Mission Need Statement
for the
Thomas Jefferson National Accelerator Facility
Utilities Infrastructure Modernization (UIM)

Non-Major System Acquisition Project

Submitted September 2009

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The undersigned have reviewed the mission need for this project and believe it is consistent with TJNAF's Ten Year Site Plan of June 2006. The undersigned concur that this project is needed to better accomplish the DOE's missions being performed by the laboratory in a cost-effective, reliable, safe and productive manner.

Concurrences

Richard Korynta, SC-TJSO
Federal Project Director
Thomas Jefferson Site Office

8-14-09
Date

James A. Turi, SC-TJSO
Manager
Thomas Jefferson Site Office

August 14, 2009
Date

Recommend for Approval

Gordon Fox, SC-31
Program Manager
Office of Safety, Security and Infrastructure

8/18/09
Date

Daniel R. Lehman, SC-28
Director
Office of Project Assessment

8/19/09
Date

Marcus Jones, SC-31
Associate Director
Office of Safety, Security and Infrastructure

9/8/09
Date

Approval

After reviewing the project justification material, including the positive recommendation from the Office of Project Assessment (SC-28), I find the Statement of Mission Need for the Technology & Engineering Development Facility project satisfactory and authorize DOE-TJSO to proceed to CD-0.

W. F. Brinkman, SC-1
Director
Office of Science

SEP 18 2009
Date

A. Statement of Mission Need

As a result of growth in the mission at the Thomas Jefferson National Accelerator Facility (TJNAF) and the aging of existing utility systems, the TJNAF cryogenic, power distribution, cooling water, and communication systems are no longer adequate to support SC mission requirements. This includes the ongoing program as well as research development and production of critical components for current and future SC mission needs.

B. Alignment

The mission of the Department of Energy's Office of Science is to deliver the remarkable discoveries and scientific tools that transform our understanding of energy and matter and advance the national, economic, and energy security of the United States. The Office of Science executes this mission by managing fundamental research programs in basic energy sciences, biological and environmental sciences, high energy and nuclear physics, fusion and computational science. In addition, the Office of Science is the Federal Government's largest single funder of materials and chemical sciences, and it supports unique and vital parts of U.S. research in climate change, geophysics, genomics, life sciences, and science education.

Another critical element in the execution of this mission is the management of 10 world-class laboratories, which often are called the "crown jewels" of our national research infrastructure. The national laboratory system, created over a half-century ago, is the most comprehensive research system of its kind in the world. The mission of the Science Laboratories Infrastructure (SLI) program within the Office of Science (SC) is to support the conduct of Departmental research missions at SC laboratories by funding line item construction for revitalization and repair of the general-purpose infrastructure, and by cleaning up and removing excess facilities that are not transferable to the Office of Environmental Management.

TJNAF is a SC Laboratory that supports a growing national and international community of scientific users conducting forefront science, applying core competencies to advance science and national goals, producing annually one third of our nation's nuclear physics PhDs, and enhancing math and science education for our community in support of the DOE mission. TJNAF has a central and unique role in the field of nuclear physics, both in the U.S. and worldwide. TJNAF's present and future program relies on maintaining its role as the world leader in hadronic physics and superconducting accelerator technologies.

C. Capability Gap

The TJNAF cryogenic, power distribution, cooling water, and communication systems are experiencing failure at increasing frequencies and have insufficient capacity to meet current and forecasted need. This project is needed to address performance gaps in

respect to providing a work environment that meets safety goals, current code standards and operational efficiency goals.

The current utility system gaps at TJNAF jeopardize its capability to provide the unique competencies to deliver its mission and customer focus, to perform a complementary role within the DOE laboratory system, and to attain the vision for scientific excellence and pre-eminence in the structure of nuclear building blocks, the underlying quark-gluon structure of the nucleus; and symmetry tests including the weak charge of the proton to test predictions of the Standard Model. In addition these gaps jeopardized TJNAF's capability to contribute to enabling technologies and emerging fields in photon science and electron-light ion colliders including advance radiofrequency superconductivity, 2K cryogenic engineering technology, photon science, advanced high power free electron lasers, energy recovering linacs (ERLs), and electron-light ion collisions at ultra-high luminosity. These enabling technologies also support the ongoing research programs and projects at TJNAF including 6 GeV, 12 GeV, and the Free Electron Laser as well as other DOE national and international projects including SNS, FRIB, EIC, APS, and ILC.

The cryogenic, power distribution, cooling water, and communication systems are 20 to 40 years old. The cryogenic system has insufficient capacity and despite significant gains over the past several years on significantly improving the efficiency of major system components, there remains a need for overall system efficiency optimization. Currently the cryogenic capacity is inadequate to support the needs in the Test Lab which is the key facility for Superconducting Radiofrequency (SRF) development and production activities. The lack of adequate cryogenic capacity is a limiting factor on scheduling SRF activities. Cryogenic system operation at TJNAF accounts for over 90% of annual electricity costs. Therefore efficiency gains in this system will significantly contribute to a reduction in overall operating costs. Electricity energy savings from an upgrade to the Cryogenic Test Facility (CTF), a key component in the cryogenic system, are estimated to be 36%.

The capacity of the power distribution system is currently taxed to its limit and will not support future projected needs. The power distribution system does not have the necessary redundancy to maintain operation of critical systems during partial power outages. The most critical element of this gap is the inability to restart the Central Helium Liquefier (CHL) from the alternate power feed when the primary feed has an outage. The CHL is the largest component in the site cryogenic system and critical to maintaining constant cryogenic temperatures in the accelerator cryomodules necessary to prevent degradation of accelerator performance and costly repairs. Electric feeders are at the end of their service life and are near failing. Insulation cracks have been observed on multiple feeders. Recent interruption to accelerator operation due to failed components of the electrical supply heightens this concern.

The cooling water distribution system is suffering frequent failures and has insufficient capacity to support optimal experimental program scheduling, computer center heat loads, and future expected growth. Over the past year failure of the cooling water distribution system has caused several weeks of down time for the Free Electron Laser facility. Cooling towers are well past their efficient life cycle utilization and are

requiring ever increasing amounts of maintenance. In addition, there is an estimated energy savings from addressing this gap of 10%.

Subsurface communications systems are outdated and unreliable. Because some of these systems are over 40 years old replacement components are often unavailable. Phone switch parts are difficult to locate and no additional cabling capacity is available for telecommunications or data lines. Inadequate capacity is impacting the ability to install communications to support staff growth and replace degraded cables as necessary. This equipment has reached the end of its life cycle. Consequently, instances of phone outages are impacting the efficiency of operations. The underground copper wiring is also past its service life. In addition, installation of an Emergency Broadcast System is necessary to meet safety goals and improve efficiency of response.

These capabilities are essential to operation of TJNAF. Universities have historically come to TJNAF for support because of the unique SRF production capabilities at the Laboratory. Similarly commercial availability for SRF is limited because of the intermittent nature and relatively small quantities of SRF components that are needed nationally. When possible, commercial production capability is used. Because of the uniqueness of this facility the work cannot be performed at universities.

D. Approach

The solutions to addressing the utility system performance gaps at TJNAF are relatively non-complex. Upgrades and expansion of cryogenic, electrical power distribution, cooling water, and communication systems are needed.

Strategies to Meet Mission Need

The key component of the cryogenic system that needs to be expanded and better integrated is the Cryogenic Test Facility (CTF). The CTF building is undersized for the current equipment and piping, and the current capacity is inadequate to serve the load in the Test Lab. An expansion of the current building is being considered to address the current overcrowding of system components and to allow for installation of additional equipment to meet the Test Lab demand. An adequately sized building would allow installation of cryogenic equipment that could double the cryogenic capacity with no resulting increase in energy consumption.

Upgrades and expansion of the electrical power distribution system being considered include replacement of primary and secondary feeders to approximately 26 substations currently beginning to fail. The system would be expanded to ensure redundancy by increasing site alternate power feed from 400 Amps to 1200 Amps. This would be sufficient backup to the primary feed to allow restart of the CHL.

Cooling water upgrades being considered include replacement of up to 9 existing cooling towers that are 20 to 40 years old. The replacement cooling towers would have increased capacity and would be co-located to allow greater efficiency and reduce the need for idle redundancy. This will reduce replacement, maintenance, and energy costs.

Communication system upgrades being considered include replacement of 20 to 40 year old underground communication and data cabling by providing distributed communication huts with a new underground distribution pathway. This would include a fiber optic backbone with approximately 630 miles of fiber optic cable and 40 miles of building computer cable. State of the art telephone support systems and an emergency broadcast system would also be provided.

Ongoing studies to refine the alternatives and approach are in process. This project will have the potential to disrupt accelerator operations and the experimental program as well as SRF work in the Test Lab. This is due to the extent of utility upgrade activities and integral nature of utilities support for all major operations. The UIM work will have to be phased to allow the Experimental Program schedule to be executed and critical necessary development and production activities to continue. A detailed phasing schedule will be developed during the conceptual design development to minimize disruption of work and personnel. An ideal time for this work to minimize operations impact would be during the currently planned 6 month accelerator down period in FY 11 and a 12 month accelerator down period starting in FY12.

Mission-Level Assumptions

To mitigate disruption to Lab activities, alternatives will be evaluated and additional planning and scheduling will be carried out in order to assure safety while avoiding negative impacts on accelerator operations, or other critical Lab activities. To accomplish this, temporary accommodations will be provided to the extent needed to assure continuity of services and minimize interruptions to the science programs and goals at JLab and other organizations. Close and continuous collaboration between the UIM project and Lab operations will be maintained to ensure minimal disruption.

Constraints on Solutions

The project will be designed and constructed in accordance with applicable Public Laws, Executive Orders, OMB Circulars, Federal Property Management Regulations, and DOE Orders. In addition, it will be designed and constructed to promote the goals of the Energy Policy Act of 2005 and Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management." All systems will be designed to applicable ASHRAE standards. The work will be consistent with DOE policy regarding LEED certification.

Planning, acquisition, siting, designing, building, operating, and maintenance decisions for this project will be based on considerations of High Performance and Sustainable Buildings principles. All new equipment and systems will be selected to achieve energy efficiencies and utilize "green" building technologies to the maximum extent possible. Application of Federal sustainable design principles for energy efficiency/sustainable design will be employed to the extent feasible in this project to comply with Federal performance standards. A goal of using 30% less energy than the ASHRAE 90.1 2004 standard will be applied to this project as applicable.

All work will comply with all requirements of the National Environmental Policy Act (NEPA) and its implementing regulations. The construction activities will be located in areas not subject to flooding determined in accordance with Executive Order 11988.

The total estimated cost of the project includes the cost of measures necessary to assure compliance with Executive Order 12088, "Federal Compliance with Pollution Control Standards"; section 19 of the Occupational Safety and Health Act of 1970, the provisions of Executive Order 12196, related Safety and Health provisions for Federal Employees (CFR Title 29, Chapter XVII, Part 1960); and the Architectural Barriers Act, Public Law 90-480; and to implement instructions in 41 CFR 101-19.6. There is no anticipated adverse impact on the cost at this point.

There are no environmental health and safety issues requiring extra scrutiny expected on this project. If hazards such as asbestos and lead are encountered, they will be removed and encapsulated or handled appropriately by other means as the issues are identified. There is always the potential for these hazards to be found in paint, roofing and insulated pipes. TJNAF will ensure that testing for lead and asbestos to determine if there is contamination is done prior to the start of design by the A-E. No work will be allowed to take place until areas have been decontaminated and any problems have been corrected.

The TJNAF site is patrolled by a guard service 24 hours a day. The TJNAF conducts only non-classified activities. This project has no classified aspects therefore no changes in safeguards and security requirements are foreseen. TJNAF has established administrative procedures and physical controls for access to all areas and buildings site-wide which will be applied to this project.

The TJNAF staff is highly qualified and has handled many projects similar to this one that require extensive coordination and interaction between construction subcontractors and laboratory personnel. TJNAF has established procedures, which require extensive planning with DOE managers, personnel representatives, Facilities Management and the subcontractors prior to commencement of design and construction activities.

There are potential interface issues with the 12 GeV CEBAF Upgrade Project and the TEDF Project. Contingency planning will be performed during the conceptual design phase of this project to examine and to minimize potential impact to other major line item projects. No other significant interface issues are anticipated with existing or planned acquisitions, pending approval and funding of the previously mentioned accelerator projects (FEL, SNS, FRIB, EIC, APS, and ILC).

Cost control during design will be managed by obtaining cost estimates at the various design phases with contingency, value engineering, and design reviews conducted in accordance with established procedures. Design activities for this project will be constrained using a "design to cost" approach. Acquisition for design activities will incorporate requirements to hold design subcontractors accountable for construction cost estimates.

Offsetting space needed for this project will come from space banked to offset new construction at TJNAF by the Science Laboratory Infrastructure program. The recently

approved TJNAF Secretarial Waiver provides offsetting space for planned projects in the TYSP through FY 2017.

Safety and Safeguards and Security Issues

The project will be designed and executed in accordance with current applicable public laws, codes, standards, DOE Orders, and best management practices. Normal building permits are anticipated. Since TJNAF is a non-nuclear low hazard facility, Section 3.1 of DOE Standard 1189, Integrated Safety into the Design Process, dated March 2008 is not applicable. No Safeguards or Security issues are anticipated.

E. Resource and Schedule Forecast

The Total Estimated Cost (TEC) range estimate for the mission need analysis is $24.3 M - $29.2 M and the Total Project Cost range for this project is $25.0M to $29.9M. The expected source of funding is the Science Laboratories Infrastructure Program.

The cost estimate range is based on the following schedule:

CD-1:	Approve Alternative Selection and Cost Range	FY 2010
CD-2/CD-3a:	Approve Performance Baseline/Initial Const.	FY 2011
CD-3b:	Approve Start Balance of Construction	FY 2012
CD-4a:	Approve Start Operations - Initial Elements	FY 2014
CD-4b:	Approve Start Operations - Balance of Elements	FY 2014

The following funding profile is needed to support this schedule (based on the high end of the TEC):

FY 2011	$1.8M PED & $ 6.0M Const.
FY 2012	$7.7M
FY 2013	$13.7M

The estimated cost (Other Project Cost) to support programmatic strategic planning, complete conceptual design, and prepare the project documentation to proceed from CD-0 to CD-1 is $ 700k.