and schedule estimates. Once the Performance Baseline is established at CD-2, the use of contingency will be managed via the Baseline Change Control processes described in the CFR Project Preliminary Project Execution Plan.

This Risk Management Plan defines the processes and methods to be used to identify, assess, quantify, monitor, and mitigate risks for the project. It describes the roles and responsibilities of the project team in performing the risk management functions, and defines reporting and tracking requirements for risk-related information.

3.0 PROJECT ASSUMPTIONS

The goals of the CFR Project Risk Management Plan are as follows:

1. Risk assessment will be a continuous and iterative process throughout the project life cycle.
2. The project will be executed in accordance with DOE and Brookhaven National Laboratory policies and procedures.
3. A close partnership with users and stakeholders will be maintained throughout project implementation.
4. Comprehensive mitigation plans will be developed and implemented.

4.0 PROJECT RISK MANAGEMENT TEAM

The project Risk Management Team will consist of the following project team members:

Member List	Term
• Federal Project Director – Lloyd Nelson	12/31/21
• Project Director – Peggy Caradonna	12/31/21
• Project Manager – Steven Cannella	12/31/21
• Environment, Safety & Health – Donald Farnam	12/31/21
• Environment, Safety & Health – Raymond Costa	12/31/21
• Procurement – Philip Gardner / Jose Velez	12/31/21
• RACF Representative – Eric Lancon	12/31/21
• CSI Representative – Kerstin Kleese Van Dam	12/31/21
• Construction Services – Steven Sawch	12/31/21

The Project Director has overall responsibility for project Risk Management. The activities required to implement Risk Management are delegated to the Project Manager. The Project Manager is responsible for the development of the overall Risk Management approach. Duties include: scheduling routine reviews of the risks; assuring the risk analysis results are documented and risk mitigation plans are developed and brought to closure; active participation in risk identification and quantification, determination of mitigation plans, and allocating budget for risk management activities through approval of Baseline Change Proposals.

The Risk Management Team is responsible for Risk Management within their assigned scope of work. This includes performing risk analysis, identifying potential vulnerabilities/risks, likelihood of occurring, and impact on the project goals and objectives; developing risk mitigation strategies; and executing plans to accomplish risk-reducing activities.

5.0 RISK MANAGEMENT METHODOLOGY

Risk Management is an organized methodology for continuously identifying and measuring the unknowns; developing mitigation options; selecting, planning and implementing appropriate risk mitigations; and tracking the implementation to ensure successful risk reduction. It is necessary to identify risks that may be encountered during the execution of the project in order to effectively manage the project budget and schedule contingencies. These risks will be assessed thoroughly and the probability and impact of these risks (should they occur) will be determined. These assessments establish an appropriate estimate of how much contingency should be reserved for these risks. Once the risks have been identified, risk handling plans are put in place to minimize the probability and/or the impact should the risk occur.

There are six primary steps that comprise the Risk Management process:

1. **Risk Planning** is an iterative process which includes describing and scheduling the activities and process to assess, handle, monitor and document the risks associated with the project. Risk Planning includes:

    - Specifying the Risk Management process
    - Developing the Risk Management Plan
    - Defining risk categories
    - Developing risk handling process

2. **Risk Identification, Assessment and Mitigation**

    - Identify Risks
    - Develop Risk Registry report
    - Conduct risk screening
    - Identify owners
    - Risk handling plans developed

3. **Quantify Risks**

    - Define probability of occurrence and consequence
    - Establish basis for probability and consequence
    - Determine risk level

4. **Develop Handling Strategies**

    - Select handling strategy (reduce and/or mitigate, accept, avoid or transfer)
    - Determine handling strategy implementation impact (Cost and Schedule)

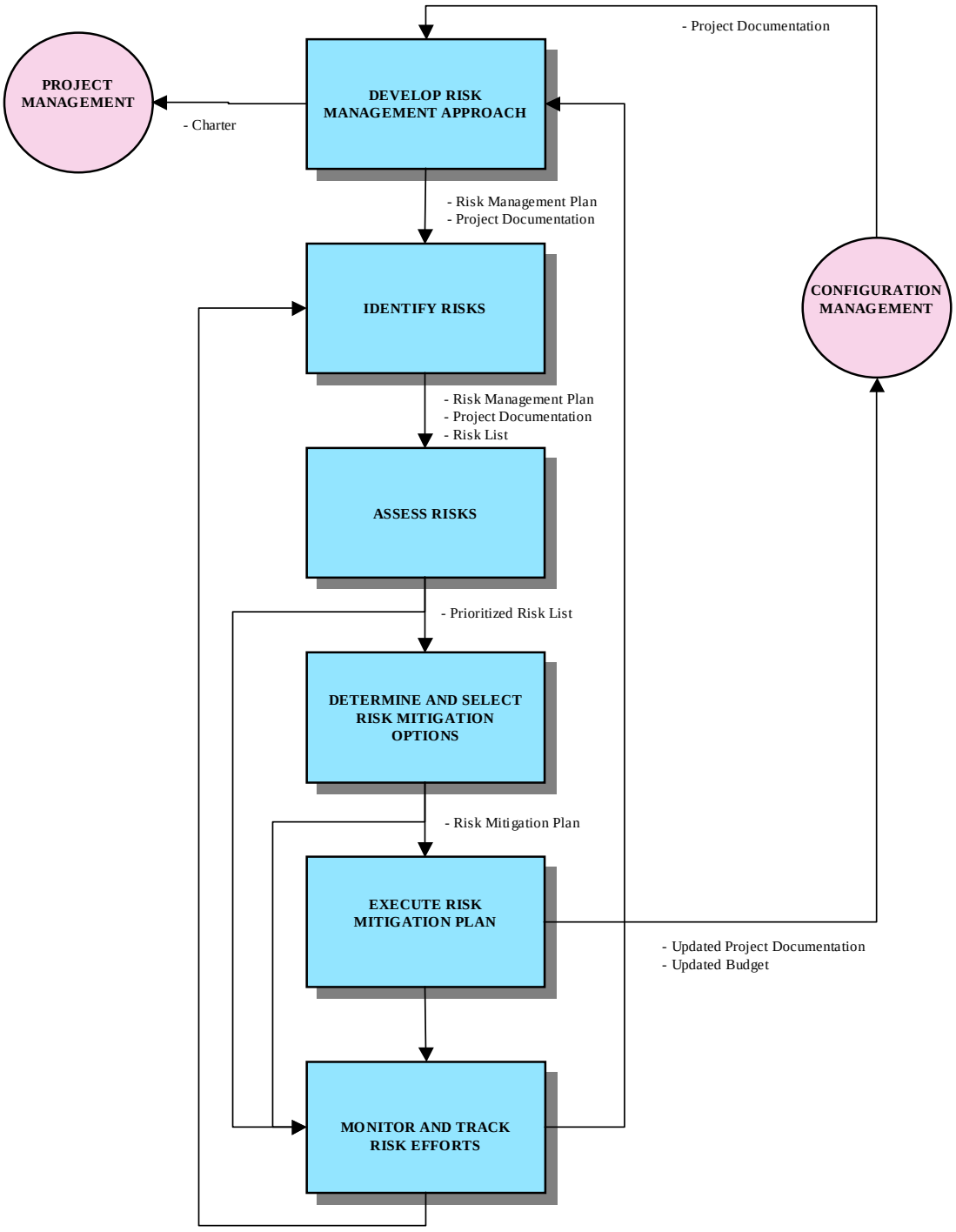
5. **Determine Baseline Impacts (Cost/Schedule)**

    - Include handling strategy cost and schedule impacts
    - Develop risk contingency allocations

6. **Risk Tracking, Reporting, and Closeout**

    - Issue Risk Analysis report
    - Implement handling strategies
    - Track Risk Action Items to Closure

Risk Management Process



6.0 CFR PROJECT RISK MANAGEMENT APPROACH

The CFR Risk Management approach consists of the examination of each Work Breakdown Structure (WBS) element in terms of root causes, sources or areas of risk by the Risk Management Team. In this WBS approach, risks are identified, assessed and tracked for individual WBS elements. Root-cause identification and analysis integrates the performance assessment, schedule assessment and cost estimates using established risk evaluation techniques. Key stakeholders in the area of programming, design, construction, contracting, administration, management, ES&H and maintenance/operations were identified as potential risk owners. The assessment team has collected, compiled, assessed, and documented a matrix of the CFR preliminary project risks with reference to Risk Screening categories in DOE G 413.3-7, *Risk Management Guide*.

Experience of the users, project management, and other team members is vital and useful during this process. The team utilized risk registries from past projects, of similar scope and magnitude, as input to determine the risks and impacts for the CFR registry. Lessons learned from other projects provide guidance for identifying technical risk drivers and provide advice for adopting methods that work.

6.1 The Graded Approach for Managing Risk

Most CFR Project activities require the preparation and completion of reviews, work planning, hazard analysis, and controls to properly manage the work. The first step in this process is to recognize the potential risk consequences and to assign ownership for the specific work. The level of treatment is graded based on the level of risk determined.

6.2 Identifying Potential Areas of Risk

The CFR Project Risk Management process begins with project management, department representatives, engineers, and scientists evaluating potential project risk for each project activity on the WBS. 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 discussions among the Federal Project Director, Project Director, Project Manager, Department Representatives, and Design Engineers.

Meetings are held to identify, categorize, and refine the list of risks. Individual risks are entered on the Preliminary Risk Registry using “cause” and “effect” descriptions of the risk incorporating the DOE methodology of a risk matrix. Upon agreement on the list, risk owners are assigned. Probability percentages and consequences of the event are then quantified based on the criteria indicated Table 6-1.

The methods to identify risks for the CFR Project include:

- Monthly Status Meetings – Risks to project schedule, budget, and technical performance will be regularly identified and discussed. Mitigation plans are developed and action items assigned to resolve these identified risks. When EVM data/trends are applied, it will help identify WBS elements that are experiencing issues. This information will then be utilized to help prioritize WBS elements that may contain unidentified risks.

- Conducting Monthly Project Reviews – Project reviews are scheduled to discuss the current status of the project and identify potential areas of risk. These reviews are conducted on an ad hoc, as well as monthly, basis.

6.3 Risk Analysis

Each undesirable event will be assessed as to the likelihood and possible consequences of occurrence in terms of performance, schedule and cost. The risk level is then categorized using the risk reporting matrix below (Figure 6-1). The level of likelihood of each root cause is established utilizing specific criteria as defined in Table 6-1.

Using the Risk Level Decision Scoring Matrix, the level of risk is then reported as low (green), medium (yellow) or high (red).

Risks have been sorted into six categories: Management, Programmatic, Cost, Schedule, Safety/Environmental, and Performance. A percentage probability of occurrence was assigned and cost and schedule impacts were quantified into dollars and months using three categories: "Optimistic", "Most Likely", and "Pessimistic".

Figure 6-1 Risk Level Decision Scoring Matrix

	Impact				
Probability	Very Low	Low	Medium	High	Very High
High	**Low Risk**	**Medium Risk**	**Medium Risk**	**High Risk**	**High Risk**
Medium	**Low Risk**	**Low Risk**	**Medium Risk**	**Medium Risk**	**High Risk**
Low	**Low Risk**	**Low Risk**	**Low Risk**	**Medium Risk**	**Medium Risk**

Table 6-1 Criteria for Risk Identification and Assessment

Likelihood of Occurrence	Probability Rating	Range
Unlikely	**Low** Probability – Not likely to occur during execution.	0-25%
Somewhat Likely	**Medium** Probability – May occur during execution	26%-75%
Likely	**High** Probability – Will likely occur during execution	> 75%
Impact	**Consequence Rating**	**Cost / Schedule Impact**
Very Low	Negligible Consequence	Insignificant
Low	Low Consequence	< $200K < 1 Month
Medium	Medium Consequence	$200K- $500K 1-2 Months
High	High Consequence	$500K - $800K 2-3 Months
Very High	Very High Consequence	> $800K > 3 Months

After determining the likelihood and consequences for each risk, an overall risk severity of High, Medium, or Low is assigned for each identified risk using Table 6-2.

The risk's level of severity dictates the risk's level of exposure or level of action. The level of action determines the amount of resources to be used and the plan of action to take.

Risk handling is included in the Risk Registry. Estimates for the resulting aggregate cost and schedule impacts are calculated. This data is used to develop overall project cost and schedule contingencies.

Methodologies utilized in identifying risks on the project are documented in the project's Risk Management Plan. Located in Appendix A of the Preliminary Risk Management Plan, the Preliminary Project Risk Registry identifies the potential risks of the project, the probabilities of the risks occurring, and the potential cost and schedule impacts. This approach breaks the potential risk impacts down into independent risk categories, and then defines the estimated probabilities for cost and schedule impacts for each risk.

The method of contingency analysis performed for this project to date has been a judgment (qualitative) analysis which calculates a contingency amount by multiplying the anticipated probability times the "Most Likely" anticipated cost and schedule impact as identified in the Risk Registry.

The quantitative analysis will be updated prior to CD-2. A Monte Carlo Simulation, a common statistical modeling technique, will be utilized to estimate how much combined risk the project contains.

Table 6-2 Level of Overall Risk Severity

Level of Risk Severity (Risk Exposure)	Description
High	Risks with a high overall risk rating are considered unacceptable and a risk mitigation plan process is initiated. Each high risk is placed on the risk registry and must have strategies, metrics and a plan of action and milestones developed by the Risk Owner and must be aggressively managed, monitored and tracked through closeout.
Medium	Risks with a medium overall risk rating require attention and must be ranked to determine if they should be on the principal risk registry. Each medium risk must have candidate strategies, metrics and a plan of action, milestones and must be managed and reviewed frequently. Medium overall ratings on the risk registry must be aggressively managed on a continuous basis and monitored until the risk is mitigated to an acceptable level or closed.
Low	The risk will be placed on a watch list. The risk will be reviewed at appropriate intervals.

7.0 DEVELOPMENT OF THE RISK REGISTRY

The Risk Registry Report is a "living" document that will be updated throughout the life of the project. The risk registry is a central repository of risks collected and a level of visibility for items having risk potential. Appendix A is the CFR Risk Registry.

The primary tool for tracking, reporting and closeout of all risks will be the monthly review and update of the Risk Registry. These risk status meetings will be the platform for analyzing newly identified risks and for reviewing the progress of all current risk-related action items. Changes to a risk's status such as "retirement", probability of occurrence, and impact are noted. A risk can be retired from the registry when the trigger event has passed, or if it has been managed to an insignificant level of probability and/or impact. Risks are continually tracked and current information used for periodic updates regarding baseline assumptions for cost and schedule contingency lessons learned. The Project Manager is responsible for conducting and documenting these meetings.

Appendix A: CFR Preliminary Project Risk Registry and Contingency Analysis

Core Facility Revitalization Preliminary Project Risk Registry - 07/31/2016

Risk No.	Risk Title	Risk Category	Date Submitted	Date Last Revised	Risk Owner	Cause	Effect	Risk Timeframe Which phase could this event occur in? Design, Bid, Construction and/or Commissioning	Probability of Event (x100,%)	Impact of Event	Current Cost Impact Estimates (Use $K) O: Optimistic, ML: Most Likely, P: Pessimistic			Schedule Impact (Use time in months) O: Optimistic, ML: Most Likely, P: Pessimistic			Assumptions for Cost and Schedule Estimates	Overview of Risk Handling Plan	Risk Handling Approach Avoid, Mitigation, Transfer, Accept	Steps and Schedule for Handling the Plan	When to Reduce or Retire Risk	Risk Retired (Date)
											O	ML	P	O	ML	P						
WBS 1.0 - General Project Risks																						
1	Continuing Resolution Beyond Base Assumptions Cause Delays	4. Schedule 3. Cost	6/8/16		FPD	Congressional continuing resolution is implemented beyond current assumptions (FY17 - 12M, FY18 - 3M, and FY19 - 3M)	Schedule delays and cost impacts.	General	0.65	Medium	$0	$430	$860	0	1	2	Monthly BNL/Contractor project support costs and potential delays.	Maintain schedule contingency and cost contingency. Avoid early FY start of major activities	Accept	Implement assumptions prior to baseline. Maintain cost and schedule contingency.	End of each FY and FY 2020 budget Approval	
2	Late Approval of Critical Decisions - BNL	1. Management	6/8/16		PD	Delays in development, review and/or approval of project documentation by BNL.	Project costs could be impacted and delays could occur.	General	0.1	Low	$0	$188	$376	0	1	2	Monthly BNL project support cost.	Strive for first round approvals by Independent Project Review. Apply adequate resources to ensure timely development, review and approval of CD documents. Track milestones on project schedule. Complete early scheduling of IPR's and ESAAB.	Mitigate	Ensure complete and accurate submittals to expedite review and approval. Maintain constant communication with Program Manager. Conduct self assessment activities.	CD-3B	
3	Late Approval of Critical Decisions - DOE	1. Management	6/8/16		FPD	Delays in development, review and/or approval of project documentation by DOE.	Project costs could be impacted and delays could occur.	General	0.1	Low	$0	$188	$376	0	1	2	Monthly BNL project support cost.	Strive for first round approvals by Independent Project Review. Apply adequate resources to ensure timely development, review and approval of CD documents. Track milestones on project schedule. Complete early scheduling of IPR's and ESAAB.	Mitigate	Ensure complete and accurate submittals to expedite review and approval. Maintain constant communication with Program Manager. Conduct self assessment activities.	CD-3B	
4	Funding Profile Changes	3. Cost 4. Schedule	6/8/16		FPD	Congressional Budget cuts and/or DOE senior level management decision to reallocate funding.	Increased cost and schedule delays	General	0.25	Medium	$0	$430	$860	0	1	2	Monthly BNL/Contractor project support costs and potential delays. Actual DOE estimates and recommendations.	Good EVM practices, risk mitigation and reporting. Avoid/mitigate baseline changes.	Mitigate	Maintain adequate cost and schedule contingency. Has not been an issue to date with prior CR's.	FY2020 budget approval	
5	Change in Management / BNL Project Personnel	1. Management	6/8/16		PD	Retirements, promotions, budget cuts and alternative employment.	Decreasing efficiency in project execution. Increased management and design costs due to loss in continuity.	General	0.1	Medium	$0	$215	$430	0	0.5	1	Monthly BNL/Contractor project support costs and potential delays.	Maintain communications and clear documentation. Ensure project knowledge is preserved through documentation and control.	Mitigate	Constant communication and knowledge transfer.	CD-4	
6	Inadequate BNL Resources	1. Management 4. Schedule	6/8/16		PD	Lack of funding, timeliness and/or commitment of matrixed organizations to provide adequate resources during design management and construction management processes, ESH&Q and procurement.	Inefficient project management, rework and schedule delays.	Design, Bid, Construction, Commissioning	0.1	Medium	$0	$215	$430	0	0.5	1	Monthly BNL/Contractor project support costs during construction	Aggressive hiring strategies, tailoring of acquisition strategy to ensure efficient use of resources. Resource loaded schedule promotes resource leveling and adequate forecasting or anticipated needs.	Mitigate	Maintain constant communication with project team and key BNL project personnel. Hire additional contract support as needed.	CD-4	

Core Facility Revitalization Preliminary Project Risk Registry - 07/31/2016

Risk No.	Risk Title	Risk Category	Date Submitted	Date Last Revised	Risk Owner	Cause	Effect	**Risk Timeframe** Which phase could this event occur in? Design, Bid, Construction and/or Commissioning	**Probability of Event** (x100,%)	**Impact of Event**	**Current Cost Impact Estimates** (Use $K) O: Optimistic, ML: Most Likely, P: Pessimistic			**Schedule Impact** (Use time in months) O: Optimistic, ML: Most Likely, P: Pessimistic			**Assumptions for Cost and Schedule Estimates**	**Overview of Risk Handling Plan**	**Risk Handling Approach** Avoid, Mitigation, Transfer, Accept	**Steps and Schedule for Handling the Plan**	**When to Reduce or Retire Risk**	**Risk Retired** (Date)
											O	ML	P	O	ML	P						
WBS 1.01 - Project Design and Engineering																						
7	Failure to Capture User Requirements	1. Management 2. Programmatic	6/8/16		PM/User	Input from users is not captured or provided on a timely basis.	Design costs may increase, additional construction costs may be incurred later in project.	Design, Construction, Commissioning	0.2	Very High	$329	$873	$1,524	0.25	1	2	Estimated .5%, 1%, 1.5% of Construction Budget (Including Design Costs) plus monthly BNL project support costs.	Continuous and proactive discussion and design reviews with user representatives. Control costs and changes through the IPT and change control board. Ensure "buy in" from stakeholders.	Mitigate	Laboratory pre-programming and Conceptual Design Effort performed. Conduct of Extensive Design Reviews.	Final design	
8	Significant Increase in Project Scope (Creep)/Design Contingency/Estimate Uncertainty	3. Cost 4. Schedule	6/8/16		PM	Scope of project significantly increases as design matures. (Technical / Mechanical)	Cost and schedule may be impacted	Design, Construction	0.75	Very High	$1,436	$2,872	$4,416	0.25	0.5	1	Estimated 3%, 6%, 9% of Construction Budget plus monthly BNL project support costs.	Project controls, value engineering and design reviews. Establish scope creep contingency in both cost and schedule. Enforce design to cost clause.	Mitigate	Scope Programming by Design team, Management oversight of the Design team, and Cost and Schedule contingencies	Receipt of Qualified Cost Proposal	
9	Failure to Comply with Code and Regulatory Requirements During Design	1. Management 3. Cost 4. Schedule 5. Safety/ Environmental	6/8/16		PM	Interpretation of applicable codes and regulations is not accepted by the AHJ.	Increase in cost and schedule delays due to installation of noncompliant systems and components.	Design, Construction, Commissioning	0.2	Medium	$218	$436	$762	0.25	0.5	1	.25%, .5%, .75% of Construction Budget Including possible Re-Design plus monthly BNL/Contractor project support costs.	Ensure involvement of key SME's in the design review process and construction inspection process. Ensure contractually that cost impacts associated with inadequate designs are borne by the A/E (design to code)	Mitigate	Maintain constant communication with AHJ throughout all phases of the project.	Final Commissioning	
10	Limited Competition results in higher than expected cost	3. Cost 4. Schedule	6/8/16		Procurement/ PM	Construction market is very active with many competing projects. The number of contractors interested in bidding is reduced to two or less thus reducing competition.	Potential cost and schedule impact	Bidding	0.3	Very High	$1,107	$2,429	$3,752	0	0.5	1	2.5%, 5%, or 7.5% of Construction Budget plus monthly BNL project support cost	Encourage interest in construction community and maintain adequate project contingency.	Mitigate	Initiate contact with Contractor community prior to and immediately proceeding RFP period to encourage interest and participation.	Receipt of Qualified Cost Proposal	
11	Design Estimate exceeds project budget	3. Cost 4. Schedule	6/8/16		PM	Design professionals cost estimate exceeds the amount budgeted for the project construction.	Potential cost and schedule impact	Design	0.2	Low	$0	$188	$376	0	1	2	BNL monthly project support costs.	Ensure QC/QA during design to develop detailed designs and valid cost estimates. Enforce design to cost clause in A/E contract.	Mitigate	Project manager will ensure detailed review of A/E design, estimates, and plans & specs. Conduct a value engineering exercise during design. Obtain independent cost estimates.	Receipt of Qualified Cost Proposal	
12	Increasing Cost Escalation Rates Results in Higher Construction Cost	3. Cost 4. Schedule	6/8/16		PM	Market prices due to worldwide demand for commodities have increased at a rate higher than the anticipated Inflation rate used for the project.	Construction costs will increase. Possible cost negotiations.	Design, Bidding	0.25	Very High	$443	$1,215	$2,429	0	0.25	0.5	1%, 2.5%, or 5% of Construction Budget due to recent market volatility plus possible BNL monthly project support cost.	Develop escalation analysis and conduct periodic estimating during the design process to ensure project cost is within funding allocation.	Mitigate	Maintain cost and schedule contingency. Conduct VE exercises and maintain potential scope deducts	Receipt of Qualified Cost Proposal	

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											O	ML	P	O	ML	P						
WBS 1.02 - Construction																						
13	User Generated Scope Changes During Construction	3. Cost 4. Schedule	6/8/16		User/PM	Additional user requirements resulting in changes to planned functional usage result in increased project scope.	Increase in cost and schedule duration.	Construction	0.9	Very High	$658	$1,094	$1,531	0.5	1	1.5	Estimated 1%, 1.5%, 2% of Construction Budget plus monthly BNL project support costs.	Project controls, value engineering and design reviews. Establish scope creep contingency in both schedule and cost. Control changes through change control board.	Mitigate	Project director will ensure detailed review and approval of proposed changes. User review of contract drawings conducted again (post award).	Substantial Completion	
14	Design Errors and/or Omissions	3. Cost 4. Schedule	6/8/16		PM	Significant errors or inadequate detail in the design documents cause changes.	Construction change orders and potential delays associated with redesign efforts.	Design, Bid, Construction, Commissioning	0.6	High	$329	$658	$1,094	0.25	0.5	1	Estimated .5%, 1%, 1.5% of Construction Budget plus monthly BNL project support costs.	Ensure QC/QA during design to develop detailed designs and investigate existing conditions to avoid design detail corrections in the field. Enforce design to cost clause in A/E contract	Mitigate	Project manager will ensure detailed review of A/E design, plans & specs.	Final Commissioning	
15	Failure to comply with OCMED / Safety Program requirements	3. Cost 4. Schedule 5. Safety/ Environmental	6/8/16		PM	Failure of contractor to comply with safety standards, lack of knowledge and understanding of OCMED program.	The project could be shut down or delayed	Construction	0.1	Low	$0	$94	$188	0	0.5	1	BNL Monthly Project Support cost.	Evaluate Sub-contractor safety records during qualification process. Specify requirement for Sub-contractor to maintain safety professional onsite. Review subcontractor safety plans and PHA's/HASP. Provide ES&H oversight.	Mitigate	Ongoing review and oversight throughout the term of the project by the Sub-contractor's health and safety professional and limited oversight by BNL staff.	Substantial Completion	
16	CM/GC Construction Contract Not Awarded	1. Management 3. Cost 4. Schedule	6/8/16		PM/ Procurement	CM/GC Construction contract not awarded due to poor pre-construction performance	Project may need to convert toevaluated "low bid" procurement	Bid	0.05	High	$564	$752	$940	3	4	5	BNL Monthly Project Support cost.	Maintain strict oversight of CM/GC pre-construction performance	Mitigate	Conduct internal assessment of CM/GC performance at 60% Design.	Construction Phase contract award	
17	Logistical issues with the isolation of existing building systems.	1. Management 3. Cost 4. Schedule	6/8/16		PM	Shared building systems prove to be difficult to isolate and maintain in operation for remaining users.	Increased cost and schedule duration.	Construction	0.6	Medium	$158	$315	$580	0.25	0.5	1	BNL/Contractor monthly project support costs plus $50K/$100K/$150K material allowance/rentals	Preparation and verification of complete as-built documentation as part of the design package	Mitigate	Anticipate areas of concern and prepare alternate work plans as required.	Substantial Completion	
18	Construction delays due to work in occupied areas of buildings.	1. Management 3. Cost 4. Schedule	6/8/16		PM	Construction activities prove too disruptive for remaining building occupants.	Increased cost and schedule duration.	Construction	0.3	Medium	$158	$315	$473	0.25	0.5	0.75	BNL/Contractor monthly project support costs plus $50K/$100K/$150K material allowance/rentals	Prepare thorough project phasing plans. Isolate construction area from occupied areas of building.	Mitigate	Coordination of phasing plans. Review work plans with user representative at logical intervals.	Substantial Completion	
19	Sub-contractor Default	1. Management 3. Cost 4. Schedule	6/8/16		Procurement	Sub-contractor Defaults, Resigns, or is Terminated.	Performance Bond is Invoked. Possible schedule delay. Potential increased costs.	Construction, Commissioning	0.05	Medium	$188	$376	$564	1	2	3	BNL Monthly project support cost. Bond will cover change in contract amount.	Performance bond requirement. Evaluate Sub-contractors proposed by GC	Mitigate	Pre-qualify Sub-contractors	Substantial Completion	

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20	A/E failure to provide engineering support in a timely fashion	3. Cost 4. Schedule	6/8/16		PM	Inadequate A/E resources	Stop work, schedule delays and cost impact.	Construction, Commissioning	0.1	Very Low	$0	$108	$215	0	0.25	0.5	BNL/Contractor monthly project support costs.	A/E statement of work and qualification criteria shall include clear expectations for timely deliverables.	Mitigate	Ongoing review and oversight of the AE contract throughout the term of the project by the Project Manager and Procurement.	Final Commissioning	
21	Unforeseen field conditions	3. Cost 4. Schedule	6/8/16			Unforeseen field conditions encountered during demolition or construction.	Schedule delays and cost impact.	Construction	0.95	Medium	$265	$530	$795	0.5	1	1.5	BNL/Contractor monthly project support cost plus $50K/$100K/$150K allowance for Re-design and Material Costs.	Preparation and verification of complete as-built documentation as part of the design package	Mitigate/ Accept	Anticipate areas of concern and prepare alternate work plans as required.	Substantial Completion	
22	Minor Event or Injury that does not trigger an investigation	3. Cost 4. Schedule 5. Safety/ Environmental	6/8/16		ES&H	Failure of contractor compliance with safety standards, unsafe work practices, Injury or event classified as ORPS SC4 or less.	schedule delays and cost impact.	Construction, commissioning	0.15	Very Low	$0	$108	$215	0	0.25	0.5	BNL/Contractor monthly project support costs.	Review and approval of HASP prior to the start of construction. Establish mandatory pre-bid meetings to ensure full understanding of all laboratory requirements. Safety oversight . Mandatory PHA review and acceptance for all activities	Mitigate	Ongoing review and oversight throughout the term of the project by the Contractor's health and safety professional and oversight by BNL staff. Pro-active promotion of safety workplace practices.. Safety first prioritization.	Final Commissioning	
23	Significant Event or Injury that does trigger an investigation	3. Cost 4. Schedule 5. Safety/ Environmental	6/8/16		ES&H	Failure of contractor compliance with safety standards, unsafe work practices, injury or event classified as ORPS SC3 or greater.	Schedule delays and cost impact. Possible job shutdown.	Construction, Commissioning	0.01	Low	$108	$215	$430	0.25	0.5	1	BNL/Contractor monthly project support costs.	Review and approval of HASP prior to the start of construction. Establish mandatory pre-bid meetings to ensure full understanding of all laboratory requirements. Safety oversight . Mandatory PHA/HASP review and acceptance for all activities	Mitigate	Ongoing review and oversight throughout the term of the project by the Contractor's health and safety professional and oversight by BNL staff. Pro-active promotion of safety workplace practices. Safety first prioritization.	Final Commissioning	
24	Construction delays attributable to BNL Management and/or policy changes	3. Cost 4. Schedule	6/8/16		PM	BNL imposed work restrictions, inadequate resources for the timely review of submittals or requests for information.	Contractors could request compensable delay damages.	Construction, Commissioning	0.25	Low	$108	$215	$323	0.25	0.5	0.75	BNL/Contractor monthly project support costs.	Control RFI, Change Order, and Baseline Control processes. Advances planning, resource forecasting.	Mitigate	Expected mitigation by cost contingency if occurs.	Final Commissioning	
25	Failure to remove all known contaminated materials/equipment from work site prior to start of construction. (Legacy contamination)Unknown Hazardous Material Exposure/ Contamination found during demolition	3. Cost 4. Schedule 5. Safety/ Environmental	6/8/16		PM / ES&H	Failure of BNL to complete pre-construction remediation activities. Discovery of environmental contaminants during demolition.	Stop work, schedule delays and cost impact.	Construction	0.75	Medium	$258	$515	$880	0.25	0.5	1	BNL/Contractor monthly project support cost plus $150K/$300K/$450K allowance for Removals / Remediation	Surveying and removal activities to be completed prior to the start of construction. Historical data and sampling will be reviewed prior to demolition. Monitoring will be performed during site preparation and demolition activities.	Mitigate	Schedule and complete site preparation / pre-construction activities to remove prior to start of construction	Substantial Completion of pre-construction activities and completion of all demolition activities.	
26	Not Used																					

Core Facility Revitalization Preliminary Project Risk Registry - 07/31/2016

Risk No.	Risk Title	Risk Category	Date Submitted	Date Last Revised	Risk Owner	Cause	Effect	Risk Timeframe Which phase could this event occur in? Design, Bid, Construction and/or Commissioning	Probability of Event (x100,%)	Impact of Event	Current Cost Impact Estimates (Use $K) O: Optimistic, ML: Most Likely, P: Pessimistic			Schedule Impact (Use time in months) O: Optimistic, ML: Most Likely, P: Pessimistic			Assumptions for Cost and Schedule Estimates	Overview of Risk Handling Plan	Risk Handling Approach Avoid, Mitigation, Transfer, Accept	Steps and Schedule for Handling the Plan	When to Reduce or Retire Risk	Risk Retired (Date)
											O	ML	P	O	ML	P						
27	Construction Material / Raw Material Shortfall / Availability	4. Schedule 3. Cost	6/8/16		CM	Materials required for construction not available due to market forces including worldwide demands for key commodities.	Construction may be delayed.	Bid / Construction	0.25	High	$265	$530	$795	0.5	1	1.5	BNL/Contractor monthly project support costs plus estimated cost increase ($50K,$100K,$150K), delay, and/or "quick-ship" cost. Possible more expensive material required.	Consider early procurement of long lead items. Value engineering to ensure that lower cost and more readily available materials are being specified. Conduct market surveys to enhance intelligence concerning availability of key materials.	Mitigate	Evaluation of chosen materials and systems as part of Value Engineering process.	Substantial Completion	
28	Delays in procurement or the approval process	4. Schedule 3. Cost	6/8/16		Procurement	The procurement process experiences unanticipated delays.	Construction may be delayed Costs may increase.	Bid / Construction	0.25	Medium	$215	$430	$645	0.5	1	1.5	BNL/Contractor monthly project support costs.	Early close coordination with procurement official and staff.	Mitigate	Conduct pre-procurement activities (review meetings) for major procurements with procurement personnel to review requirements and time-lines.	Substantial Completion	
29	Building system performance, materials, or components do not meet design criteria.	2. Programmatic 4. Schedule 3. Cost	6/8/16		PM	The installed building systems do not perform as designed. Materials and/or components are non-compliant	Construction may be delayed Costs may increase.	Construction / Commissioning	0.25	Medium	$215	$430	$645	0.5	1	1.5	BNL/Contractor monthly project support cost	Early involvement of commissioning agent and development of commissioning plan	Mitigate	Consider early involvement of commissioning agent	Final Commissioning	
30	Inclement Weather "Act of God" Natural Disasters	4. Schedule 3. Cost	6/8/16		CM	Inclement weather inhibits or prevents certain construction activities.	Inclement weather or "Act of God" inhibits or prevents critical construction activities.	Construction	0.95	Low	$104	$208	$365	0.125	0.25	0.5	BNL/Contractor monthly project support costs plus allowance for cost of temporary protection and damage $50K/$100K/$150K	Scheduling of Construction Activities. Apply adequate schedule contingency based on potential weather delay.	Avoid/ Accept	Plan construction activities to avoid exterior work during seasons of likely adverse weather conditions.	Substantial Completion	
31	Delays Due to Organized Labor	4. Schedule 3. Cost	6/8/16		CM	Labor disputes result in work stoppage, delays, or subcontractor replacement.	Construction may be delayed. Increase schedule duration results in increased management costs	Construction	0.5	Very Low	$0	$108	$215	0	0.25	0.5	BNL/Contractor monthly project support costs	Conduct market surveys to determine the potential for labor disputes and disruptions in the local market.	Mitigate	Open communications with unions and contractor.	Substantial Completion	
32	Claims & Disputes	3. Cost	6/8/16		Procurement	Significant construction claims and disputes	Increase cost	Construction / Close-out	0.5	Medium	$242	$484	$726	1	2	3	Extended General Conditions	Accurate documentation of schedule performance and change orders. Execute a CM/GC project execution methodology	Mitigate	Continuous involvement and communication with Sr. Procurement Manager.	Substantial Completion/ Contract Close-out	

Brookhaven National Laboratory - Core Facility Revitilization (CFR) Project

Project Contingency Analysis - 7/31/2016

No.	Risk Title	Probability of Event (percentage)	Current Cost Impact Estimates (Use $K) O: Optimistic, ML: Most Likely, P: Pessimistic			Schedule Impact (Use time in months) O: Optimistic, ML: Most Likely, P: Pessimistic			Weighted Impact (Use $K) Probability x Cost Impact O: Optimistic, ML: Most Likely, P: Pessimistic			Weighted Impact (Time in Months) Probability x Duration O: Optimistic, ML: Most Likely, P: Pessimistic		
			O	ML	P	O	ML	P	O	ML	P	O	ML	P
WBS 1.0- General Project Risks														
1	Continuing Resolution Beyond Base Assumptions Cause Delays	0.65	$0	$430	$860	0	1	2	$0	$280	$559	0	0.65	1.3
2	Late Approval of Critical Decisions - BNL	0.1	$0	$188	$376	0	1	2	$0	$19	$38	0	0.1	0.2
3	Late Approval of Critical Decisions - DOE	0.1	$0	$188	$376	0	1	2	$0	$19	$38	0	0.1	0.2
4	Funding Profile Changes	0.25	$0	$430	$860	0	1	2	$0	$108	$215	0	0.25	0.5
5	Change in Management / BNL Project Personnel	0.1	$0	$215	$430	0	0.5	1	$0	$22	$43	0	0.05	0.1
6	Inadequate BNL Resources	0.1	$0	$215	$430	0	0.5	1	$0	$22	$43	0	0.05	0.1
	WBS 1.0 Totals		$0	$1,666	$3,332	0	5.0	10	$0	$468	$935	0.0	1.2	2.4
WBS 1.01 - Project Design and Engineering														
7	Failure to Capture User Requirements	0.2	$329	$873	$1,524	0.25	1	2	$66	$175	$305	0.05	0.2	0.4
8	Significant Increase in Project Scope (Creep)/Design Contingency	0.75	$1,436	$2,872	$4,416	0.25	0.5	1	$1,077	$2,154	$3,312	0.1875	0.375	0.75
9	Failure to Comply with Code and Regulatory Requirements During Design	0.2	$218	$436	$762	0.25	0.5	1	$44	$87	$152	0.05	0.1	0.2
10	Limited Competition results in higher than expected cost	0.3	$1,107	$2,429	$3,752	0	0.5	1	$332	$729	$1,125	0	0.15	0.3
11	Design Estimate exceeds project budget	0.2	$0	$188	$376	0	1	2	$0	$38	$75	0	0.2	0.4
12	Increasing Cost Escalation Rates Results in Higher Construction Cost	0.25	$443	$1,215	$2,429	0	0.25	0.5	$111	$304	$607	0	0.0625	0.125
	WBS 1.01 Totals		$3,533	$8,014	$13,259	0.75	3.8	7.5	$1,629	$3,486	$5,577	0.2875	1.1	2.175

No.	Risk Title	Probability of Event (percentage)	Current Cost Impact Estimates (Use $K) O: Optimistic, ML: Most Likely, P: Pessimistic			Schedule Impact (Use time in months) O: Optimistic, ML: Most Likely, P: Pessimistic			Weighted Impact (Use $K) Probability x Cost Impact O: Optimistic, ML: Most Likely, P: Pessimistic			Weighted Impact (Time in Months) Probability x Duration O: Optimistic, ML: Most Likely, P: Pessimistic		
			O	ML	P	O	ML	P	O	ML	P	O	ML	P
WBS 1.02 - Construction														
13	User Generated Scope Changes During Construction	0.9	$658	$1,094	$1,531	0.5	1	1.5	$592	$985	$1,378	0.45	0.9	1.35
14	Design Errors and/or Omissions	0.6	$329	$658	$1,094	0.25	0.5	1	$197	$395	$657	0.15	0.3	0.6
15	Failure to comply with OCMED / Safety Program requirements	0.1	$0	$94	$188	0	0.5	1	$0	$9	$19	0	0.05	0.1
16	CM/GC Construction Contract Not Awarded	0.05	$564	$752	$940	3	4	5	$28	$38	$47	0.15	0.2	0.25
17	Logistical issues with the isolation of existing building systems.	0.6	$158	$315	$580	0.25	0.5	1	$95	$189	$348	0.15	0.3	0.6
18	Construction delays due to work in occupied areas of buildings.	0.3	$158	$315	$473	0.25	0.5	0.75	$47	$95	$142	0.075	0.15	0.225
19	Sub-contractor Default	0.05	$188	$376	$564	1	2	3	$9	$19	$28	0.05	0.1	0.15
20	A/E failure to provide engineering support in a timely fashion	0.1	$0	$108	$215	0	0.25	0.5	$0	$11	$22	0	0.025	0.05
21	Unforeseen field conditions	0.95	$265	$530	$795	0.5	1	1.5	$252	$504	$755	0.475	0.95	1.425
22	Minor Event or Injury that does not trigger an investigation	0.15	$0	$108	$215	0	0.25	0.5	$0	$16	$32	0	0.0375	0.075
23	Significant Event or Injury that does trigger an investigation	0.01	$108	$215	$430	0.25	0.5	1	$1	$2	$4	0.0025	0.005	0.01
24	Construction delays attributable to BNL Management and/or policy changes	0.25	$108	$215	$323	0.25	0.5	0.75	$27	$54	$81	0.0625	0.125	0.1875
25	Failure to remove all known contaminated materials/equipment from work site prior to start of construction. (Legacy contamination)Unknown Hazardous Material	0.75	$258	$515	$880	0.25	0.5	1	$193	$386	$660	0.1875	0.375	0.75

No.	Risk Title	Probability of Event (percentage)	Current Cost Impact Estimates (Use $K) O: Optimistic, ML: Most Likely, P: Pessimistic			Schedule Impact (Use time in months) O: Optimistic, ML: Most Likely, P: Pessimistic			Weighted Impact (Use $K) Probability x Cost Impact O: Optimistic, ML: Most Likely, P: Pessimistic			Weighted Impact (Time in Months) Probability x Duration O: Optimistic, ML: Most Likely, P: Pessimistic		
			O	ML	P	O	ML	P	O	ML	P	O	ML	P
26	Not Used	0	$0	$0	$0	0	0	0	$0	$0	$0	0	0	0
27	Construction Material / Raw Material Shortfall / Availability	0.25	$265	$530	$795	0.5	1	1.5	$66	$133	$199	0.125	0.25	0.375
28	Delays in procurement or the approval process	0.25	$215	$430	$645	0.5	1	1.5	$54	$108	$161	0.125	0.25	0.375
29	Building system performance, materials, or components do not meet design criteria.	0.25	$215	$430	$645	0.5	1	1.5	$54	$108	$161	0.125	0.25	0.375
30	Inclement Weather "Act of God" Natural Disasters	0.95	$104	$208	$365	0.125	0.25	0.5	$99	$197	$347	0.1188	0.2375	0.475
31	Delays Due to Organized Labor	0.5	$0	$108	$215	0	0.25	0.5	$0	$54	$108	0	0.125	0.25
32	Claims & Disputes	0.5	$242	$484	$726	1	2	3	$121	$242	$363	0.5	1	1.5
			$3,832	$7,483	$11,618	9.125	17.5	27.0	$1,835	$3,542	$5,510	2.7	5.6	9.1
	Total		$7,365	$17,163	$28,209	9.9	26.3	44.5	$3,464	$7,496	$5,511	5.03	7.9	13.7

Total "Most Likely" Weighted Impact **$7,496** **7.9** **Months**