Appendix C

Risk Management Plan
for
The BNL Center for Functional Nanomaterials

At
Brookhaven National Laboratory
Upton, New York 11973

May, 2004

Risk Management Plan
for
The BNL Center for Functional Nanomaterials

Approved by:

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CFN Director
Brookhaven National Laboratory

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Table of Contents

Risk Management Plan
for
The BNL Center for Functional Nanomaterials

1.0 INTRODUCTION

Risks anticipated for the Brookhaven National Laboratory (BNL) Center for Functional Nanomaterials (CFN) project will be managed using a tailored approach in accordance with the methodology identified in the DOE M 413.3-1, Project Management for the Acquisition of Capital Assets. The CFN Risk Management Plan (RMP) identifies the scope of the project's risk definition and delineates the methodology that has been used to identify, quantify, and assess risks. The level of treatment is graded based on the level of risk determined. The RMP identifies the controls and processes used to identify and mitigate areas of cost, scope, schedule, and technical risk that may occur during project planning and implementation. The RMP will be maintained and updated throughout the life of the project.

2.0 PROJECT DESCRIPTION

The project scope includes the design and construction of a laboratory building and the acquisition of the requisite instrumentation to support the targeted nanoscience thrust areas and laboratory functions.

The CFN facility will be a two-story building of approximately 94,500 square feet, housing clean rooms, wet and dry laboratories, office space for BNL staff and users, and conference rooms. The building will incorporate human factors into its design so as to encourage peer interactions and collaborative visits between BNL staff and users. In addition to offices and laboratories, it will house "interaction areas" for informal discussions on each floor to foster scientific discourse. This design approach is commonly regarded as the state-of-the-art in research facility design. Material and system selections will address the principles of sustainable design to insure low energy and maintenance costs over the life of the building. Design features will be incorporated into the building design that account for the sensitivity of nanoscience instrumentation, i.e., vibration isolation, temperature controls as precise as +/- 0.1 degrees C, and shielding from electromagnetic interference.

The CFN will operate through major laboratory clusters: including facilities for nanopatterning fabrication, ultrafast short wavelength sources, electron microscopy, materials synthesis, proximal probes surface characterization, theory and computation, and an endstation at an NSLS beamline optimized for nanoscale characterization using small angle scattering. An initial set of scientific equipment for these laboratories will be purchased as part of the project. The NSLS provides a wide range of imaging, spectroscopy, and diffraction/scattering techniques. In order to take advantage of these features, including the NSLS endstation, the CFN Users will have access to a suite of existing beamlines at the NSLS including: soft x-ray microscopy beamlines; UV, soft and hard x-ray spectroscopy beamlines; soft and hard x-ray scattering beamlines; an infrared spectro-microscopy beamline; an undulator insertion device microprobe beamline; and an undulator insertion device nanoprobe beamline.

The BNL Center for Functional Nanomaterials will be a new building located across the street from the existing NSLS to complement the existing functions of that facility. Siting of the Center will take advantage of proximity to the Instrumentation Division (Building 535), the Physics (Building 510), Materials Science (Building 480), and NSLS (Building 725) Departments, which are key interdisciplinary participants in nanoscience research.

3.0 RISK ASSESSMENT METHODOLOGY

The CFN Project Manager has overall responsibility for implementing the RMP during the design and construction phases of the project. However, the CFN Risk Management Team (see Attachment A) will develop and document an organized, comprehensive, and inactive strategy, as well as methods for identifying and tracking risk areas. The methodology that was used for the CFN RMP was as follows:

The CFN Risk Management Team performed the risk identification and analysis with input from BNL engineering and technical divisions. Risk identification was based on team experience with similar projects, lessons learned from previous BNL projects, knowledgeable personnel input, and lessons learned from other DOE Nanoscale Science Research Centers. The risks were analyzed and mitigation actions were identified and documented. The risk assessment will be performed periodically during the duration of the project.

4.0 RISK REPORTING, TRACKING, AND CLOSEOUT

Risk reporting involves documenting risk identification, risk quantification, risk handling strategies, impact determination, and risk closeout. Risk tracking involves monitoring action items from risk handling strategies/responses, identifying a need to evaluate new risks, and re-evaluating changes to previous risks. Risk closeout is assigning risk associated action items to a responsible individual and identifying a completion date. Completion dates are tracked and each action item status updated until closeout.

5.0 CRITERIA FOR RISK IDENTIFICATION AND ASSESSMENT

5.1 Likelihood of Occurrence

- Very Likely (VL): risk is likely to occur with a probability greater than or equal to 90%
- Likely (L): risk is likely to occur with a probability greater than or equal to 50%
- Unlikely (U): There is a less than 50% chance that this event will occur

5.2 Expected Consequence

Consequence will identify impact that occurrence of this event will have on cost, schedule and/or technical performance of the facility/equipment. Each issue will be evaluated on these three.

	Marginal (M)	**Significant (S)**	**Critical (C)**
Cost impact on the project's contingency is:	≤$100K	$100K - $500K	>$500K
Schedule: Impact on the project schedule is:	None	Impacts milestone dates	Impacts project finish date
Technical: Impact on performance is:	Minor degradation	Significant degradation	CD-4b will not be met

5.3 Risk Categorization Matrix

Seriousness			
Likelihood of Occurrence	Marginal	Significant	Critical
Very Likely	Medium	High	High
Likely	Low	Medium	High
Unlikely	Low	Low	Medium

6.0 ASSESSMENT RESULTS

This section presents the results of the specific risk assessments that were conducted for each of the identified project areas of consideration.

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Design

2. POTENTIAL EVENT #1:

The cost estimate for the project during design increases due to scope creep.

3. LIKELIHOOD OF OCCURRENCE:

Likely

4. EXPECTED CONSEQUENCE:

Cost Overruns due to scope creep.

5. SERIOUSNESS: Significant

6. RISK CATEGORIZATION: Medium

7. ACTIONS REQUIRED? YES X **NO** ___

8. LIKELY CAUSE(S):

During design the scope increases due to customer requests or design enhancements not in the Conceptual Design Report.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

During the preparation of drawings and specifications the CFN Director and Project Manager will maintain close control of scope. Scope changes are discussed at each project meeting and the changes and associated costs are closely monitored. "Design to budget" requirements are included in the Title I and II design contract. Adequate contingency has been assigned to the project WBS elements.

Responsible Individual(s): R. Hwang, CFN Director
M. Schaeffer, CFN Project Manager

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Design

2. POTENTIAL EVENT #2:

Schedule delays due to inadequate coordination and customer response to A/E inquiries.

3. LIKELIHOOD OF OCCURRENCE:

Unlikely

4. EXPECTED CONSEQUENCE:

Delays in the design resulting in the late delivery of the completed design package.

5. SERIOUSNESS: Marginal

6. RISK CATEGORIZATION: Low

7. ACTIONS REQUIRED? YES __X__ NO_____

8. LIKELY CAUSE(S):

Inadequate coordination between BNL and the A/E and inadequate tracking and timely response to A/E questions. A/E does not adequately address the design review comments.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

The A/E and BNL Integrated Project Team hold bi-weekly coordination meetings. Project status and design questions are discussed, answered, and documented in the meeting minutes. A CFN Action Items Tracking List is maintained and reviewed at each meeting for any outstanding items which could not be immediately resolved in the meeting.

Responsible Individual(s): O. Dyling, Conventional Construction Design Manager
M. Fallier, Conventional Construction Manager

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Design

2. POTENTIAL EVENT #3:

Design changes.

3. LIKELIHOOD OF OCCURRENCE:

Very Likely

4. EXPECTED CONSEQUENCE:

Increase cost.

5. SERIOUSNESS: Marginal

6. RISK CATEGORIZATION: Medium

7. ACTIONS REQUIRED? YES __X__ NO_____

8. LIKELY CAUSE(S):

Changes in selection of technical equipment. Customer requests.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

An A/E with laboratory and nanoscience design experience will be selected and frequent design meetings will be held with customers. Technical equipment list will change only with the approval of the CFN Director and Project Manager. A design will be provided that has flexibility in laboratory layout and an expandable "footprint".

Responsible Individual(s): O. Dyling, Conventional Construction Design Manager
M. Fallier, Conventional Construction Manager

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Design

2. POTENTIAL EVENT #4:

Development of a Fresnel Beamplate is delayed or unsuccessful.

3. LIKELIHOOD OF OCCURRENCE:

Unlikely

4. EXPECTED CONSEQUENCE:

The improvement of the resolution of the beam by an order of magnitude will not happen.

5. SERIOUSNESS: Significant

6. RISK CATEGORIZATION: Low

7. ACTIONS REQUIRED? YES __X__ NO_____

8. LIKELY CAUSE(S):

This development program is separately funded by BES and is being performed jointly with Argonne National Laboratory. Funding by BES can change or be delayed affecting the schedule of the endstation. The developmental program can be unsuccessful.

10. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

The technology will improve the resolution of the beam by an order of magnitude. This improvement is required to meet the technical objectives for the endstation. An existing state-of-the-art beamplate can be used if the new beamplate development is delayed or unsuccessful. This may however reduce functionality of the endstation performance and impact the beamline from a cost and schedule viewpoint.

Responsible Individual(s): R. Hwang, CFN Director
R. Pindak, CFN Endstation at NSLS Facility Leader

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Construction

2. POTENTIAL EVENT #5:

Higher construction costs and/or non-competitive bids

3. LIKELIHOOD OF OCCURRENCE:

Likely

4. EXPECTED CONSEQUENCE:

Increase cost.

5. SERIOUSNESS: Critical

6. RISK CATEGORIZATION: High

7. ACTIONS REQUIRED? YES __X__ NO_____

8. LIKELY CAUSE(S):

There are several possible causes for the bids to be over the construction estimate. The construction estimate may not have been accurately prepared, the estimators did not take into account the bidding climate on Long Island or the number of qualified General Contractors in the region. The construction documents may not have been adequately prepared.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

The A/E is required to "design to budget" and to prepare a set of construction documents to ensure adequate design is reflected. If bids are over the cost estimate the IPT/DOE may elect to award the contract with the use of contingency or have the A/E redesign the project to bring it within the budget. An Independent Cost Estimate will be prepared during Title II for the building. Alternates will be used as well as increased advertising in trade journals to increase competition. Adequate contingency has been assigned to the building construction.

Responsible Individual(s): M. Fallier, Conventional Construction Manager
M. Schaeffer, CFN Project Manager

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Construction

2. POTENTIAL EVENT #6:

Construction delays and field changes.

3. LIKELIHOOD OF OCCURRENCE:

Likely

4. EXPECTED CONSEQUENCE:

Increased cost and schedule impacts.

5. SERIOUSNESS: Significant

6. RISK CATEGORIZATION: Medium

7. ACTIONS REQUIRED? YES _X_ NO____

8. LIKELY CAUSE(S):

Delays due to schedule inadequacies and poor construction management. Delays in delivery of equipment and materials. Changes in the field due to design errors and omissions or customer changes to the facility after contract award.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

Design oversight is done by the BNL Plant Engineering (EP) Design Group. BNL will review the A/E design on a regular basis to ensure an adequate design is reflected in the drawings and specifications. BNL will evaluate the schedule and variances on an ongoing basis. Adequate schedule and cost contingency has been assigned to cover field changes.

Responsible Individual(s): M. Fallier, Conventional Construction Manager

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Construction

2. POTENTIAL EVENT #7:

Construction contractor unfamiliar with construction requirements for a clean room facility. Therefore adequate quality construction is not performed and the cleanliness requirements are not met.

3. LIKELIHOOD OF OCCURRENCE:

Unlikely

4. EXPECTED CONSEQUENCE:

Project delays and increased cost.

5. SERIOUSNESS: Significant

6. RISK CATEGORIZATION: Low

7. ACTIONS REQUIRED? YES _X_ **NO** ___

8. LIKELY CAUSE(S):

Construction contractor has no previous experience in the construction of clean room facilities.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

The specification and the request for proposal shall require that the construction contractor be evaluated based on previous experience in clean room (and laboratory) construction, safety, and other factors to ensure Best-Value to the Government. Proper protocols during construction of the clean room will be included in the specifications and contractor protocols will be submitted and reviewed with the contractor bids. The A/E has extensive experience to in the preparation of protocols.

Responsible Individual(s): M. Fallier, Conventional Construction Manager

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE**: May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Construction

2. POTENTIAL EVENT #8:

Construction contractor unfamiliar with construction requirements for a laboratory/clean room facility. Therefore adequate quality construction is not performed and the EMI, Vibration and Acoustic Requirements are not met.

3. LIKELIHOOD OF OCCURRENCE:

Unlikely

4. EXPECTED CONSEQUENCE:

Facility does not meet the EMI, Vibration and Acoustic Requirements for the effective operation of the instruments.

5. SERIOUSNESS: Critical

6. RISK CATEGORIZATION: Medium

7. ACTIONS REQUIRED? YES __X__ **NO**____

8. LIKELY CAUSE(S):

Construction Contractor does not follow the drawings and specifications for grounding, routing power, and installing design features to mitigate vibrations and acoustics.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

The specification and the request for proposal shall require that the construction contractor be evaluated based on previous experience in clean room (and laboratory) construction, safety, and other factors to ensure Best-Value to the Government. A/E Field Engineer and BNL Construction oversight staff will be in the field daily to adequately manage and inspect construction to ensure that the Construction Contractor follows the CFN drawings and specifications in the field. These critical areas will be discussed with engineering and scientific team members at the weekly construction meeting.

Responsible Individual(s): O. Dyling, Conventional Construction Design Manager
M. Fallier, Conventional Construction Manager

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Construction

2. POTENTIAL EVENT #9:

Settlement of the west parking lot.

3. LIKELIHOOD OF OCCURRENCE:

Unlikely

4. EXPECTED CONSEQUENCE:

Functionality and use of west parking lot may be at risk.

5. SERIOUSNESS: High

6. RISK CATEGORIZATION: Medium

7. ACTIONS REQUIRED? YES __X__ **NO**_____

8. LIKELY CAUSE(S):

Inadequate compaction of loose fill from prior building foundation removal.

11. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

Special attention will be taken during construction of the west parking lot. Soil borings have been taken over the CFN building site indicating where material has to be removed and replaced with structural fill. The specifications will identify where structural fill will be required. Adequate contingency has been assigned to cover potential field changes during excavation.

Responsible Individual(s): O. Dyling, Conventional Construction Design Manager
M. Fallier, Conventional Construction Manager

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

ESH&Q issues

2. POTENTIAL EVENT #10:

Unplanned ESH&Q issues need to be resolved.

3. LIKELIHOOD OF OCCURRENCE:

Unlikely

4. EXPECTED CONSEQUENCE:

Increase cost or delay completion.

5. SERIOUSNESS: Significant

6. RISK CATEGORIZATION: Low

7. ACTIONS REQUIRED? YES _X_ **NO**____

8. LIKELY CAUSE(S):

Unplanned environmental impact or inadequate hazard identification.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

The impacts of ESH&Q issues are well acknowledged. A Preliminary Hazards Analysis (PHA) has been developed which identifies hazards and appropriate mitigation techniques. A NEPA review of this project has been conducted and the project has been determined to be Categorically Excluded (CX) from further NEPA review based on negligible environmental impact. The results of both the PHA and NEPA review will be re-examined on an annual basis to provide assurance that the bases for the conclusions of these analyses have not changed.

Responsible Individual(s): S. Hoey, ESH&Q Coordinator

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Procurement of Technical Equipment

2. POTENTIAL EVENT #11:

Technical Equipment does not meet the specified requirements.

3. EVENT LIKELIHOOD:

Likely

4. EXPECTED CONSEQUENCE:

Technical Equipment would not operate properly.

5. SERIOUSNESS: Critical

6. RISK CATEGORIZATION: High

7. ACTIONS REQUIRED? YES _X_ **NO**____

8. LIKELY CAUSE(S):

Vendor does not have previous experience in building the required type of technical equipment or does not properly build and test the equipment prior to delivery.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

Specifications and procurement documents to include QA, inspection and testing requirements for each critical piece of technical equipment. Vendors will be required to have successful previous experience in building the equipment. BNL will perform necessary QA and test inspections to ensure that the vendors are meeting the technical specifications and equipment performance prior to delivery.

Responsible Individual(s): P. Simons, Technical Procurement Manager
A. Moodenbaugh, Technical Equipment Coordinator
T. Vogt, Technical Equipment Coordinator

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Procurement of Technical Equipment

2. POTENTIAL EVENT #12:

Change in the required type of technical equipment based upon ongoing development of research focus topics with the future user community.

3. EVENT LIKELIHOOD:

Likely

4. EXPECTED CONSEQUENCE:

The list of technical equipment in the current baseline would change, with concurrence from DOE.

5. SERIOUSNESS: Marginal

6. RISK CATEGORIZATION: Low

7. ACTIONS REQUIRED? YES _X_ NO____

8. LIKELY CAUSE(S):

Changes in nanoscience R&D focus and direction.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

Maximize the interactions with the future user community during the design phase, prior to placing orders. Long lead time items will be ordered early in the process. Scientific team members are included in the design review process to insure that they have an awareness of the consequences of such changes and the need for early notification of potential problems.

Responsible Individual(s): R. Hwang, CFN Director

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Construction of Conventional Facilities and Procurement of Technical Equipment

2. POTENTIAL EVENT #13:

Delay in DOE construction/procurement funding for the project.

3. EVENT LIKELIHOOD:

Likely

4. EXPECTED CONSEQUENCE:

If funding is not received (delayed) as shown on the Project Data Sheet some major technical equipment orders may not be placed and/or construction of the building may not be awarded. Any delay in receiving funding would result in delayed schedules and increased costs.

5. SERIOUSNESS: Significant

6. RISK CATEGORIZATION: Medium

7. ACTIONS REQUIRED? YES _X_ NO____

8. LIKELY CAUSE(S):

Congress not passing legislation in a timely manner. BES Program Office changing funding profile.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

Perform the maximum amount of work possible with existing funds and contingency. Maintain original construction and equipment delivery dates by increasing the monthly effort on these tasks after construction/procurement start is approved and funded. Continuous communication with BES Program Office to maintain current funding profile.

Responsible Individual(s): R. Hwang, CFN Director
M. Schaeffer, CFN Project Manager

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Procurement of Technical Equipment

2. POTENTIAL EVENT #14:

Increase in cost due to foreign procurements.

3. EVENT LIKELIHOOD:

Likely

4. EXPECTED CONSEQUENCE:

Increase in cost of specific items based on the value of the dollar compared to the value of the currency in the country in which the equipment is manufactured.

5. SERIOUSNESS: Significant

6. RISK CATEGORIZATION: Medium

7. ACTIONS REQUIRED? YES _X_ **NO** ___

8. LIKELY CAUSE(S):

Changes in the value of the dollar due to the international economic situation.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

The most recent cost estimates took into account the value of the dollar in the summer/fall of 2003. Procurement plans will fix prices of technical equipment as early as possible for expensive equipment procured in foreign countries.

Responsible Individual(s): R. Hwang, CFN Director

RISK MITIGATION ASSESSMENT AND PLAN

PROJECT TITLE: Center for Functional Nanomaterials	**DATE:** May, 2004

1. PROJECT ELEMENT, STEP, OR ACTIVITY:

Stakeholder issues

2. POTENTIAL EVENT #15:

Concerned stakeholder creates hold on project.

3. EVENT LIKELIHOOD:

Likely

4. EXPECTED CONSEQUENCE:

Construction delays and poor public relations.

5. SERIOUSNESS: Marginal

6. RISK CATEGORIZATION: Low

7. ACTIONS REQUIRED? YES _X_ NO____

8. LIKELY CAUSE(S):

Failure to properly address stakeholders needs and concerns.

9. MITIGATION ACTION(S) RESPONSIBILITY / SCHEDULE:

Public workshops to identify stakeholder needs and concerns. CFN website and newsletter to advise stakeholders of important CFN activities and project status.

Responsible Individual(s): R. Hwang, CFN Director

7.0 CONTINGENCY RISK

CFN CONTINGENCY RISK												
		Conv/Tech Design			Constr/Equip Procurement			Schedule			Total	
Task Groups	Estimate	Risk	Weight %	%	Risk	Weight %	%	Risk	Weight %	%	Total %	$
1.1 Project Support	**8,538,000**											
1.1.1 Project Management	4,166,000	2	2.0%	4.0%	1	2.0%	2.0%	2	2.0%	4.0%	10.0%	417,000
1.1.2 Project Engineering	4,372,000	2	2.0%	4.0%	1	2.0%	2.0%	2	2.0%	4.0%	10.0%	437,000
1.2 Technical Equipment	**26,393,000**											
1.2.1 Nanopatterning	7,472,000	2	2.0%	4.0%	2	3.6%	7.2%	2	3.0%	6.0%	17.2%	1,286,000
1.2.2 Ultrafast Optical Sources	3,042,000	2	2.0%	4.0%	2	3.5%	7.0%	2	3.0%	6.0%	17.0%	517,000
1.2.3 Electron Microscopy	5,850,000	2	2.0%	4.0%	2	3.6%	7.2%	2	3.0%	6.0%	17.2%	1,007,000
1.2.4 Materials Synthesis	2,759,000	2	2.0%	4.0%	2	3.5%	7.0%	2	2.0%	4.0%	15.0%	414,000
1.2.5 Proximal Probes	5,628,000	2	2.0%	4.0%	2	3.5%	7.0%	2	2.0%	4.0%	15.0%	844,000
1.2.6 Theory & Computation	602,000	2	2.0%	4.0%	2	2.0%	4.0%	1	2.0%	2.0%	10.0%	60,000
1.2.7 CFN Endstations at NSLS	1,040,000	2	2.0%	4.0%	2	3.5%	7.0%	2	3.0%	6.0%	17.0%	177,000
1.3 Conventional Construction	**32,349,000**											
1.3.1 Improvements to Land	865,000	0	0%	0%	2	2.4%	4.8%	2	2.5%	5.0%	9.8%	85,000
1.3.2 Building	26,957,000	0	0%	0%	2	5.8%	11.6%	3	3.0%	9.0%	20.6%	5,553,000
1.3.3 Utilities	3,700,000	0	0%	0%	2	5.0%	10.0%	2	3.0%	6.0%	16.0%	592,000
1.3.4 Other Construction Costs	827,000	0	0%	0%	2	2.0%	4.0%	3	2.0%	6.0%	10.0%	83,000
1.4 Standard Equipment	**903,000**	0	0%	0%	1	5.0%	5.0%	0	0%	0%	5.0%	45,000
	68,183,000										Cont. 16.9%	11,517,000
												68,183,000
											TEC	**79,700,000**
1.5 Other Project Costs												
1.5.1 Conceptual Design Report												280,000
1.5.2 NEPA Documentation												10,000
1.5.3 Hazards Analysis												10,000
1.5.4 Bldg/LEED Commissioning												275,000
1.5.5 Final Hook-up & Testing												490,000
1.5.6 Move-in Costs												100,000
1.5.7 Other Project-Related Costs												135,000
											TPC	**81,000,000**

8.0 RISK FACTORS AND WEIGHT TABLE

CFN			
Risk Factors			
Factors	**Convent/Technical Design**	**Construction/Equipment Procurement**	**Schedule**
1	Standard Design	Std office or storage bldg. Construction Std off the shelf equipment No contamination	
2	Nonstandard bldg. Design	Non-standard construction Standard commercially available equipment No contamination	Delay will not impact other areas
3	Special Expertise needed for design	Special construction	Delay impacts critical path activities
5	Some new R&D design		
8	Complete R&D design	R&D construction and or matl-equipment Contamination identified but not quantified	

Weight for Risk Areas	
Area	**Cost Weight Factor Range**
Conventional/Technical Design	2 to 4%
Construction or Equipment Procurement	2 to 6%
Schedule	2 to 4%

9.0 RISK FACTORS AND COST WEIGHTING DESCRIPTION FOR CFN CONTINGENCY RISK ANALYSIS

WBS 1.1 Project Support:

The contract for the Title I and II design is a fixed priced contract. Currently, Title I design is completed and has been reviewed by the BNL Integrated Project Team and has been estimated. The work that remains during the design phase is the Title II detail design and preparations of the specifications and the statement of work for the Construction Request for Proposal.

The risk of changes during construction is due to the identification of errors and omissions in the design package and differing site conditions. Field changes and differing site conditions result in schedule delays. These impacts on construction would also impact the amount and duration of BNL project management and construction support required.

Design and schedule risk factor of 2 was assigned and construction/procurement risk factor of 1 was assigned. Cost weight factor of 2% was assigned. A total of 10.0% contingency has been assigned to WBS 1.1.

WBS 1.2 Technical Equipment:

The technical equipment will be standard commercially available equipment. The risks of changes during procurement are due to possible changes in the type and quality of equipment procured due to advancement of equipment technology or changes in the research focus of the CFN. More than 50% of this equipment will be procured from a foreign country that makes the price vulnerable to currency fluctuations. Currently, we are anticipating that we will not owe import duty since this is research equipment that is not available from a USA manufacturer. Design, procurement, and schedule risk factors of 2 were assigned (risk factor 1 for Theory and Computation Schedule) with cost weighting ranging from 2 to 3.6%. A total of 15.8% contingency has been assigned to WBS 1.2.

WBS 1.3 Conventional Construction:

The construction contract will be competitively bid based on the bid package of drawings and specifications issued by the A/E. The contract will be a fixed price award with specified performance period; the contractor must meet specific criteria including adequate experience in this type of construction. The risk of changes during construction is due to the identification of errors and omissions in the design package, and differing site conditions. Also there is the risk that market conditions will change from the current conditions and the bid prices would exceed our estimate. Field changes and differing site conditions would delay the schedule for the installation of equipment. Design, construction, and schedule risk factors ranged from 0 to 3 with a cost weighting ranging from 0 to 5.8%. A total of 19.0% contingency has been assigned of WBS 1.3.

WBS 1.4 Standard Equipment:

This includes office furniture, personal computers, blinds and equipment that are off the shelf or only require nominal engineering. A procurement risk factor of 1 was assigned with a cost weighting of 5%. No schedule risk was assigned. A total of 5.0% contingency was assigned to WBS 1.4.

10.0 CONTINGENCY TABLE

BNL CENTER FOR FUNCTIONAL NANOMATERIALS
CONTINGENCY TABLE

FY 2003 START

WBS #	DESCRIPTION	LEVEL 3			LEVEL 2			LEVEL 1		
		%	Burden $	Contingency $	%	Burden $	Contingency $	%	Burden $	Contingency $
1.0	CENTER FOR FUNCTIONAL NANOMATERIALS							16.9%	68,183	11,517
1.1	PROJECT SUPPORT				10.0%	8,538	854			
1.1.1	PROJECT MGT.	10.0%	4,166	417						
1.1.2	PROJECT ENGINEERING	10.0%	4,372	437						
1.2	TECHNICAL EQUIPMENT				15.8%	26,393	4,306			
1.2.1	NANOPATTERNING	17.2%	7,472	1,286						
1.2.2	ULTRAFAST OPTICAL SOURCES	17.0%	3,042	517						
1.2.3	ELECTRON MICROSCOPY	17.2%	5,850	1007						
1.2.4	MATERIALS SYNTHESIS	15.0%	2,759	414						
1.2.5	PROXIMAL PROBES	15.0%	5,628	844						
1.2.6	THEORY & COMPUTATION	10.0%	602	60						
1.2.7	CFN ENDSTATIONS AT NSLS	17.0%	1,040	177						
1.3	CONVENTIONAL CONSTRUCTION				19.0%	32,349	6,313			
1.3.1	IMPROVEMENTS TO LAND	9.8%	865	85						
1.3.2	BUILDING	20.6%	26,957	5,553						
1.3.3	UTILITIES	16.0%	3,700	592						
1.3.4	OTHER CONSTRUCTION COSTS	10.0%	827	83						
1.4	STANDARD EQUIPMENT				5.0%	903	45			

Attachment A

The BNL Center for Functional Nanomaterials
at
Brookhaven National Laboratory

CFN Risk Management Team

I. Charge

The CFN Risk Management Team shall develop and document an organized, comprehensive, and inactive strategy, as well as methods for identifying and tracking risk areas, developing risk handling plans, performing continuous risk assessments to determine how risks have changed, and assigning adequate resources. The CFN Risk Management Team may also require support from experts knowledgeable in risk areas essential to the success of the CFN Project. The CFN Risk Management Team will follow the process below to ensure a successful risk management program.

- Assess project risks using this process and develop strategies to manage risks throughout each acquisition phase.
- Identify at an early stage and intensively manage design parameters that critically affect cost, capability, or readiness.
- When necessary use technology demonstrations/modeling/simulation and aggressive prototyping to reduce risks.
- Evaluate and test preliminary results of the risk management process as a means to better quantify these results.
- Include industry and user representatives in risk management.
- Use development test and evaluation when appropriate.
- Establish a series of "risk assessment reviews" to evaluate the effectiveness of risk management against clearly defined success criteria.
- Establish the means and format to communicate risk information and to train participants in risk management.
- Prepare an assessment training package for members of the Integrated Project Team and others, as needed.
- Retire risks as appropriate
- Acquire approval of accepted risks at the appropriate decision level.

All essential participants, including users are to be part of the assessment process so that an acceptable balance among performance, scope, schedule, cost, and risk can be reached.

II. Background

Risk has always been a concern in the acquisition of DOE capital assets. The acquisition process is designed, to a large degree, to allow risks to be controlled from conception to delivery. Often, managers view risk as something to be avoided, yet the projects are often complex, technically challenging, and costly. All of this translates to risk. Because risk is inherent in all projects regardless of the complexity and other factors the objective is not to avoid risks but to understand them and control them.

The key to successful risk management is early planning, unbiased assessments, and aggressive execution. Good planning enables an organized, comprehensive, and iterative approach for identifying and assessing the risk and handling options necessary to successfully carry out the acquisition of a capital asset. Risk assessment and identification should be 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. Managers should continuously update acquisition and risk assessments and modify their management strategies accordingly.

The CFN project scope includes the design and construction of a laboratory building and the acquisition of the requisite instrumentation to support the nanoscience mission.

The CFN facility will be a two-story building of approximately 94,500 square feet, housing clean rooms, wet and dry laboratories, office space for CFN staff and users, and conference rooms. The building will incorporate human factors into its design so as to encourage peer interactions and collaborative encounters between BNL staff and users. In addition to offices, meeting rooms, and laboratories, the CFN will house “interaction areas” and lunch rooms to foster scientific discourse. This design approach is commonly regarded as the state-of-the-art in research facility design. Material and system selections will address the principles of sustainable design to insure low energy and maintenance costs over the life of the building. Design features will be incorporated into the building design that account for the sensitivity of nanoscience instrumentation, i.e., vibration isolation, temperature controls as precise as +/- 0.1 C degrees and shielding from electromagnetic interference.

The CFN will operate through major laboratory clusters: including facilities for nanopatterning fabrication, ultrafast optical sources, electron microscopy, materials synthesis, proximal probes surface characterization, theory and computation, and an endstation at an NSLS beamline optimized for nanoscale characterization using small angle scattering.

III. Membership

a. Appointed by: Associate Laboratory Director – Basic Energy Sciences
b. Term: Varies
c. Members:

Membership List	Affiliation	Term Ends
M. Schaeffer, Chair	CFN Project Manager	03/31/08
R. Hwang	CFN Director	03/31/08
J. Eng	DOE Federal Project Director	03/31/08
T. Vogt	Tech. Equipment Coordinator	03/31/08
A. Moodenbaugh	Tech. Equipment Coordinator	03/31/08
M. Fallier	Conv. Construction Manager	03/31/08
O. Dyling	Conv. Constr. Design Manager	03/30/07
A. Soueid	A/E Project Manager	03/30/07
P. Simons	Tech. Procurement Manager	03/30/07
S. Hoey	ESH&Q Coordinator	03/31/08
K. Koebel	Cost Control Manager	03/31/08
J. Taylor	Special Assistant to the ALD	03/31/08

IV. Meeting Frequency

The CFN Risk Management Team will meet on a quarterly basis, or as directed by the project Director or the Associate Laboratory Director – Basic Energy Sciences.

Attachment B – Risk Assessment Summary and Tracking Table

Risk Item	PROJECT ELEMENT	POTENTIAL EVENT	LIKELIHOOD	CONSEQUENCE	SERIOUSNESS	RISK CATEGORIZATION	ACTIONS REQUIRED	LIKELY CAUSE(S)	MITIGATION ACTION(S)	RESPONSIBILITY	SCHEDULE	STATUS
1	Design	The cost estimate for the project during design increases due to scope creep.	Likely	Cost Overruns due to scope creep.	Significant	Medium	Yes	During design the scope increases due to customer requests or design enhancements not in the Conceptual Design Report.	During the preparation of drawings and specifications the CFN Director and Project Manager will maintain close control of scope. Scope changes are discussed at each project meeting and the changes and associated costs are closely monitored. “Design to budget” requirements are included in the Title I and II design contract. Adequate contingency has been assigned to the project WBS elements.	R. Hwang, CFN Director, M. Schaeffer, CFN Project Manager	Closeout 9/30/2004	Open
2	Design	Schedule delays due to inadequate coordination and customer response to A/E inquiries.	Unlikely	Delays in the design resulting in the late delivery of the completed design package.	Marginal	Low	Yes	Inadequate coordination between BNL and the A/E and inadequate tracking and timely response to A/E questions. A/E does not adequately address the design review comments.	The A/E and BNL Integrated Project Team hold bi-weekly coordination meetings. Project status and design questions are discussed, answered, and documented in the meeting minutes. A CFN Action Items Tracking List is maintained and reviewed at each meeting for any outstanding items which could not be immediately resolved in the meeting.	O. Dyling, Conventional Construction Design Manager, M. Fallier, Conventional Construction Manager	Closeout 9/30/2004	Open
3	Design	Design changes.	Very Likely	Increase cost.	Marginal	Medium	Yes	Changes in selection of technical equipment. Customer requests.	An A/E with laboratory and nanoscience design experience will be selected and frequent design meetings will be held with customers. Technical equipment list will change only with the approval of the CFN Director and Project Manager. A design will be provided that has flexibility in laboratory layout and an expandable "footprint".	O. Dyling, Conventional Construction Design Manager, M. Fallier, Conventional Construction Manager	Closeout 9/30/2004	Open
4	Design	Development of a Fresnel Beamplate is delayed or unsuccessful.	Unlikely	The improvement of the resolution of the beam by an order of magnitude will not happen.	Significant	Low	Yes	This development program is separately funded by BES and is being performed jointly with Argonne National Laboratory. Funding by BES can change or be delayed affecting the schedule of the endstation. The developmental program can be unsuccessful.	The technology will improve the resolution of the beam by an order of magnitude. This improvement is required to meet the technical objectives for the endstation. An existing state-of-the-art beamplate can be used if the new beamplate development is delayed or unsuccessful. This may however reduce functionality of the endstation performance and impact the beamline from a cost and schedule viewpoint.	R. Hwang, CFN Director, R. Pindak, CFN Endstation at NSLS Facility Leader	Closeout 12/31/2004	Open
5	Construction	Higher construction costs and/or non-competitive bids	Likely	Increase cost.	Critical	High	Yes	There are several possible causes for the bids to be over the construction estimate. The construction estimate may not have been accurately prepared, the estimators did not take into account the bidding climate on Long Island or the number of qualified General Contractors in the region. The	The A/E is required to “design to budget” and to prepare a set of construction documents to ensure adequate design is reflected. If bids are over the cost estimate the IPT/DOE may elect to award the contract with the use of contingency or have the A/E redesign the project to bring it within the budget. An Independent Cost Estimate will be prepared during Title II for the building. Alternates will be used as well as increased advertising in trade journals to increase competition. Adequate contingency has been assigned to the building construction.	M. Fallier, Conventional Construction Manager, M. Schaeffer, CFN Project Manager	Closeout 3/31/2005	Open

Attachment B – Risk Assessment Summary and Tracking Table

Risk Item	PROJECT ELEMENT	POTENTIAL EVENT	LIKELIHOOD	CONSEQUENCE	SERIOUSNESS	RISK CATEGORIZATION	ACTIONS REQUIRED	LIKELY CAUSE(S)	MITIGATION ACTION(S)	RESPONSIBILITY	SCHEDULE	STATUS
								construction documents may not have been adequately prepared.				
6	Construction	Construction delays and field changes.	Likely	Increased cost and schedule impacts.	Significant	Medium	Yes	Delays due to schedule inadequacies and poor construction management. Delays in delivery of equipment and materials. Changes in the field due to design errors and omissions or customer changes to the facility after contract award.	Design oversight is done by the BNL Plant Engineering (EP) Design Group. BNL will review the A/E design on a regular basis to ensure an adequate design is reflected in the drawings and specifications. BNL will evaluate the schedule and variances on an ongoing basis. Adequate schedule and cost contingency has been assigned to cover field changes.	M. Fallier, Conventional Construction Manager	Closeout 2/28/2007	Open
7	Construction	Construction contractor unfamiliar with construction requirements for a clean room facility. Therefore adequate quality construction is not performed and the cleanliness requirements are not met.	Unlikely	Project delays and increased cost.	Significant	Low	Yes	Construction contractor has no previous experience in the construction of clean room facilities.	The specification and the request for proposal shall require that the construction contractor be evaluated based on previous experience in clean room (and laboratory) construction, safety, and other factors to ensure Best-Value to the Government. Proper protocols during construction of the clean room will be included in the specifications and contractor protocols will be submitted and reviewed with the contractor bids. The A/E has extensive experience to in the preparation of protocols.	M. Fallier, Conventional Construction Manager	Closeout 2/28/2007	Open
8	Construction	Construction contractor unfamiliar with construction requirements for a laboratory/clean room facility. Therefore adequate quality construction is not performed and the EMI, Vibration and Acoustic Requirements are not met.	Unlikely	Facility does not meet the EMI, Vibration and Acoustic Requirements for the effective operation of the instruments.	Critical	Medium	Yes	Construction Contractor does not follow the drawings and specifications for grounding, routing power, and installing design features to mitigate vibrations and acoustics.	The specification and the request for proposal shall require that the construction contractor be evaluated based on previous experience in clean room (and laboratory) construction, safety, and other factors to ensure Best-Value to the Government. A/E Field Engineer and BNL Construction oversight staff will be in the field daily to adequately manage and inspect construction to ensure that the Construction Contractor follows the CFN drawings and specifications in the field. These critical areas will be discussed with engineering and scientific team members at the weekly construction meeting.	O. Dyling, Conventional Construction Design Manager, M. Fallier, Conventional Construction Manager	Closeout 2/28/2007	Open

Attachment B – Risk Assessment Summary and Tracking Table

Risk Item	PROJECT ELEMENT	POTENTIAL EVENT	LIKELIHOOD	CONSEQUENCE	SERIOUSNESS	RISK CATEGORIZATION	ACTIONS REQUIRED	LIKELY CAUSE(S)	MITIGATION ACTION(S)	RESPONSIBILITY	SCHEDULE	STATUS
9	Construction	Settlement of the west parking lot.	Unlikely	Functionality and use of west parking lot may be at risk.	High	Medium	Yes	Inadequate compaction of loose fill from prior building foundation removal.	Special attention will be taken during construction of the west parking lot. Soil borings have been taken over the CFN building site indicating where material has to be removed and replaced with structural fill. The specifications will identify where structural fill will be required. Adequate contingency has been assigned to cover potential field changes during excavation.	O. Dyling, Conventional Construction Design Manager, M. Fallier, Conventional Construction Manager	Closeout 2/28/2007	Open
10	ESH&Q issues	Unplanned ESH&Q issues need to be resolved.	Unlikely	Increase cost or delay completion.	Significant	Low	Yes	Unplanned environmental impact or inadequate hazard identification.	The impacts of ESH&Q issues are well acknowledged. A Preliminary Hazards Analysis (PHA) has been developed which identifies hazards and appropriate mitigation techniques. A NEPA review of this project has been conducted and the project has been determined to be Categorically Excluded (CX) from further NEPA review based on negligible environmental impact. The results of both the PHA and NEPA review will be re-examined on an annual basis to provide assurance that the bases for the conclusions of these analyses have not changed.	S. Hoey, ESH&Q Coordinator	Closeout 3/31/2008	Open
11	Procurement of Technical Equipment	Technical Equipment does not meet the specified requirements.	Likely	Technical Equipment would not operate properly.	Critical	High	Yes	Vendor does not have previous experience in building the required type of technical equipment or does not properly build and test the equipment prior to delivery.	Specifications and procurement documents to include QA, inspection and testing requirements for each critical piece of technical equipment. Vendors will be required to have successful previous experience in building the equipment. BNL will perform necessary QA and test inspections to ensure that the vendors are meeting the technical specifications and equipment performance prior to delivery.	P. Simons, Technical Procurement Manager, A. Moodenbaugh, Technical Equipment Coordinator, T. Vogt, Technical Equipment Coordinator	Closeout 3/31/2008	Open
12	Procurement of Technical Equipment	Change in the required type of technical equipment based upon ongoing development of research focus topics with the future user community.	Likely	The list of technical equipment in the current baseline would change, with concurrence from DOE.	Marginal	Low	Yes	Changes in nanoscience R&D focus and direction.	Maximize the interactions with the future user community during the design phase, prior to placing orders. Long lead time items will be ordered early in the process. Scientific team members are included in the design review process to insure that they have an awareness of the consequences of such changes and the need for early notification of potential problems.	R. Hwang, CFN Director	Closeout 3/30/2007	Open
13	Construction of Conventional Facilities and Procurement of Technical Equipment	Delay in DOE construction/procurement funding for the project.	Likely	If funding is not received (delayed) as shown on the Project Data Sheet some major technical equipment orders may not be placed and/or construction of the building may not be awarded. Any delay in	Significant	Medium	Yes	Congress not passing legislation in a timely manner. BES Program Office changing funding profile.	Perform the maximum amount of work possible with existing funds and contingency. Maintain original construction and equipment delivery dates by increasing the monthly effort on these tasks after construction/procurement start is approved and funded. Continuous communication with BES Program Office to maintain current funding profile.	R. Hwang, CFN Director, M. Schaeffer, CFN Project Manager	Closeout 3/31/2008	Open

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Risk Item	PROJECT ELEMENT	POTENTIAL EVENT	LIKELIHOOD	CONSEQUENCE	SERIOUSNESS	RISK CATEGORIZATION	ACTIONS REQUIRED	LIKELY CAUSE(S)	MITIGATION ACTION(S)	RESPONSIBILITY	SCHEDULE	STATUS
				receiving funding would result in delayed schedules and increased costs.								
14	Procurement of Technical Equipment	Increase in cost due to foreign procurements.	Likely	Increase in cost of specific items based on the value of the dollar compared to the value of the currency in the country in which the equipment is manufactured.	Significant	Medium	Yes	Changes in the value of the dollar due to the international economic situation.	The most recent cost estimates took into account the value of the dollar in the summer/fall of 2003. Procurement plans will fix prices of technical equipment as early as possible for expensive equipment procured in foreign countries.	R, Hwang, CFN Director	Closeout 3/30/2007	Open
15	Stakeholder issues	Concerned stakeholder creates hold on project.	Likely	Construction delays and poor public relations.	Marginal	Low	Yes	Failure to properly address stakeholders needs and concerns.	Public workshops to identify stakeholder needs and concerns. CFN website and newsletter to advise stakeholders of important CFN activities and project status.	R, Hwang, CFN Director	Closeout 3/31/2008	Open