# Statement of Mission Need
# for the
# Thomas Jefferson National Accelerator Facility
# Technology & Engineering Development Facility (TEDF)
# Office of Science
# Laboratory Policy & Infrastructure Division

## Non-Major System Acquisition Project

**Submitted September 2007**

**Originator:** **James A. Turi**
**Manager, Thomas Jefferson Site Office**
**757-269-5094**

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**Thomas Jefferson National Accelerator Facility**
**Technology & Engineering Development Facility (TEDF)**
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## A. Mission Need

Science Laboratories Infrastructure Program Mission

The mission of the Science Laboratory Infrastructure program within the Office of Science (SC) is to support the conduct of Departmental research missions at SC laboratories by funding line item construction to repair the general-purpose infrastructure, and by cleaning up and removing excess facilities that are not transferable to the Office of Environmental Management (EM). In support of this mission, Thomas Jefferson National Accelerator Facility (TJNAF) has established goals and objectives in the "Ten-Year Site Plan" for the infrastructure at the laboratory.

The 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. These core competencies enable TJNAF to deliver its mission and customer focus, to perform a complementary role within the DOE laboratory system, and to attain its 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 to Nuclear Physics, TJNAF contributes to enabling technologies and emerging fields – 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 technologies support the ongoing research programs and projects at TJNAF including 6 GeV, 12 GeV, and Free Electron Laser as well as other DOE national and international projects including SNS, RHIC, and ILC.

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. TJNAF's recapitalization and modernization needs include: renovation of the Test Lab to improve safety and efficiency; correcting building code issues; updating building systems and equipment; new office space to consolidate staff and allow elimination of

deteriorated trailers and shipping containers used for storage; termination of leased office space offsite; and additional technical, experimental, and storage space.

Prioritization

TJNAF's Ten-Year Site Plan identifies projects needed as a platform for the science and technology mission of the laboratory. This project was the highest priority in the plan and provides needed infrastructure improvements to correct facility gaps that will benefit TJNAF operations as well as support other laboratories and support the SC mission.

A Capital Asset Management (CAMP) Score of 67 was assigned to this project based on mission impact.

## B. Analysis to Support Mission Need

There has been a shortage of technical development and support space since the Continuous Electron Beam Accelerator Facility (CEBAF) was originally constructed in the late 1980s. Success of the program and the ever increasingly complexity of experimental apparatus have overstressed the availability of adequate space. Currently over 150 accelerator and physics engineers and technicians are spread across the site in accelerator service buildings (klystron galleries), tunnel access buildings, and trailers which are characterized as inefficient and poor quality work environments. Experimental apparatus are continually shifted to make room for other experimental setup activities.

Using Service Buildings as work space

Trailers have played a major role at the Lab in providing space for office, work benches, and development labs. Over 17,000 square feet of trailers are currently being used as technical work and support space across the Lab. This project will remove between 10,000 and 12,000 square feet of dilapidated trailer space.

Trailer space being used as technical work space

A large portion of the superconducting accelerator technologies work at TJNAF is being performed in the 96,000 square foot Test Lab building. The Test Lab building was constructed in 1965 and initially used for National Aeronautics and Space Administration (NASA) research. The building contains a 40 foot High Bay, fabrication and shop areas, laboratories and clean rooms, as well as offices. This project will correct the Test Lab building code deficiencies associated with mixed-use occupancies and egress deficiencies that have to be mitigated by administrative controls.

Elevated Work Areas (Pueblo Style)

The Test Lab is the home of the Lab's Superconducting Radio Frequency (SRF) research and production, magnet test facilities, physics program staging areas and several other groups. The layout of the building was inherited from NASA and is dominated by several large concrete shielding enclosures that were used to house a NASA cyclotron facility. These structures were adapted for CEBAF production when the building was taken over in the late 1980's and were useful for the development of shielded test areas for superconducting cryomodule production. As the complexity and scope of the SRF development and production processes have evolved, those same features and the multiple uses for the building have resulted in a convoluted and inefficient work flow through the building. Components often have to be transported back and forth through the building many times, which requires multiple lift rigging processes for access to production areas at different elevations.

Transport of Completed Cryomodule to Test Cave

Key electrical system components have surpassed their life expectancy and replacement is necessary to prevent a prolonged unscheduled shutdown of the facility. In addition, many of the other building systems have surpassed their life expectancy by many years and need to be replaced.


1960s Vintage Electrical Systems

Mechanical and electrical systems over 40 years old contribute to the deteriorated condition of the Test Lab. Numerous components in these current systems are no longer commercially available. The building has never undergone a major rehab of its systems or components. The three main air handlers serving the High Bay area are well past the end of their design life, and a number of other air handlers that were installed in 1987 are nearing the end of their life cycles. A HVAC renovation to replace these systems and upgrade all systems to full electronic control will improve maintainability and energy management capabilities. The electrical systems are of the same vintage. As this equipment degrades and becomes unreliable, it poses increasing risk of fire or arc flash hazards. Renovation of the electrical distribution system will increase safety and enable improved load distribution and flexibility for future power utilization.

Environmental management functions such as waste water treatment, waste acid neutralization and air handling are complicated by the piecemeal evolution of the Test Lab with multiple systems of differing vintage being used to maintain safe and environmentally responsible conditions. A significant portion of plumbing remains from the original construction, and needs rehabilitation to ensure future reliability of services and to assure dependable environmental protection.

Numerous work items are required to bring the building up to current codes and standards. Many aspects of the building, while meeting code at the time of construction, do not meet current safety code standards, regulations and practices. Currently, in order to comply with code requirements, administrative controls are required in certain work areas. To bring the building up to current safety and accessibility standards a number of upgrades are required to stairways, walkways, guardrails, the fire alarm system, fire doors, fire walls, door hardware, and signage.

The improvements to the work environment of this project provides will also improve the morale of staff currently in areas not intended as work space such as in service buildings or in offices built on large concrete shielding enclosures with access by suspended walkways . This project will also enhance the laboratory's ability to attract and retain world-class scientists by providing a quality work environment.

In addition, mechanical and electrical upgrades will result in reduced energy cost. The improved process layout and use of space is expected to result in increased efficiency and improved safety. The completed project will reduce energy costs by approximately 30 percent and provide a quality work environment that will enable technical support needed for future DOE science programs.

The proposed scope of this project includes rehabilitation of the Test Lab and providing for additional technical space. The Test Lab is currently and will continue to be used for highly specialized superconducting accelerator technologies work, extremely large detector assembly, and SRF research and production. The new technical space is needed to address the current severe shortage of space to support the same functions as well as the overall technical support needs for the Laboratory.

## C. Importance of Mission Need and Impact if Not Approved

This project is needed to address the overall health of the Laboratory to perform core competency activities safely and efficiently. It will provide a work environment that meets current code standards, operational safety goals, and efficiency goals for R&D, fabrication, and assembly, and acceptance testing of cryomodules and experimental equipment used at TJNAF for 6 GeV, 12 GeV, and FEL as well as for other DOE projects (SNS, RHIC, FRIB, and ILC).

As stated in Section A, it is anticipated that as a result of TJNAF's reputation and expertise as a "National SRF Center of Excellence", TJNAF will be used in the design and construction of cryomodules for future Office of Science accelerator projects. Renovation of the Test Lab along with the additional technical space will ensure that TJNAF facilities can reliably support production of advanced cryomodules with the quality required for future projects and sustain the current high demand for mounting numerous unique large scale particle detectors.

To enable further advancement of TJNAF state of the art research capabilities, it is necessary to reconfigure the layout of laboratory, shop, clean room and office areas to provide efficient and effective work flow and assure safe working conditions across the Laboratory. The Test Lab Rehabilitation along with the additional technical space under this project will address many of these limitations by streamlining the production process, renovating or replacing obsolete infrastructure, relocating critical production and testing facilities to more appropriate locations, and consolidating emerging research and technology development functions.

If this project does not receive mission need approval, it will increase the likelihood that the laboratory will be unable to fully support SC projects and carryout exceptional science,and the TJNAF mission with a safe, efficient and environmentally sound workplace. TJNAF excellence in the areas of SRF technology, accelerator cryogenics, and energy recovery linacs will be challenged. Specific capabilities for cryomodule production, nuclear physics detector setup, and supporting technical functions that will be impacted if this project is not funded are:

- Niobium cavity fabrication including precision electron beam welding applications
- Cavity cleansing to the atomic level using highly specialized chemical and electropolishing processes
- Injector system design and testing for highly polarized delivery of electrons with uniquely configured time scales for the continually evolving experimental program
- Cryogenic systems to meet the growing demand for 2 degree K helium, reliably, and efficiently. TJNAF has the largest 2 degree K cryogenic system in the world.
- Massive detector assembly (>500,000 lbs)
- Vacuum systems capable of achieving state-of-the-art sub-atmospheric pressures
- Data collection system assembly incorporating hundreds of miles of cable assembly and testing

The following project alternatives will be further analyzed as warranted, as part of the CD-1 process:

- Alternative 1: Do nothing (i.e., continue to operate buildings under current conditions and procedures, continue to work out of trailers and inefficient work space).
- Alternative 2: Acquire a new laboratory building and renovate the existing Test Lab building.
- Alternative 3: Use non-capital alternatives to provide new space and renovate the existing Test Lab to meet minimal current safety standards with capital funds.
- Alternative 4: These capabilities are essential to operation of the Laboratory. If these capabilities were moved to another national laboratory, TJNAF would loose its core competencies and be unable to continue to fill its unique role in supporting the SC mission. Similarly, moving these capabilities to a university would compromise the Laboratory's ability to support the SC mission.

- Alternative 5: Universities have historically come to TJNAF for support because of the unique SRF production capabilities at the Laboratory. This production capability is critical to maintaining the core competencies of the Laboratory and needed because of the very limited commercial availability. Commercial availability 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. Constraints and Assumptions

Operational Limitations

Due to the extent of the proposed renovations, occupation of the building may have to be limited for the majority of the time during rehabilitation. Rehabilitation may have to be phased to allow critical necessary development and production activities to continue. Personnel and equipment will be relocated as work spaces are renovated. A detailed phasing schedule will be developed during the conceptual design development to minimize disruption of work and personnel.

To mitigate disruption to Test 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 cryomodule development and production, or other activities that are performed in the building. To accomplish this, temporary accommodations will be utilized to the extent possible to assure continuity of services and minimize interruptions to the science programs and goals at JLab and other organizations. The intent is to use the additional space constructed under this project to accommodate relocation of personnel and production rather than leasing space off site. It is expected that this will be more cost effective and will provide close, continuous collaboration between Test Lab operations and the accelerator operations and associated staff.

Organizational, Geographical, or Environmental Location Limitations

This project upgrades the Test Lab and constructs additional space with associated infrastructure in the adjacent area. The nature of the Test Lab building makes it impractical to consider abandoning the building and replacing it with a new facility. The Test Lab is a large concrete structure with many areas designed to withstand substantial floor loading. Removal of the existing facility is estimated to be more costly than the proposed rehabilitation.

Standardization and Standards Requirements

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.

Sustainability Considerations

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.

Environmental, Safety and Health Requirements

All work will comply with all requirements of the National Environmental Policy Act (NEPA) and its implementing regulations. The project will be located in an area 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.

Because the Test Lab was constructed in 1965, there are some environmental health and safety issues requiring extra scrutiny and resources that have to be considered. During demolition, there might be hazards such as asbestos and lead that will have to be removed and encapsulated. These materials may be found in floor tiles, paint, roofing and insulated pipes. TJNAF will ensure that testing for lead and asbestos to determine the extent of contamination is done prior to the start of design by the A-E. No work will be allowed to take place until the space has been decontaminated and the problem has been corrected.

Safeguards and Security Considerations

The TJNAF site is patrolled by a guard service 24 hours a day. The TEDF conducts only non-classified activities therefore no change in safeguards and security requirements are foreseen. TJNAF has established administrative procedures and physical controls for access to all buildings site-wide.

Interfaces with Existing and Planned Acquisitions

The TJNAF staff is highly qualified and has handled many renovation projects that required relocation and collocation of personnel and 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. Contingency planning will be performed during the conceptual design phase of this project to examine and to minimize potential impact to the 12 GeV Upgrade Project. Current planning schedules for this project and the 12 GeV Upgrade Project allow for completion of most cryomodule production prior to start of the Test Lab rehab elements of work. No other significant interface issues are anticipated with existing or planned acquisitions, pending approval and funding of the previously mentioned accelerator projects (FEL, SNS, RHIC, FRIB, and ILC).

Affordability Limits on Investment

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.

Goals for Limitations on Recurring or Operating Costs

Application of Federal sustainable design principles for energy efficiency/sustainable design will be employed to the extent feasible in this upgrade project to comply with Federal performance standards. A goal of using 30% less energy than the ASHRAE 90.1 2004 standard will be applied.

Legal and Regulatory Constraints and Requirements

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.

Stakeholder Considerations

This project would provide modern, flexible work spaces which promote the interaction of the scientific teams. The project will modernize the Lab's oldest facility by installing modern energy-efficient electrical and mechanical systems, establishing appropriate adjacencies to correct mixed use occupancies separation and building code compliance issues, and correct discrepancies in building systems as well as make improvements in the overall use of space to optimize layout for current and planned uses. A detailed phasing schedule will be developed in coordination with building occupants during the conceptual design development to minimize disruption of work and production.

Other Limitations

There are no other limitations expected with program structure, competition and contracting, streamlining, or use of development prototypes or demonstration.

## E. Applicable Conditions and Interfaces

There are no foreseen operational limitations that will interfere with the operation of the accelerator nor cause major disruption of service to the science programs. The need to maintain SRF research development and production during implementation of this project is a key consideration for finalizing the project scope. Use of the new space constructed under this project will support this need. Removal of approximately 10,000 square feet of inadequate and obsolete work space in and next to the Test Lab plus about 12,000 square feet of dilapidated trailers is included in the project. The balance of offsetting space needed would 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.

## F. Resource Requirements and Schedule

The Total Estimated Cost (TEC) range estimate for the mission need analysis is $66M - $72.2M and the Total Project Cost range for this project is $67M to $75M. The expected source of funding is the Science Laboratories Infrastructure Program.

The cost range estimate is based on the following schedule:

| | | |
|---|---|---|
| CD-1: | (Alternative Selection and Cost Range) | 3rd Quarter FY2008 |
| CD-2: | (Performance Baseline) | 3rd Quarter FY2009 |
| CD-3: | (Start Construction) | 1st Quarter FY2010 |
| CD-4a: | (TED Building Operational) | 4th Quarter FY2012 |
| CD-4b: | (Test Lab Operational) | 4th Quarter FY 2014 |

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

| | |
|---|---|
| FY 2009 | $3.7M PED |
| FY 2010 | $12.8M |
| FY 2011 | $16.3M |
| FY 2012 | $39.4M |

Major deliverables required to signify completion of the project include:

- Completion construction of new technical building
- Replacement of obsolete Test Lab systems
- Reconfiguration of Test Lab for efficient work flow including removal of approximately 7,000 square feet of "pueblo style" offices in the High Bay
- Removal of approximately 3,000 square feet of inadequate space next to the Test Lab
- Correction of Test Lab building code deficiencies including:
  - Stairways and walkways
  - Fire detection systems
  - Fire partitions and doors
- Trailer demolition (not less than 10,000 square feet)

Measures used to determine if the project is successful will be completion of the major deliverables, acceptance of all major deliverables by the 4$^{th}$ quarter FY 2014, and completion of the project within the Total Project Cost estimate.

## G. Development Plan

Some of the requirements to be included in the project scope are listed below. However, the exact scope, together with all requirements, will be identified during the Conceptual Design Report (CDR) development. Design will be based on priorities and needs discussed with the research program managers, researchers, and building managers.

Partial list of space requirements:

- Cryogenics shop
- Mechanical shop
- Electrical shop
- Safety Systems
- Chemistry rooms
- Clean rooms
- Laboratories
- Cryomodule Assembly Area
- Magnet Test Area
- Physics Assembly Area
- Supporting Shop Areas
- Office Space

Because of the technical experience and knowledge of TJNAF personnel the TJNAF staff will develop design specifications for use by a competitively awarded A-E design

contractor. The Architect-Engineer (A-E) will perform design through 100% and the subcontract will be managed by the TJNAF operating contractor, Jefferson Science Associates, LLC (JSA). The A-E subcontractor will be selected based on the demonstrated competence and qualifications of potential firms to perform the required design services at a fair and reasonable price.

Construction is being evaluated to be performed in phases under a construction manager arrangement: preliminary site work, construction of the additional space, relocation to the new facility, rehabilitation of the Test Lab, and removal of trailers.

Following completion of design the TJNAF operating contractor will solicit offers from prospective large and small business construction-management firms, and award a best value firm fixed price construction subcontract. Evaluation of offers will include consideration of each offeror's relative experience and past performance in successfully completing similar construction projects.

Inspection of construction will be performed by TJNAF in conjunction with the construction-management subcontractor who will prepare and analyze changes, and review of submittals and other performance related documents.

**TEDF Elevation**

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 — 8-17-07

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

James A Turi — 8/17/07

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

**Recommend for Approval**

Caryle B Miller — 28 August 200 7

Caryle B. Miller, SC-31.2
Program Manager
Laboratory Infrastructure Division
Date

Caryle B Miller — 28 August 2007

John G. Yates, SC-31.2
Director
Laboratory Infrastructure Division
Date

8/28/07

Daniel R. Lehman, SC-1.3
Director
Office of Project Assessment
Date

8/31/07

Dennis G. Kovar, SC-26
Associate Director
Office of Nuclear Physics
Date

9/12/2007

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

## Approval

After reviewing the project justification material, including the positive recommendation from the Office of Project Assessment (SC-1.3), I find the Statement of Mission Need for the Technology & Engineering Development Facility project satisfactory and authorize DOE-TJSO to proceed to CD-0.

Raymond L. Orbach, S-4
Under Secretary for Science

Sept. 18, 2007
Date

## CD-0 Review—TJNAF Technology & Engineering Development Facility

**Recommendations**

The undersigned "Do Recommend" (Yes) or "Do Not Recommend" (No) approval of CD-0, Approval Mission Need Statement, for this project.

Kim K. Chan 9/18/07 Yes ✓ No ___
ESAAB Secretariat, Office of Project Assessment / Date

Paul Brindza 9/18/07 Yes ✓ No ___
Representative, Non-Proponent SC Program Office/ Date

[signature] 9-18-07 Yes ✓ No ___
Representative, Environmental Safety and Health Division/ Date

[signature] 9/18/07 Yes ✓ No ___
Representative, Office of Budget and Planning / Date

Paul Brindza 9/18/07 Yes ✓ No ___
Representative, Security Management Team / Date

___ Yes ___ No ___
Representative, Grants and Contracts Division / Date

Carole B Miller 18 Sept 07 Yes ✓ No ___
Representative, Laboratory Infrastructure Division/ Date

## CD-0 Review—TJNAF Technology & Engineering Development Facility

**Approval**

Based on the material presented above and this review, Critical Decision 0, Approve Mission Need, is approval.

Raymond L. Orbach, S-4
Under Secretary for Science

Sept. 18, 2007
Date