Department of Energy
Office of Science
Washington, DC 20585

SEP 2 2 2016

MEMORANDUM FOR STEPHANIE SHORT
ASSOCIATE DEPUTY DIRECTOR
OF THE OFFICE OF SCIENCE
FOR FIELD OPERATIONS

FROM: STEPHEN W. MEADOR Stephen W Meador
DIRECTOR
OFFICE OF PROJECT ASSESSMENT

SUBJECT: Final Report on the DOE/SC Review of the CFR Project, August 2016

Attached for your consideration and use is the final report on the Department of Energy/Office of Science review of the Core Facility Renovation (CFR) project. The CFR review was conducted on August 23-25, 2016, at the Brookhaven National Laboratory in Upton, New York.

If you have any questions or would like to discuss the report further, please contact me.

Attachment

cc:
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Office of Project Assessment
CD-1 Review Report on the

Core Facility Revitalization (CFR) Project

at Brookhaven National Laboratory

August 2016

EXECUTIVE SUMMARY

A Department of Energy/Office of Science (DOE/SC) review of the Core Facility Revitalization (CFR) Project was conducted on August 23-24, 2016, at the Brookhaven National Laboratory (BNL). The review was conducted by the Office of Project Assessment (OPA) at the request of Stephanie Short, Associate Deputy Director for Field Operations, SC. The review was chaired by Ethan Merrill, OPA. The purpose of this review was to assess the project's readiness to approve Critical Decision (CD) 1, Approve Alternative Selection and Cost Range. The project team presented a detailed, well-thought-out plan for this stage of project development. The Committee found that the project is ready for CD-1 approval.

Technical and Environment, Safety and Health

Technical documentation for CD-1 is detailed and robust. Renovation of Building 725 (B725) is the most effective alternative for providing critical computation facilities and associated power and cooling infrastructure to replace the Building 515 (B515), the Relativistic Heavy Ion Collider (RHIC)/ATLAS computing facility. The project will provide a renovated building envelope, 2.4 megawatts (MW) IT power, and up to 2.4 MW emergency backup power capability. The residual hazardous metals on building surfaces have been adequately evaluated to develop an approach to remediate the hazards and previously performed remediation within facility B725 has provided a sound basis for the preliminary cost estimate. The estimated value (approximately $3 million/approximately 6 months) for abatement of residual hazardous material and the short schedule duration of the activities provides an opportunity to reduce the project risk prior to establishing the performance baseline. Identification of multiple trade space scope alternatives that can be added or removed from the project and still meet the preliminary Threshold Key Performance Parameters (KPPs) is a commendable practice at this stage of project development.

Cost and Schedule

A bottom-up cost estimate was prepared using unit/quantity pricing from current market and regional pricing data for data centers being built in the Washington DC/New York/Boston areas. The project's Total Project Cost range is $64.5-77.5 million with a preliminary point estimate of $67.9 million. The low end represents completing the Threshold KPP (2.4 MW IT Power with 1.2MW Emergency Pack-up); the high end represents completing the Objective KPP (2.4 MW Emergency back-up).

The $67.9 million preliminary point estimate includes 3% escalation, 11% of scope contingency, 20% cost contingency, and partial design contingency built into the estimate. The conceptual design cost estimate has gone through a 30%, 60%, and 90% reviews. Vendor quotes are being used for much of the equipment being specified, and do not have design contingency. A 10% to 15% design contingency was added to areas with more uncertainty such as demo, HVAC, and raised flooring. The $67.9 million includes components of the objective scope that have been identified as scope contingency to meet the preliminary Threshold KPPs. The point estimate includes 100% (2.4MW) backup generation and 50% (1.2MW) backup is scope contingency.

CD-4 is currently planned for fourth quarter FY 2021with 12 months of schedule contingency and the plan is based on the assumption of a one-year Continuing Resolution in FY 2017 and a three-month Continuing Resolution in FY 2018. Both cost and schedule contingency appear adequate for this stage of the project. Early finish is scheduled for fourth quarter FY 2020. There is a need by RHIC and the ATLAS experiment at Large Hadron Collider (LHC) to have the new computational facility online by April 2021. This schedule currently includes a CD-3a, Approve Long Lead Procurement for site preparation and procurement of generators/air handlers. The generators and air handlers can take up to eight months to procure after award. The project developed a preliminary resource loaded schedule with 143 activities and 35 milestones.

Management

An effective and capable management team has been formed and the project seems to be managed very well, with an experienced project director, project manager, and project control personnel. Documentation required for CD-1 has been adequately developed and is ready for approval.

The Analysis of Alternatives (AoA) document has been developed in accordance with DOE Order 413.3B along with a Life Cycle Cost Analysis report subject to OMB A-94 prepared by HDR, Inc., an independent sub-contractor of the M&O site contractor. The AoA estimated the following in-house savings over the Cloud for a three-year (for only 10% for computing/data storage) period:

- $3.3 million for 7 PB since the Cloud is 3.6 more expensive than in-house for data storage.
- $0.6 million for 5K cores since the Cloud is twice as expensive as in-house for computing.

The proposed project delivery method will incorporate a two phased Contract Manager/General Contractor approach with best-value selection criteria used. At this stage, the project has an appropriate risk registry and risk management plan. Risks associated with design and execution of the project seems to be sufficiently captured in the risk registry. The risk registry is reviewed monthly during the status meetings and quarterly by the risk management team.

Potential Basic Energy Sciences computational/data needs have not been included in the project scope and will impact the cost and schedule if included later. The project should continue to monitor the ramp up to the 6MW to ensure that the modular solution provided by the CFR project can meet the potentially evolving requirements of the RHIC/ATLAS Computing Facility (RACF) at CD-4. BNL's initial response to the recent Data Center Optimization Initiative memo requirements appear reasonable and should not have impact on the CD-1.

Key Recommendation

- The Committee recommended that the project proceed to CD-1.

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1. INTRODUCTION

The Core Facility Revitalization (CFR) project at Brookhaven National Laboratory (BNL) is a Department of Energy (DOE) line-item project that will provide mid-range computational and data storage support to current and planned particle physics experiments using Relativistic Heavy Ion Collider (RHIC) and the ATLAS Detector at CERN that are funded by the Office of Nuclear Physics (NP) and the Office of High Energy Physics (HEP), respectively. The project received Critical Decision (CD) 0, Approve Mission Need on September 1, 2015.

In a May 24, 2016 memorandum, Ms. Stephanie Short, Associate Deputy Director for Field Operations, SC, requested that an Independent Project Review (IPR) be conducted to support CD-1, Approve Alternative Selective and Cost Range.

The CFR project will provide the critical computational facilities, and associated power and cooling infrastructure required to support the mission need identified in the approved CFR Mission Need Statement (MNS).

The desired outcome will be obtained when design and construction of new computing facilities with modern power and cooling capabilities to replace aging, unreliable, and physically inadequate facilities are completed. The conceptual design effort identified and documented the need for a new 2.4MW (IT Power) facility. The facility design shall include incremental power and cooling expansion capabilities as future needs are realized.

The focus of this review was to assess all aspects of the project's conceptual design and associated plans—technical, cost, schedule, management, and Environment, Safety and Health (ES&H)—in preparation for CD-1.

2. TECHNICAL and ENVIRONMENT, SAFETY and HEALTH

2.1 Findings and Comments

Technical

The scope of CFR is to provide critical computational facilities and associated power and cooling infrastructure to replace the RHIC/ATLAS Computing Facility (RACF) to fill the projected capability gaps in computing infrastructure of mid-scale computing. The CFR will be constructed within the existing core and shell of the decommissioned NSLS-I facility Building 725 (B725). B725 has greater than 50,000 gsf available for the initial CFR project scope, with additional space available for future expansion.

The CFR project preliminary Threshold Key Performance Parameter (KPP) scope is to provide 2.4 MW IT Power and 1.2 MW emergency back-up capabilities, and an objective scope of 2.4 MW IT power and 2.4 MW emergency back-up capabilities. Identification of multiple trade space scope alternatives that can be added or removed from the project and still meet the preliminary Threshold scope is a commendable practice at this stage of project development.

An independent Analysis of Alternatives (AoA) and Life Cycle Cost Analysis was performed by HDR, Inc., an independent sub-contractor of the M&O site contractor. The AoA is credible and comprehensive. The AoA reviewed five alternatives, and Alternative 2, Renovate B725, has the lowest life cycle cost of the alternatives that meet the mission capability gap.

The acquisition approach is a best value selection for design, and a best value selection for Contract Manager/General Contractor (CM/GC) for construction with project definition and management by the Site M&O Contractor. The use of a CM/GC acquisition strategy has been successfully utilized by other Science laboratories. It is critical to ensure a preliminary procurement plan is thoroughly developed and approved at all levels of the procurement process. Successful use of a CM/GC acquisition is dependent on a thorough and clear Statement of Work.

The Risk Management Plan concludes, at this stage of the project, that the available cost and schedule contingency exceeds the 80% probability of success. As the project scope and cost estimate is further developed, the project should consider monthly risk meetings, as the project moves into detailed design, for inclusion into updated Monte Carlo analysis of contingencies.

The CFR project will meet or exceed High Performance and Sustainable Buildings (HPSB) Guiding Principles and comply with Data Center Optimization Initiative (DCOI) metering and power usage guidelines.

Environmental, Safety and Health

Project objective and mission need are understood by ES&H staff, they are very knowledgeable of the potential hazards, are integrated into the project team, and involved in all levels of planning and field work. Integrated Safety Management (ISM) systems are mature and well

integrated into the project through BNL's subject areas within the Standards-Based Management System. The project is within the scope of the BNL Facilities' National Environmental Protection Act (NEPA) categorical exclusion.

The Preliminary Hazard Analysis Report (PHAR) adequately addresses the identified chemical, biological, and radiological hazards. Off-project hazardous material remediation efforts previously performed provide confidence that remaining hazards are fully characterized. Lead shielding remains in the X-17 hutch and the x-ray tunnel mezzanine HVAC penetrations. Removal of this material is in the project scope. The project should consider removing all lead shielding materials prior to initiating final cleaning of the facility to minimize the potential spread of lead contamination. Residual metals on surfaces have been adequately evaluated to develop an approach to remediate the dispersible metal hazards. A validated statistical approach should be considered, in lieu of professional judgement, to confirm the 40 ug/ft^2 housekeeping criteria has been achieved. This is of particular importance where eating, drinking, and applying cosmetics may occur so as to minimize the potential for skin absorption and ingestion to the lowest reasonable risk.

Previously performed remediation activities within facility B725 have provided a sound basis for the preliminary hazardous material remediation cost estimate. The estimated value (approximately $3 million) for abatement of residual hazardous material in B725 and the short schedule duration of the remediation activities provides an opportunity to complete these activities and reduce the project risk prior to establishing the performance baseline.

Consider performing a validation of the existing asbestos survey prior to abatement and demolition to ensure suspect asbestos-containing materials (e.g., caulking, glazing, adhesives, etc.) have been adequately identified to prevent unanticipated costs and delays to the project during window removal and other activities. Additionally, prior to the replacement of the roof, consideration should be given for incorporating a fall protection system as part of the design in order to protect staff accessing and/or working on air handling units, chillers, cameras, lighting, etc. from significant fall hazards.

CFR has a service level agreement to deliver 99% reliable power and cooling, with allowable downtime of 3.5 days per year. Design will accommodate concurrent maintenance. CFR has an efficiency requirement of < or = to1.4 PUE (Power Usage Effectiveness) with a target of 1.2 PUE, which is driven by DCOI.

Cooling of data center loads is planned through a combination of a Dry Air Economizer (DAE) for air cooled loads and direct water cooling for high density High Performance Computing (HPC) loads. The plan to cool large portions of the load with DAE is an innovative approach that should allow for achievement of PUE goals. The plan for use of hot aisle containment is best practice for air cooled loads.

Consider further review of the following design parameters during the detailed design phase of the project (prior to CD-2):

- Review the backup generator requirement to confirm that full generator backup is needed to deliver the 99% reliability goal. It may be possible to obtain 99% reliability through use of UPS power only without full generator backup on portions of the load.
- Review the plan to put fans and pumps on UPS power. It may be possible to put these loads on generator backed power only and allow brief interruptions of air/water flow during generator startup.
- Consider delaying final design for the direct cooling water loop until more information is available on the specific system requirements. Supply water temperature, water quality, and materials of construction could vary depending on the actual HPC equipment to be supported.
- Review plans to use bus for 480v distribution. It may be possible to use cable tray and conductor cables for less cost and increased flexibility.
- Consider use of open source DCMI (Data Center Infrastructure Management) solution vs commercial product.
- Review decision to not install smoke detectors and sprinklers under raised floor in data center. Confirm there are no code issues with this decision.
- Review decision to use DAE in the network and tape storage spaces. Light loads may be better suited to more traditional cooling approaches.
- Continue to review the plan for a staging and uncrating area is a best practice and should improve the utilization of data center space.

Availability of large capacity chilled water storage tank on-site (1 M gal) is a valuable asset for increasing reliability of the cooling infrastructure. It may be possible to achieve reliability goals with less generator backup as a result. The BNL site has dedicated fuel delivery trucks and storage tanks to support fueling of data center generators during extended power.

2.2 Recommendation

1. Proceed to CD-1.

3. COST and SCHEDULE

3.1 Findings

PROJECT STATUS – Pre CD-1 as of July 2016		
Project Type	Line Item	
CD-1	Planned: 4Q FY16	Actual: TBD
CD-2/3A	Planned: 3Q FY18	Actual: TBD
CD-3B	Planned: 1Q FY19	Actual: TBD
CD-4	Planned: 4Q FY21	Actual: TBD
TPC Percent Complete	Planned: N/A	Actual: N/A
TPC Cost to Date	$0.40M in OPC	
TPC Committed to Date	$0.73M in OPC	
TPC - Preliminary Range	$64.5M - $77.5M	
TEC - Preliminary Range	$63.6M - $76.6M	
Contingency Cost – Preliminary	$11.2M	
Contingency Schedule on CD-4 – Preliminary	12 months	
CPI Cumulative	N/A	
SPI Cumulative	N/A	

The Total Project Cost (TPC) range is $64.5-77.5 million and is solely based on the proposed alternative of renovating B725. The low end represents completing the Threshold KPP (2.4 MW IT Power with 1.2MW emergency back-up), 10% of scope contingency, 2% escalation, and architect/engineer (A/E) fees of 10% of construction contract. The high end represents completing the Objective KPP (2.4 MW Emergency back-up with Bypass), 25% contingency, 3% escalation, and A/E fees of 11.5% of construction.

The proposed $67.9 million optimal point estimate includes 3% escalation, 11% of scope contingency, 20% cost contingency, and partial design contingency built into the estimate. The conceptual design cost estimate has gone through a 30%, 60%, and 90% review. The cost estimate includes vendor quotes for much of the equipment being specified. No design contingency is included in the equipment cost estimates. Design contingency (10% to 15%) was added to areas with more uncertainty such as demo, HVAC, and raised flooring. The $67.9 million includes components of the objective scope that have been identified as scope contingency to meet the preliminary Threshold KPPs. The point estimate 100% (2.4MW) includes backup generation and 50% (1.2MW) backup is scope contingency. The $67.9 million TPC includes an EDIA percentage of approximately 21%.

A bottom-up cost estimate was prepared by a consulting firm using unit/qty pricing from current market and regional pricing for data centers being built in the Washington DC/New York/Boston areas. HVAC and electrical make up two-thirds of the construction cost.

CD-4 is currently planned for fourth quarter FY 2021 with 12 months of schedule contingency. Early finish is scheduled for fourth quarter FY 2020. There is a need by RHIC and the ATLAS experiment at Large Hadron Collider (LHC) to have the new computational facility online by April 2021. The schedule currently includes CD-3a, Approve Long Lead Procurement for site preparation and procurement of generators/air handlers. The generators and air handlers can take up to eight months to procure after award.

The project developed a preliminary resource loaded schedule with 143 activities and 35 milestones. The project also developed the schedule based on the assumption of a one-year Continuing Resolution (CR) in FY 2017 and a three-month CR in FY 2018. The critical path runs through a projected 15-month (FY 2017/2018) CR, design/site preparation, and then construction.

The project is currently funding and CR constrained. The project is scheduled to receive $1.8 million in Project Engineering and Design (PED) funds in FY 2017, but due to a potential yearlong FY 2017 CR, preliminary design and the use of PED funds is scheduled to start second quarter FY 2018 after the projected 15 month CR is completed. Site preparation activities are scheduled to start third quarter FY 2018.

The risk registry identified 31 risks. A preliminary cost and schedule Monte Carlo analysis was performed showing 80% confidence of completing by November 2020 with a cost of $64 million. A Risk Management Plan was developed and the project is currently holding quarterly meetings to review and update risks. Monthly meetings will occur after CD-1 approval.

The anticipated time window for migration to the new computational facility is in early FY 2021, in line with the LHC shutdown and RHIC schedule. No external dependencies are specifically identified in the cost estimate or schedule.

The project analyzed five different alternative strategies. It was determined that alternatives 2 (B725) and 3 were viable and further analyzed. The total life cycle cost for alt. 2 ($125 million) was the lowest when compared to alt. 3 ($148 million).

The five alternatives are as follows:

Alternative 1	Do Nothing
Alternative 2	Utilize Existing BNL Facilities (B515, B725, Other)
Alternative 3	Construct New Facility (Line Item)
Alternative 4	Construct New Facility (Alternative Financing)
Alternative 5	Establish Capacity at Another Location (i.e. Cloud)

The Alternative 1 (Status Quo/Do Nothing) will not full fill the mission gap. Alternative 2 (renovate current facility) considered several existing facilities to be renovated, including renovating B725, which is the preferred alternative, as it contains sufficient space for the current plan as well as future expansion. Furthermore, it can be relatively easily upgraded to fulfill the technical requirements. Several other facilities were considered, such as B515 where the current data center is stationed. However, due to lack of swing space (or unacceptable shutdown), space

for expansion, and antiquated utilities systems this was not a viable solution. For the preferred Alternative 2 (B725), the renovated building is anticipated to last at least 25 years, which is the life of the HVAC/electrical equipment. Alternative 3 and 4 (construct a new facility) are viable, but cost prohibitive both in initial cost and life cycle cost when compared to Alternative 2. For Alternative 5, the project evaluated cloud computing (Amazon Web Services) against the cost of in-house and determined that the first three years the cost of storage would be 3.6 times more cost prohibited and computing costs would be 2.0 times as expensive. Also there is poor performance for certain science applications. This alternative was deemed not viable.

B725 hazardous removal site preparation scope was estimated using internal in-house estimators ($2.0 million w/o contingency) and then verified by a consultant cost estimate. This estimate does not include additional costs, such as contingency and project management, ES&H support, etc. Full characterization of the remaining lead was done using a metals wipe survey. A local environmental consulting firm who has performed work at BNL in the past completed the cost estimate and lead dust removal plan for the project.

The Preliminary Project Execution Plan (PPEP) states that no project permits will be needed.

3.2 Comments

The project completed a thorough analysis of several alternatives and the proposed renovation of B725 appears to be the best and lowest cost alternative to fulfill the mission gap. The potential future growth from additional user programs at the laboratory further validates the selection B725.

The cost range based on Alternative 2 (Renovate B725) appears realistic at this stage of the project. The proposed optimal cost estimate of $67.9 million appears adequate to meet the Threshold KPPs. Traditionally, projects at this stage contain more design contingency. However, the project's cost estimate, which was independently estimated from bottom-up, is further along than the typical conceptual design cost estimate. Consider including into the point estimate additional design contingency to account for unknown design issues/comments that occur during design development. The 11% scope contingency currently on the point estimate can be considered design contingency and partially offset this need.

The CD-4 date of September 2021 with 12 months of schedule contingency appears realistic and achievable. The early finish date is based on obtaining CD-2/3a (Approve Performance Baseline and site preparation and long lead procurement approval) and adequate construction funding in FY 2018. Without early authorization of site preparation, schedule contingency may be inadequate. Also without performing site preparation activities in FY 2018 (residual B725 residual hazardous materials abatement), the project will likely not be able to meet the required computing needs in a timely matter by 2020.

The proposed funding profile calls for $10 million in construction funding during FY 2018. If the full $10 million is not available, the project may be able to optimize and prioritize the long lead activities in order to meet the early completion schedule. The project should consider breaking out the site preparation construction scope from CD-3a and performing this scope on a Project Management Executive (PME) letter approval basis. This provides better flexibility to meet the early completion schedule.

With current estimates, it appears the letter approval would be in the range of $3 million (includes contingency and project management/ES&H support). Performing site preparation early would retire one of the major cost risks and allow for project costs to be better bound at CD-2.

The risks in the register appear thorough and complete. The higher risk items include scope creep, failure to capture user requirements, unknown contaminated materials, limited competition for construction, escalation in construction costs, and continuing resolution/funding availability.

The cost ($11.2 million) and schedule contingencies (12 months) presented appear adequate and were validated qualitative analysis and Monte Carlo analysis. EDIA of 21% is in the range of similar SC conventional construction projects.

There will likely be RHIC/ATLAS computing and storage needs beyond current BNL capability before the CD-4 date. If the project does not complete by the early completion timeframe, the project can prioritize and have a partial Beneficial Occupancy Date in those areas that are needed. Ensure the Request for Proposal (RFP) and construction schedule are optimized to accommodate the computing needs of the users given the late finish scenario.

Confirm and validate the need for project permits. The project includes environmental components, such as diesel generation, water and sanitary sewer construction, which may require specific permits. If permits are needed, ensure permit information is included in the PEP and schedule by CD-2.

The scope and cost related to B725 residual hazardous materials abatement appears properly included in the alternatives analysis and cost/schedule ranges.

3.3 Recommendation

2. Proceed to CD-1.

4. PROJECT MANAGEMENT

4.1 Findings

CFR provides the critical computational facilities and associated power and cooling infrastructure required to support the computational and data storage mission needs of the RHIC/ATLAS Computing Facility (RACF). The current facility supporting RACF housed in B515 in the central campus has been developed in a series of increments over time, with mechanical and electrical infrastructure typically configured and installed with capacity limited to the scale of a specific project or need. There is little consistency in system configuration or in the reliability that can be expected from systems in different portions of the building. The data volume generated by the RHIC experiments and ATLAS are expected to increase three to six times over the next ten years and will require proportional increases in computational and data storage capacities. Therefore the current facility, B515, will not meet the future needs of the RACF. On September 1, 2015 the Mission Need Statement was approved to provide mid-range computational and data storage support to current and planned particle physics experiments at both RHIC and the ATLAS detector at CERN.

The 70K cores of computing capacity at the RACF is being expanded to 100K cores in FY 2017. It was noted that the low reliability of the existing power and cooling may result in the existing system failing to function before the CD-4 date for the CFR project is reached.

A very good detailed AoA was performed of the five alternatives in accordance with DOE Order 413.3B, Associated Life Cycle Cost Analysis, which set forth the description, cost, and benefits of the alternatives analyzed for the project. The analysis is consistent with the cost effectiveness, constant dollar analysis requirements of OMB A-94. It was concluded that detailed analysis of constructing a new facility using alternative financing would be problematic and establishing the RACF at another location either another National Laboratory, which does not have the space or computing storage capability would be cost prohibitive and cloud storage of the data had reliability and data speed transfer issues. Therefore, the Life Cycle Cost Analysis compared the costs of remaining in B515, maintain status quo, renovating an existing facility at BNL, and constructing a new facility.

The Life Cycle Cost Analysis was performed by HDR, Inc. with assistance from Subject Matter Experts (SMEs) at the BNL and concluded that doing nothing had no positive aspects and had the negative aspects of not addressing the mission need or capability gaps and will not meet the DCOI requirements. Utilizing an existing facility at BNL would require expanding and renovating the existing RACF. This would provide the positive aspects of a moderate initial cost and a new addition would meet the DCOI requirements; however, the current facility space would not meet DCOI requirements. The negative aspects are a limited size/layout capability, limited power/cooling capability, down time of the data center for the program utilization. Renovating B725 provided positive aspects of the lowest initial cost, fastest project delivery, would utilize existing infrastructure and future utilization of additional co-located space. This would meet the requirements of DCOI. The negative aspect is a greater proportion of BSA investment. It was concluded that the most advantageous would be B725, which had the lowest life cycle cost versus new construction.

The AoA estimated the following in-house savings over the Cloud in three years (for only 10% of the computing/data storage):

- $3.3 million for 7 PB since the Cloud is 3.6 more expensive than in-house for data storage.
- $0.6 million for 5K cores since the Cloud is twice as expensive as in-house for computing.

Finally, the project will reduce the PUE from the present 2 to meet the 1.4 requirement.

The following documents were provided to the Committee for review and are further discussed in the comments of this section:

- PPEP with the IPT Charter
- Preliminary Hazard Analysis Report
- Preliminary Risk Management Plan and Risk Registry
- Conceptual Design Report that was independently reviewed by Oak Ridge National Laboratory
- The Implementation of an Integrated Safety Management Plan, Quality Assurance Program (QAP), Safeguards and Security requirements, and completion of the NEPA are referenced or documented in the PPEP.

The PPEP has been drafted outlining the roles and responsibilities of the project team.

- A/E Services will be fixed price contract, best value section
- CM/GC will be a fixed price contract, best value selection with two phases:

    - Phase I—pre-construction services
    - Phase II (option)—construction

As part of a tailoring strategy the CFR project will propose a CD-2/3a for the start of early site preparation activities (hazardous material remediation, procurement of the long lead procurement HVAC and electrical equipment).

The CFR Laboratory project team is supported by:

- BNL Modernization Project Office
- BNL CFR Advisory Group
- BNL CFR User Representatives
- BNL Procurement and Property Management
- BNL Support Organization (Environmental Services, Fire Protection, QA, ES&H Oversight, and Environmental Compliance)
- The Federal Project Director will be formally appointed at CD-1, but he has been following very closely the development of the project since its inception.

In the future, the project team will be supported by an A/E, CM/GC and a Commissioning Agent.

When fully staffed, the project management will be 5.8 FTEs that will include 2 full time FTEs.

A Preliminary Risk Management Plan has been developed with the very high impact risk being stated as:

- Significant increase in project scope (Creep)/Design contingency/estimate uncertainty.
- Limited competition results in higher than expected cost
- User generated scope changes during construction
- Increasing construction cost escalation rates (cost)
- Continuing resolution and delays in FY 2017/2018 funding

Risk associated to the design and execution of the project seems to be sufficiently captured in the risk registry. The risk registry is reviewed monthly during the status meetings and quarterly by the risk management team.

4.2 Comments

The project has a good management team and seems to be managed very well, with an experienced project director, project manager, and project control personnel. The concept of using a CM/GC is a good concept, but it needs to be good contractor that the project can work with and it is important that a good relationship be maintained between the Laboratory and the CM/GC.

Early procurements of Long Lead Equipment for generators and Air Handlers is planned for FY 2018 and is approximately $7 million. Also, approximately $3 million will be required in FY 2018 for lead removal that will take approximately six months.

Early removal of lead from the space would help reduce scope risk and would be advantageous to moving the project forward.

The impacts of BES computational/data needs have not been quantified in the scope of the project. If BES is included into the project scope, there will be impacts on the cost and schedule. The BES program decided not to sign the Mission Need Statement, so the need for future computing resources located in the refurbished B725 will have to be addressed directly by the program, by providing its own funds to expand the current scope of the CFR project.

In the analysis of alternatives, the possibility of using Cloud services was analyzed in some depth and, while discarded as a viable alternative, the issues related to using Cloud services for HEP and NP scientific data analysis have been extensively documented in light of recent mandates, such as the DCOI and the eventuality of seeking an exemption.

Risk associated to the design and execution of the project seems to be sufficiently captured in the risk registry. It was stated that the risk registry is reviewed monthly during the status meetings and quarterly by the risk management team.

One of the highest impact risks is connected to scope creep and users generated scope changes during construction. Scope changes during construction are considered a high impact risk. The principal stakeholders in the mission need statement are the HEP and NP programs, and consequently the CFR project will deliver a computing facility addressing the needs of these two programs. A failure to capture their needs properly might result in scope creep. In particular, while the NP computing needs are projected to increase by only 5-10% per year, as RHIC prepares to terminate its run, the needs of the ATLAS Tier 1 are increasing significantly and will continue to do so until at least 2025 (when, during a two-year shutdown, high luminosity upgrades will be installed for the machine and the detectors). At the moment, the project is designed to allow modular extensions of the IT power capacity, up to 6 MW by 2025. However, this figure is not definitive, as the volume of data delivered by the LHC and processed and stored by the experiments is already increasing beyond levels that were not previously anticipated, as the machine has finally reached the original design luminosity. The possibility of scope changes to the computing facility provided by the CFR, needs to be monitored carefully over the next couple of years, to make sure that the modularity of the solutions provided by CFR are still relevant to the needs of ATLAS by the time the facility will be operational in late 2021.

Documentation required for CD-1 has been adequately developed and is ready for CD-1.

4.3 Recommendation

4. Proceed to CD-1.

Appendix A Charge Memo

Department of Energy
Office of Science
Washington, DC 20585

JUL 2 2 2016

MEMORANDUM FOR STEPHEN W. MEADOR
DIRECTOR
OFFICE OF PROJECT ASSESSMENT

FROM: STEPHANIE A. SHORT
ASSOCIATE DEPUTY DIRECTOR FOR FIELD OPERATIONS

SUBJECT: Independent Project Review (IPR) of the Core Facility Renovation (CFR) project at Brookhaven National Laboratory (BNL)

I request that you organize and conduct an IPR of the CFR project located at BNL. The purpose of the IPR is to assess aspects of the project to determine readiness to achieve Critical Decision (CD) – 1, Approve Alternative Selective and Cost Range. This IPR will occur at Brookhaven on consecutive days August 23 - 25, 2016.

The CFR project achieved CD-0 on September 1, 2015. The project is expected to receive initial funding under the Science Laboratories Infrastructure program in FY 2017.

In carrying out its charge, the review committee should respond to the following questions:

1. Have performance requirements been appropriately and sufficiently defined for this stage of the project?

2. Has a credible and sufficient alternatives analysis been performed? Are project risks identified and has a credible Risk Management Plan been developed?

3. Are the estimated cost and schedule ranges supporting the alternatives credible and realistic for this stage of the project? Are scope, cost, and schedule contingency adequate?

4. Is the project being appropriately managed? Is the Integrated Project Team established and functioning?

5. Are environment, safety, and health aspects being properly addressed given the project's current stage of development? Are Integrated Safety Management principles being followed?

6. Are project documents (e.g., Acquisition Strategy, Preliminary Project Execution Plan, and Preliminary Hazard Analysis Report) complete and ready for approval? Is the project ready for CD-1?

7. Is the abatement of residual hazardous materials within B725 technically feasible, and if so, is abatement scope appropriately bounded in the alternatives analysis and cost and schedule ranges?

Gary Brown is the program manager for the CFR project and will serve as my point of contact for this review. You can contact Gary at (301) 903-6253. I would appreciate receiving the review committee's report within 30 days of the conclusion of the review.

cc:
E. Merrill, SC-28
F. Crescenzo, BSO
L. Nelson, BSO
P. Caradonna, BNL
S. Trischman, SC-33
G. Brown, SC-33

Appendix B Review Committee

DOE/SC CD-1 Review of the
Core Facility Revitalization (CFR) Project (BNL)
August 23-25, 2016

REVIEW COMMITTEE PARTICIPANTS

Department of Energy

Ethan Merrill, DOE/SC, Chair

Review Committee

Subcommittee 1: Technical and ES&H
*Gary Bloom, ORNL
Bart Hammontree, ORNL
Chad Replogle, ORNL

Subcommittee 2: Cost and Schedule
*Jerry Kao, DOE/ASO
Tim Maier, DOE/OPA
Randy Wielgos, FNAL

Subcommittee 3: Project Management
*Ronald Lutha, DOE/ASO
Dave Goodwin, DOE/ASCR
Simona Rolli, DOE/HEP

*Lead

Observers

Stephanie Short, DOE/SC
Steve Trischman, DOE/SC
Gary Brown, DOE/SC
Lloyd Nelson, DOE/BHSO
Frank Crescenzo, DOE/BHSO

Appendix C Review Agenda

DOE/SC CD-1 Review of the
Core Facility Revitalization (CFR) Project (BNL)
August 23-25, 2016

AGENDA

Tuesday, August 23, 2016—B734 Conference Room 201

8:00 am	DOE Full Committee Executive Session (Review Committee Only)	E. Merrill
	• Charge to Committee	G. Brown
	• Federal Project Director's Perspective	L. Nelson
8:30 am	Welcome and Introductions	TBD
8:45 am	BNL Campus Strategy	M. Fallier
9:00 am	CFR Science Mission	E. Lancon / K. Kleese Van Dam
	• RHIC/ATLAS Computing	
	• Computational Sciences Initiative	
9:45 am	CFR Project Overview	P. Caradonna
	• Project Overview	
	• Project Management	
10:15 am	Break	
10:30 am	CFR Project Scope, Schedule and Cost	S. Cannella
	• Project Scope	
	• Analysis of Alternatives	
	• CFR Conceptual Design	
	• Preliminary Cost and Schedule Range, Contingency	
	• Risk Management	
11:45 am	DOE Executive Session (Review Committee Only)	
12:00 pm	Lunch	
1:00 pm	Environment, Health and Safety	R. Costa
	• Preliminary Environmental and Hazards Analysis	
	• Construction Safety	
1:30 pm	Tours	S. Cannella
	• RHIC/ATLAS Computing Facility	
	• B725	
3:00 pm	Breakout Sessions	
	• Technical & ES&H - 201	
	• Cost and Schedule - 253	
	• Management - 253	
4:30 pm	DOE Full Committee Executive Session	
5:30 pm	Adjourn	

Wednesday, August 24, 2016 – B734 Conference Room 201

8:00 am	Breakout Sessions • Technical & ES&H - 201 • Cost and Schedule - 253 • Management - 253
10:00 am	Break
11:00 am	Breakout Sessions (cont.)
12:00 pm	Lunch
1:00 pm	DOE Executive Session (Review Committee Only) • Cost and Schedule—TBD, if required • Technical—TBD, if required
2:00 pm	Report Writing (Review Committee Only)
4:00 pm	DOE Full Committee Executive Session/Dry Run #1
5:30 pm	Adjourn

Thursday, August 25, 2016 – B734 Conference Room 201

8:00 am	DOE Full Committee Executive Session/Dry Run #2
10:30 am	Break
11:00 am	Closeout Presentation
11:30 am	Adjourn

Appendix D CFR Cost Chart

CFR – Cost Range Summary

	Low Range K$	High Range K$
Total Estimated Cost (TEC)		
Preliminary and Final Design	$4,654	$6,335
Construction	$40,820	$50,281
Project Support	$4,348	$4,701
Direct TEC	$49,822	$61,317
Contingency (% TEC)	$9,964 (20%)	$15,329 (25%)
Scope Contingency (10% Const.)	$3,837	
Subtotal TEC	$63,623	$76,646
Other Project Costs (OPC)		
Conceptual Design - OPC	$850	$850
Total Project Cost (TPC)	$64,474	$77,496

Appendix E CFR Funding Profile

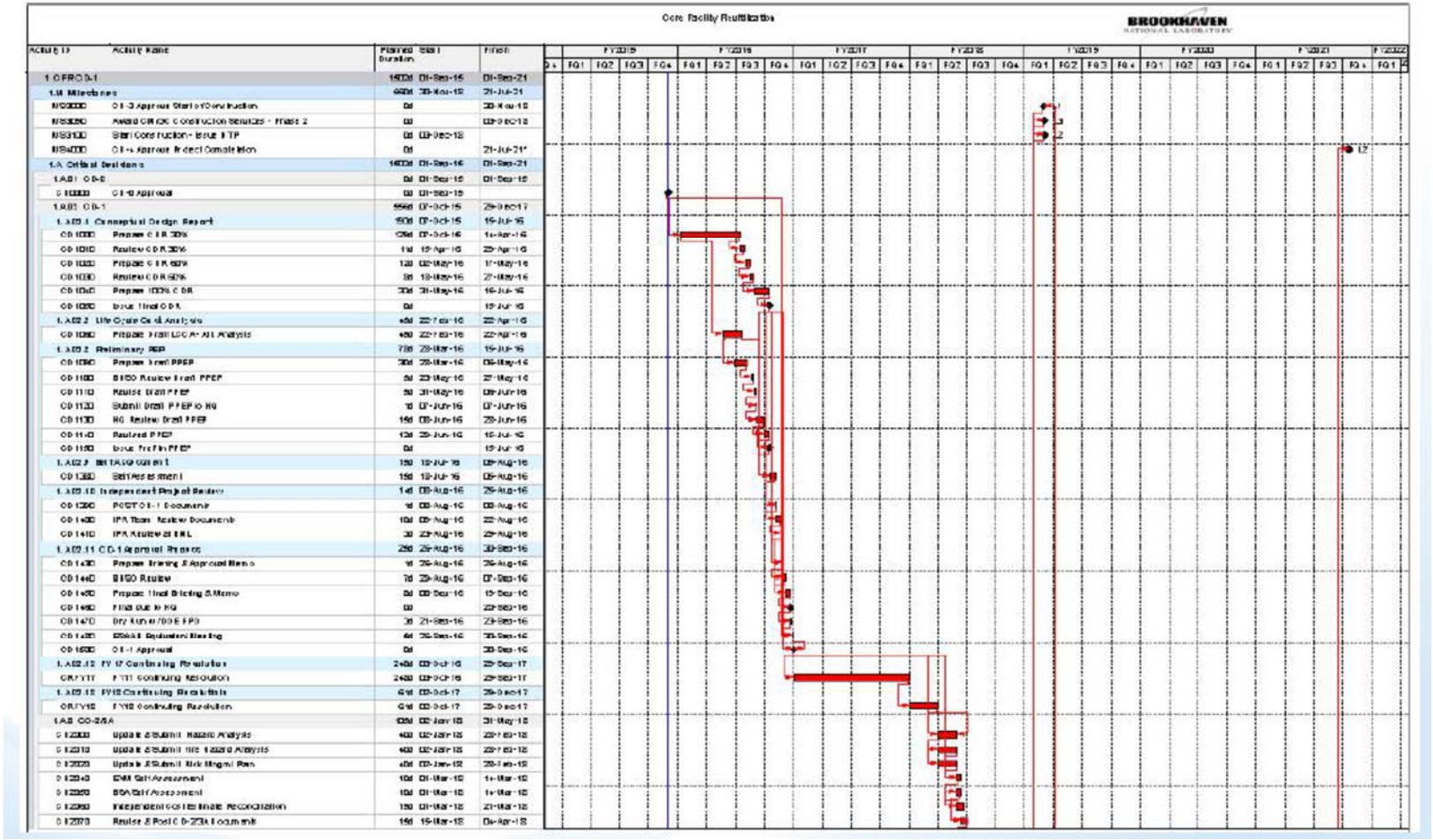
CFR Overview – Preliminary Funding Profile

Preliminary Funding Profile ($K)

	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	Total
OPC	$850					$850
TEC PED		$1,800	$5,200			$7,000
TEC Construction			$10,000	$30,000	$20,023	$60,023
Total Project Cost	$850	$1,800	$15,200	$30,000	$20,023	$67,873

CFR – Schedule

- Preliminary Critical Path Schedule



Appendix G CFR Management Chart