

# OPA (SC-28) Mission Validation Independent Review Summary

## Core Campus Revitalization Projects (CCRP)

Review Date: **August 7, 2019**

Review Chairperson: **Kurt Fisher**

Location of Review: **Germantown/Remote**

Purpose: **Mission Validation**

Location of Project: **FNAL**

### EXECUTIVE SUMMARY

Fermi National Accelerator Laboratory (FNAL) has proposed an infrastructure improvement, replacement and/or revitalization project, the Core Campus Revitalization Projects (CCRP) to address current and future risks to the laboratory's ability to accomplish the mission of the Office of Science. The project breaks down into three major scope areas: Accelerator Controls Modernization, Technology Campus Modernization, and the Wilson Hall Restoration—all of which could be executed as individual or subprojects.

In general, the Committee judged that the need for the respective subprojects are necessary; however, they have identified opportunities to strengthen the justification as the project proceeds toward CD-0. The Committee provided input in the form of recommendations for the project team to consider while preparing the required documentation and recommended proceeding to Critical Decision (CD) 0, Approve Mission Need.

### 1. CONTROL SYSTEM UPGRADE

#### *Findings*

The controls team at FNAL is requesting funding to facilitate the upgrade of the core accelerator control system. The existing system was developed in the 1980s to support Tevatron accelerator operations. Although this original system served the laboratory well, it is quickly approaching the end of its useful life. The existing system consists of both hardware and software components that will be replaced with modern counterparts as part of this upgrade. A parallel project, the Proton Improvement Project II (PIP-II) upgrade, will deploy modern hardware components and a new software control system for a portion of the accelerator complex. The remaining accelerator areas will continue to use the existing aging system to support a number of experiments including the Large Baseline Neutrino Facility (LBNF), NOvA, MicroBoone, ICARUS, SBND, Muon g-2, Mu2e and the test beam facility.

This requested upgrade will include hardware component upgrades, including magnet and RF power supplies, control system electronics crates, and other instrumentation support electronics. Along with this hardware, the upgrade will replace many software components including crate support software, the inter module communications layer, user interfaces, and support databases.

#### *Comments*

It is very clear that the accelerator controls systems for the FNAL accelerator complex is in need of an upgrade. The equipment is reaching its end of life, with many components lacking proper spare components and replacement modules. Many of the electronics used have been

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decommissioned in similar beamlines at other national laboratories. New crate and power supply technologies are more efficient, easier to maintain and meet modern safety requirements put in place over time as new safety lessons are learned. Many of these older technologies are not used in other laboratories or commercial institutions, limiting the pool of manpower available with direct experience on these aging platforms. The ability to hire younger talent is minimized as there is little interest in working on outdated technologies.

A similar problem exists in the software infrastructure which makes up the accelerator control system. Low-level software is targeted to outdated platforms and cannot be easily ported to new hardware technologies. Many of these low-level software systems require expensive licensing and should be replaced with open source options which are available along with modern platforms. The overall control system inter-communication layer is custom to FNAL and not used at other institutions. The talent pool available to service this software infrastructure is limited to existing employees and those willing to learn an outdated system. The PIP-II upgrade will introduce EPICs to the FNAL accelerator complex, which opens the talent pool available for maintenance and upgrades as it is used at many other national laboratories.

Modern user interfaces will make it easier to add new beamline components more efficiently and provide a look and feel of a more modern control system. This will reduce the learning curve required when training new operators and users. These new user interfaces will take advantage of new user interface tools, replacing out of date and soon to be deprecated graphical frameworks.

The review material did not fully define which portions of the accelerator will be upgraded as part of this funding request and which portions are already funded under existing beamline projects such as PIP-II. It is very likely the requested funding will not be sufficient to fully upgrade all electronics and software components identified in the described plan. Future reviews should include a closer analysis of the required upgrade effort as compared to the funds being requested.

The review material also did not define a forward looking plan on how to re-train and/or add new staff familiar with modern hardware platforms and software frameworks. Some existing staff will need to be retrained, new staff will need to be hired, and contractors will need to be brought in to fill in the knowledge gaps. A clear plan detailing the impacted systems, organized by accelerator section, will be required in order to determine how many systems can be realistically upgraded with the requested funds. Similarly, the major software components will need to be identified with clear interfaces to other systems in order to properly budget the effort required and prioritize the deployment of these new systems.

### ***Recommendations***

1. Clearly define which accelerator sections are not being upgraded as part of separately funded projects such as PIP-II.
2. Clearly define the scope of the accelerator controls upgrade project, including which physical components and software elements are impacted.
3. Create a list of individual sub-assemblies (hardware and driver software) including the cost of each, by accelerator section.

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4. Create a prioritized list of subsystem upgrades by accelerator section, including cost estimates, which includes items from recommendation 3.
5. Create a list of individual partitionable software subsystems with a clear interface description to other systems.
6. Create a prioritized list of upgrades, including cost estimates, which includes items from recommendation 5.

## 2. TECHNOLOGY CAMPUS IMPROVEMENTS

### *Findings*

This Committee reviewed the Technology Campus Modernization portion of the project scope. FNAL is currently meeting the mission needs of the Office of Science and preparing for an exciting future of continuing the present core missions and adding to those with breaking, evolutionary science opportunities.

The presentation on the Technology Campus Modernization scope restated the charge questions for this review. The Technology Campus Modernization focuses on three separate, distinct geographic areas of the laboratory: the Technology Core Campus, the Village, and Mxx Area (old Meson Lab area). These three areas host multiple core technologies that are critical to the support of the FNAL science mission.

FNAL seeks to consolidate, modernize, and expand on these core technologies through infrastructure investments. Individual core technologies are often spread across more than one geographic area requiring work to be transported from one area to another. Work forces are also spread across these geographical areas within the FNAL campus.

Notional funding profiles were presented for the entire project along with individual ones for the subproject areas. The Technology Campus Modernization scope has an associated cost of \$125.0 million.

### *Comments*

The presentation on the mission critical activities that take place across the FNAL campus was well done and pointed out the extensive research capabilities that currently exist and even capabilities that are thought to be needed. Unfortunately, there was very little presented that pointed to any capability gaps. The current needs are being met with the existing facilities. Yes, the geographic locations do present some challenges that so far are being handled. Yes, the facilities are aging and will probably be problems in some number of years. Yes, additional space may be needed for current activities and more needed for future activities. And yes, some buildings and infrastructure needs to be replaced or need immediate renovation.

Many of the capability gaps that were presented really were not gaps but risks that resulted from a number of conditions which include aging infrastructure.

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The Committee determined there are deficiencies but little or no real impacts were presented during the review. It is understood that equipment needs to move from one site to the next, and yes it takes time but so far FNAL has been very successful at doing it. The presenter was unable to give examples of harms that occurred to equipment as a result of transportation within the Laboratory.

An integrated, modern, updated, expanded Technology Campus is a “nice to have”, not a “must have”. It is a matter of priorities, for which none were really presented, either within the three subprojects or among the three scope areas themselves. If this Committee were to prioritize the three based on what was presented, the accelerator controls modernization would be first, with the restoration of Wilson Hall second, and third would be modernization of the Technology Campus. However, that said, there are elements of the Wilson Hall renovation that the Committee would prioritize higher than some scope in accelerator controls modernization. The Technology Campus does have some areas that should be addressed with similar priority as the top items in the other two subprojects; however, what those areas are and what it would take to address them was not clear.

However, there is a serious need for an influx of capital funds to accomplish needed upgrades, improvements, enhancements, and some D&D. The level of funding needed is high and that sets the bar high for the Mission Need Statement (MNS). The project is probably best served if the MNS is written as an overarching mission need designed to be the parent of subprojects. The MNS needs to include some form of strawman list of things that could be accomplished with in the current budget range. Granted, these are pre-conceptual estimates, but it would provide DOE leadership with an idea of what they are buying. More details will come with a conceptual design from the alternatives reviewed and finally selected.

### ***Recommendations***

7. Rewrite the MNS to establish a clear set of prioritized needs, gaps, or risks that need to be addressed and present a least one potential approach to meet them that supports the cost range and schedule presented.
8. Organize the MNS as an umbrella document that can be used to stand up either one large project with multiple subprojects or multiple smaller standalone projects.
9. Define a set of alternatives to be evaluated that are applicable to the particular scope being defined.

## **3. WILSON HALL RESTORATION**

### ***Findings***

The 16-story Wilson Hall Building is the iconic focal point of FNAL campus and was constructed about 45 years ago. It is the main office for 40% of FNAL’s staff and supports users, guests, and visiting public.

The project identified as a gap the need for office, meeting, and collaboration space for staff, users, and collaborating institutions. The Wilson Hall Restoration was identified as a subproject

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to address this gap. FNAL also identified that corrective maintenance has increased over the years indicating the condition of Wilson Hall is degrading. Numerous safety concerns, modern code compliance issues, and degrading piping and controls issues contribute to the need for renovation of Wilson Hall. One to two times per month, Femilab is experiencing impacts to its operations on one of Wilson Hall floors.

A recent renovation/modernization of one floor of Wilson Hall resulted in the number of usable employee spaces increasing by 20%. This recent renovation also provided a good basis of estimate for the modernization aspect of this project.

Four preliminary alternatives at CD-0 were considered. Cost basis was estimated based on previous projects and includes a 30-50% contingency level.

The three subprojects that make up this mission need statement may eventually be separated into separate stand-alone projects.

### *Comments*

FNAL project team members identified that this renovation will address the mission gap regarding office, meeting, and collaboration space for staff, users, and collaborating institutions. However, the primary message presented was about the many issues related to utilities, envelop deficiencies, life safety, modernization, improved entrance, and parking. Considering the safety concerns, code issues, and degrading conditions, FNAL has a case for the renovation of Wilson Hall. However, information was not well presented about how this project will satisfy the overall mission gap for office, meeting, and collaboration space.

The MNS could be improved to better capture how it addresses the mission gap, while also addressing the many issues that are impacting operational efficiencies. Doing so should better help define the scope and the priorities of the Wilson Hall renovation within what appears as a constrained budget, for example, it may help justify the number of floors that need to be modernized to improve utilization that will address the mission gap while still addressing the critical safety concerns and code issues.

The nature of this project will likely disrupt the office efficiency while underway. A space management board looking at flexi-space needs in the context of temporarily displacing individuals impacted by ongoing and future projects is a benefit to minimize potential impacts to ongoing operations.

The alternatives considered as part of CD-0 appear reasonable for the CD-0 stage. However, FNAL should review at the alternatives at CD-1 so that the project is undertaking a clear alternative rather than a portion of many alternatives.

The estimate for Wilson Hall is \$100.0 million and appears to be based on a defined cap rather than the needs. As such, the total cost appears low in light of the minimal understanding of the overall scope. In addition, other project costs at \$1.0 million appears low to perform the conceptual design, moving, furnishings, etc. if they are to be part of the overall project scope.

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When better defined, the proposed scope should be prioritized if accomplishing all the needs cannot be established within the current proposed funding level.

### *Recommendations*

10. Work with HEP to improve the CD-0 documentations and proceed to CD-0.
11. As the project works towards CD-1, work closely with HEP to understand the entire scope of the project to ensure the critical priorities are addressed within the available funds.

## 4. COST and SCHEDULE

### *Findings*

The CCRP includes three large subprojects proposed as part of the draft MNS including:

**Accelerator Controls Modernization**—\$125.0 million with a six year duration

- Update existing site-wide accelerator control systems to support accelerator operations and future FNAL projects

**Technology Campus Modernization**—\$125.0 million with a ten year duration

- Provide sufficient space in the FNAL Central Campus to co-locate engineers and technicians
- Update detector science and technology facilities
- Update/construct High bay assembly and production facilities

**Wilson Hall Restoration**—\$100.0 million with a seven year duration

- Update office, meeting, and collaboration space for staff, users, and collaborating institutions

The pre-CD-0 Total Project Cost (TPC) range is \$200-350.0 million and the project duration is ten years beginning with \$5.0 million Other Project Cost (OPC) funding in FY 2020 and completing in FY 2029. The CCRP team noted that the preliminary TPC includes 30-50% project contingency.

The pre-CD-0 preliminary funding profile for the project is shown below:

Fiscal Year	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029	Total
Other Project Costs (OPC)	\$ -	\$5.0	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$2.0	\$7.0
Total Estimated Cost (TEC)	\$ -	\$ -	\$28.0	\$35.0	\$45.0	\$50.0	\$50.0	\$50.0	\$45.0	\$35.0	\$5.0	\$343.0
Total Project Cost (TPC)	\$ -	\$5.0	\$28.0	\$35.0	\$45.0	\$50.0	\$50.0	\$50.0	\$45.0	\$35.0	\$7.0	\$350.0

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The draft MNS states that the preliminary options supporting the alternatives analysis have been identified, which may be implemented in combinations or phased over time as separate scopes of work.

### ***Comments***

The CCRP team did a credible job of presenting information describing high-level capability gaps, risks, and impediments that are appropriately tied to preliminary project requirements at this stage of the project. The proposed project includes a broad array of projects ranging from facility construction and rehabilitation to construction of accelerator control systems in a single, draft MNS. Taken individually, the subproject preliminary TPCs appear reasonable for this stage of the project. However, the current preliminary point estimate is also at the top of the cost range allowing little room for error given the dissimilar nature of preliminary project scope.

The preliminary alternatives described in the draft MNS should continue to be refined based on the specifics of each subproject, to ensure a credible and unbiased evaluation is prepared. The project should consider preparing separate Analysis of Alternatives and Lifecycle Cost Analyses for each subproject to support the CD-1 decision. The project should consider breaking down the cost table in the draft MNS by subproject that totals to the preliminary TPC of \$350.0 million to better illustrate the time-phasing of funding.

As the project proceeds to CD-1, the CCRP team and HEP should evaluate the time-phasing of the subprojects to prioritize critical work and optimize the funding profile and project schedule. As the project proceeds to CD-1, FNAL should also continue developing the management and project integration teams to ensure appropriate coordination with other projects and programs is continued.

### ***Recommendation***

12. Proceed to CD-0.

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Appendix A  
Charge Memorandum



Department of Energy  
Office of Science  
Washington, DC 20585

JUN 17 2019

MEMORANDUM FOR RONALD LUTHA  
ACTING DIRECTOR  
OFFICE OF PROJECT ASSESSMENT

FROM: MICHAEL PROCARIO   
DIRECTOR, FACILITIES DIVISION  
FOR HIGH ENERGY PHYSICS

SUBJECT: Request to Conduct a Mission Validation Independent Review for the  
Core Campus Revitalization Projects at Fermilab

I request the Office of Project Assessment organize and conduct a Mission Validation Independent Review on August 7, 2019, in Germantown, Maryland, for the Core Campus Revitalization Projects at Fermilab. The purpose of this review is to assess the current capability gaps, potentials benefits, and preliminary cost range for the proposed projects to support the development of their Mission Need Statement.

In carrying out this charge, the review committee should consider the following questions for each project:

1. Mission Need: Is the documentation adequate to confirm that a specific capability gap, risk, and/or impediment exists to the execution of Office of Science mission?
2. Program Requirements: Are high-level requirements sufficiently defined to identify preliminary alternatives to address the capability gap, risk, and/or impediment? Are the preliminary alternatives reasonable for this stage?
3. Cost Range and Schedule: Are the preliminary cost range and preliminary schedule reasonable for this stage of the project? Does the cost range bound the preliminary alternatives deemed to be viable? Is planning for this project being appropriately coordinated to ensure that it does not interfere with ongoing operations or projects?

For this review, Dr. John Kogut will serve as the point of contact with the Office of HEP.

I would appreciate receiving the final report within 60 working days after the conclusion of this review.



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Appendix B  
Review Committee Participants

## DOE/SC Mission Validation Review (MVIR) of the Core Campus Revitalization Projects (CCRP) at FNAL August 7, 2019

### REVIEW COMMITTEE PARTICIPANTS

#### Department of Energy

Kurt Fisher, DOE/OPA, Chair

#### Review Committee

##### *Control System Upgrade*

Ryan Herbst, SLAC

##### *Technology Campus Improvement*

Phil Kraushaar, DOE/BES

##### *Wilson Hall Renovation*

James Hawkins, DOE/NP

##### *Cost and Schedule*

Ethan Merrill, DOE/OPA

\*Lead

#### Observers

Mike Procaro, DOE/HEP

John Kogut, DOE/HEP

Ted Lavine, DOE/HEP

Gary Brown, DOE/SLI

#### FNAL Participants

Karen Kosky, FNAL

Dennis Nicklaus, FNAL

Anna Grassellino, FNAL

Jonathan Lewis, FNAL

Katherine Gregory, FNAL

Mary Convery, FNAL

Adam Walters, FNAL

Allen Schmitt, FNAL

Adam Bihary, DOE/FSO

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Appendix C  
Review Agenda

### DOE/SC Mission Validation Review (MVIR) of the Core Campus Revitalization Projects (CCRP) at FNAL August 7, 2019

#### AGENDA

DOE Germantown Facility, Conference Room G-207  
Call-In Number: 646-876-9923 ~ Meeting ID: 515 400 7922

#### Wednesday, August 7, 2019

9:00 am	DOE Full Committee Executive Session.....	K. Fisher
9:30 am	FNAL Campus Infrastructure Planning, CCRP Context .....	K. Kosky
10:00 am	Accelerator Controls Modernization.....	D. Nicklaus
10:45 am	Break	
11:00 am	Technology Campus Modernization.....	A. Grassellino
12:15 pm	Lunch	
1:15 pm	Wilson Hall Restoration.....	K. Kosky
2:00 pm	Break	
2:15 pm	DOE Full Committee Executive Session.....	K. Fisher
3:00 pm	Final Questions/Wrap-Up or Closeout Presentation.....	K. Fisher
3:30 pm	Adjourn	