Princeton Plasma Physics Laboratory

Infrastructure

Overview of Site Facilities and Infrastructure

Princeton Plasma Physics Laboratory is located on 88.5 acres within the Princeton University Forrestal Campus approximately mid-way between Philadelphia and New York City. Princeton Forrestal Campus is one of the nation's premier university-associated office/research parks. The Princeton Forrestal Campus provides an outstanding work environment with businesses, research institutions, and hotel/conference facilities in reasonable proximity to very desirable residential communities. The 1,750-acre Campus is punctuated by dense woods, brooks and nearby streams; almost 500 acres remain in their natural state in order to protect and enhance the character of the Campus. The Plasma Physics Laboratory is located in this rural/suburban setting which provides an attractive environment for the Laboratory to conduct research, appropriately separated from it's neighbors.

The Laboratory utilizes 754,196 gross square feet of space in Government-owned buildings located on "C" and "D" sites [see Figure 1]. There are currently no leased buildings or facilities and no plans to enter into any lease agreements. The Total Replacement Value (RPV) of all PPPL facilities and infrastructure is approximately $463M. Non-Programmatic RPV (used for calculating indices) is approximately $310M. There are thirty-four buildings: twenty-six buildings on C-Site, seven buildings on D-Site and one off-site. The overall Asset Utilization Index (AUI) is .998 and categorized as "excellent" and the overall Asset Condition Index (ACI) is .97 and categorized as "good". The goal for funding of facility maintenance is based on a calculation of 2% of the Replacement Value – referred to as the Maintenance Investment Index (MII). The PPPL maintenance budget for FY2008 is approximately $5.5M.

The PPPL Environmental Management System (EMS) provides an approach to environmental improvement and provides a systematic framework for managing and controlling PPPL activities while minimizing negative impacts to the land and environment. The EMS description can be found online at the following web address: http://www.pppl.gov/polImage.cfm?doc_Id=24&size_code=Doc

SC Infrastructure Data Summary

Replacement Plant Value ($M)*		$310
Total Deferred Maintenance ($M)		$9.5
Asset Condition Index	MC	0.97
	MD	0.93
	NMD	N/A
Asset Utilization Index	Office	100
	Warehouse	100
	Laboratory	100
	Other	99.3
Prior Year Maintenance ($M)		$5.2

MC = Mission Critical, MD = Mission Dependent, NMD = Non-Mission Dependent
* This is the RPV value used for calculating indices. It excludes category 3000 facilities. Total RPV is $463M.

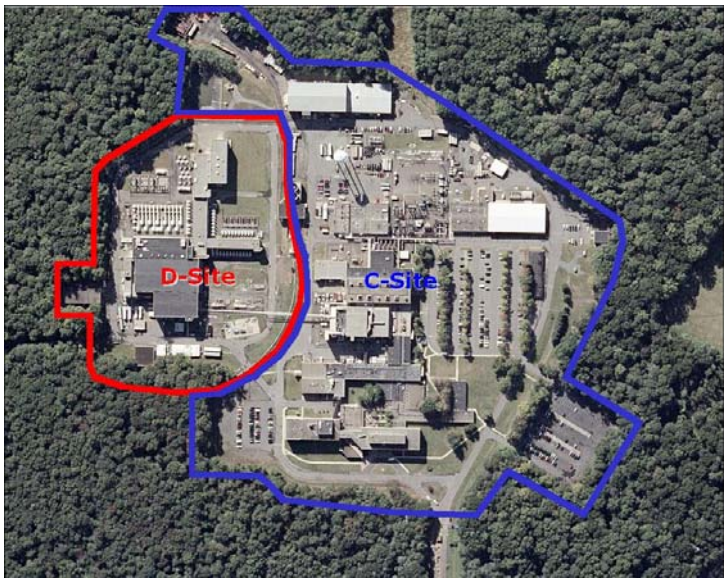


Figure 1. PPPL C- and D-Sites

Facilities and Infrastructure to Support Laboratory Missions

PPPL has developed a comprehensive plan that will result in a thoroughly modern facility to support world-class research. The plan addresses how real property assets will support and implement the

objectives of the Department of Energy Strategic Plan, the Energy Policy Act, the American Competitiveness Initiative, and the DOE Office of Science report "Facilities for the Future: A Twenty-Year Outlook". Planning is developed in accordance with the Real Property Asset Management (RPAM) Order, DOE 0 430.1B and DOE-SC guidance with the objective of integrating components of land use, facilities and infrastructure acquisition, maintenance, recapitalization, safety and security, and disposition plans into a comprehensive site-wide management plan.

The American Competitiveness Initiative anticipates doubling of funding for innovation-enabling research at key Federal agencies over ten years to support high-leverage fields of physical science and engineering, which include the Department of Energy's Office of Science. One of the goals of the initiative is to improve the capacity, maintenance and operations of DOE labs.

The Energy Policy Act requires the development and implementation of a strategy for Facilities & Infrastructure at the DOE Laboratories. The strategy must provide cost-effective means for: maintaining existing facilities; closing unneeded facilities, making facility modifications; and building new facilities. Princeton Plasma Physics Laboratory's strategic planning provides a map that outlines the plans and funding for high leverage improvements that address these objectives of the Energy Policy Act and that will allow PPPL to support the goals of the American Competitiveness Initiative.

The primary goal of the facilities plan is to provide first class facilities that enable world-leading science. The major need is for more modern reliable facilities. A phased and steady pursuit of this goal is necessary to provide facilities within realistic budget scenarios. The focus of the facilities planning must, and has been, on the persistent refurbishment, modernization, and conversion of several existing buildings so that we can provide facilities that are suited to current and planned R&D activities. The size of the PPPL site is adequate for current and anticipated future needs. The staff size will remain relatively unchanged in the foreseeable future. The issue facing the Laboratory is not the amount of facility space, but the immediate need to modernize and replace outdated facilities in order to most effectively support the Laboratory's scientific mission and business lines.

In recent years, additional funding has been directed toward reducing maintenance backlogs with substantial success. However, this does not enable developing the infrastructure needed to support world leading programs in the future and attract scientists and engineers. Funding of the Science Laboratory Infrastructure (SLI) beginning in FY10 will allow PPPL to better meet infrastructure goals and modernize facilities to enable critical missions.

There are two key Science Laboratory Infrastructure (SLI) projects that will allow PPPL to appropriately modernize its facilities to support mission lines. The first project will entail construction of a new Science and Technology Center, rehabilitate and convert the existing Laboratory and C-Site MG Buildings, and demolish five outdated inefficient buildings. This project will begin in FY10 and be completed in FY12. The second SLI project will upgrade Critical Utility Infrastructure and will begin in FY16 and be completed in FY18.

The following table provides a list of PPPL's business lines and the facility and infrastructure plans that are in place to appropriately support those business lines, including the two SLI projects. This table summarizes a process that assesses building and facility conditions and links the results to the critical business lines and determines the mission readiness of those facilities. The facility improvement plans are designed to ensure the mission readiness is attained to fully support the business lines as needed. Details of the first SLI project are discussed under the Strategic Site Investments section.

Facilities and Infrastructure to Support Laboratory Business Lines			
Business Line	**Facilities and Infrastructure**	**Summary Condition Evaluation**	**Planned Investments**
Burning Plasma Physics	LSB West Wing (C02) RF Building (C40) L Wing Addition (C21) C-MG Building (C51)	The LSB Building provides adequate office space for current staffing levels and the building ACI is good. In future years, ITER staff will be added to the LSB building and technical staff supporting NCSX will be relocated. Modernization of those offices will be needed at that time. Additionally, more modern conference and collaboration facilities will be required to support ITER. Adequate space and capability exist in the L Wing, RF building, and C-Site MG buildings to conduct component fabrication, testing, and assembly to support the short-term needs of ITER. Modifications and upgrades to these areas will be needed to fill the long-term ITER needs Deferred maintenance in the RF building is too high and utility upgrades and configuration modifications will be necessary to support ITER R&D in future years.	Additional space for ITER staff and research activities in the LSB will become available as SLI project 1 is completed and staff are moved from the LSB into the converted Laboratory building offices and adjacent Shop building (S-Wing). The modernization of LSB office space and collaboration facilities will be provided using operating and GPP funds As part of SLI project 1 the C-MG building will be converted into a modern shop area, which will be used to support ITER fabrications and R&D. Areas on the third and fourth floors of the RF building will also be modified and upgraded as needed to support ITER R&D and component testing work using GPP, operating, or project funds, as appropriate. These modifications will decrease deferred maintenance, energy, and maintenance costs. The L wing will be converted to NCSX office space as part of SLI project 1.
Predictable High-Performance Steady-State Plasmas; Taming Plasma Material Interface; and Harnessing Fusion Power	CS Building including NCSX test cell (C41) COB Building (C42) RF Building (C40) Laboratory Building (C22) Shop Building (S-wing) (C32) NSTX test cell (D44) D-Site Experimental area (D42 and D43)	The NCSX machine will be located in the CS building, which requires multiple utility system upgrades. The COB building will house offices for support technicians and operations engineers for NCSX, as well as shops to support the experiment The building is in fair condition and requires significant utility upgrades and major modifications to the office areas. The RF building will house support functions and diagnostic rooms for the NCSX project. The building has a fair ACI rating and requires significant utility upgrades and reconfigurations of rooms. Within the next five years, in order to increase collaborations and productivity, modern space will be needed to collocate NCSX experimentalists and theorists, as well as engineering. The rehabilitation and conversion of the Laboratory building is necessary to accomplish this. The Shop building (S-wing), which currently houses graduate students, will also house some engineering staff for the NCSX project. The building has a fair ACI rating and requires significant refurbishment of the offices and electrical utilities for those rooms. The NSTX test cell and D-Site Experimental areas support NSTX and will support a possible future experimental machine. The D-Site Test Cell Roofing System needs replacement, but the areas are in generally good condition and will require reconfiguration to support future experimental operations.	As part of SLI project 1, the Laboratory building will be completely rehabilitated and converted to modern office space for the collocation of NCSX experimentalists, theorists and collaborators.. Modern collaboration and remote conferencing facilities will be included. With the removal of the C-site motor generators, the building will be converted to a shop and the existing shops will be consolidated. This will provide improved access to technical staff working on NCSX and improved oversight and communications with the staff working in the shops. PPPL will utilize GPP and operating funds to implement several utility upgrades in the CS building, including the following planned GPP projects: Replacing the AC Power distribution system in the Test Cell area; Splitting the CS HVAC system from the RF Building system; Replacing the CS Building Control Room HVAC; Installing new CS Building Test Cell Nitrogen Exhaust Ventilation; and Installing CS Building Control Room Lighting & Outlets. The COB building office areas will receive new HVAC, and electrical distribution, and be reconfigured as functional office space to house technicians to support NCSX. The RF Building Exterior Wall System will be insulated and sealed as a GPP project. Several rooms on the second floor will be reconfigured and provided with utility upgrades to support NCSX using GPP funds. The Shop building (S-wing) offices will be renovated with new electrical wiring and outlets, lighting, HVAC ducting, flooring, partitions, and painting. This will provide modern office space for NCSX engineers that are adjacent to the experiment and NCSX scientific staff in order to promote collaboration. The D-Site Test Cell Roofing System will be replaced as part of a GPP project.

Facilities and Infrastructure to Support Laboratory Business Lines			
Business Line	**Facilities and Infrastructure**	**Summary Condition Evaluation**	**Planned Investments**
Theoretical and Computational Understanding	Theory Building (C23) Administration Building and PPLCC (C13) Laboratory Building (C22)	The Theory building has a poor ACI with a high degree of deferred maintenance. The building is not configured in a manner that is conducive to modern collaborative work. The PPLCC has adequate size and infrastructure for the short-term. A computing facility capable of providing significantly more power and cooling capacity will be required for future growth of theoretical computational physics. The Administration building, which is occupied by theoretical physicists, has an ACI rating of adequate. The same issues as cited above for the Theory building apply to the majority of the Administration building. The Laboratory building requires extensive rehabilitation and conversion to a modern office area to house theorists who will be collocated with NCSX experimentalists and moved out of the Theory and Administration buildings.	The Theory building and most of the Administration building, which house the majority of PPPL's theorists, are scheduled to be demolished as part of the SLI project that is scheduled for FY10-12. Adequate and modern offices and collaboration areas with state-of-the-art computing capabilities will be provided in the converted Laboratory building. Theorists will be relocated to the rehabilitated modern Laboratory building and collocated with experimentalists and collaborators. If the SLI project is not funded as expected, significant funds will have to be provided to repair and maintain the existing Theory building, which is considered an impediment to collaborations and attracting and retaining world-class scientists. . Options for meeting future theoretical computation needs are being investigated. Options include, upgrading the existing PPLCC, third party financing of a new facility, and collaborations with other Laboratories, Princeton University, and NOAA's Geophysical Fluid Dynamics Laboratory. .
Plasma Science and Technology (PS&T)	Laboratory Building (C22) and L Wing (C21) RF Building (C40) New Science and Technology Center	The Laboratory building and L Wing house the majority of the PS&T experimental devices; as well as offices for principal investigators, experimental scientists, and graduate students; and shop areas. The deferred maintenance for these buildings is too high, they are inefficient and inadequately equipped with utilities, poorly configured to support the experiments operated and too crowded for expansion. Office conditions are substandard with failing HVAC and drafty, leaky windows and ceilings. The RF building houses the Hall Thruster Experiment, its Principal Investigator, and collaborating research staff.	New modern experimental, office, and collaboration space will be provided by the new Science & Technology Center that will be built as part of the SLI project commencing in (FY10-12). As a result, experiments from the Laboratory building and L Wing will be relocated to the new building and those buildings will be converted to modern office space for the theorists, experimentalists, and collaborators supporting NCSX. The Hall Thruster will be moved to the new Science & Technology Center and the RF building will be modernized in conjunction with previously mentioned facility efforts associated with NCSX and ITER efforts. The new Center will provide the much needed capabilities for experimental flexibility and innovation, which is described later in the "Strategic Site Investments" section of this report.
Education	Science Education Center and RF Building (C40) Theory Building (23)	The Science Education Center and RF building house the Science Education laboratories, experiments, and classrooms. The facilities were recently renovated and are adequate for the needs of the program, although the RF building is in fair condition and has a high amount of deferred maintenance. The RF building is very inefficient and the exterior is in need of insulation and waterproofing. Since the exterior walls are made of asbestos containing transite, covering them is an option, while replacing them is not. HVAC and electrical modifications are necessary for the balance of the RF building. Electrical power for Science Education is adequate for the near-term. The Theory building, which house staff and some graduate students, has a poor ACI with a high degree of deferred maintenance. The building is not configured in a manner that is conducive to educating the next generation of scientist.	The RF building exterior walls will be covered as part of a planned GPP project. The HVAC system will also be replaced via a planned GPP project. The Theory building is scheduled to be demolished as part of the SLI project that is scheduled for FY10-12. Adequate classroom and meeting room space will be provided in the new Science and Technology Center, as well as the renovated Laboratory building and Shop buildings, which will be converted to modern office, classroom, and collaboration areas.

Facilities and Infrastructure to Support Laboratory Business Lines			
Business Line	**Facilities and Infrastructure**	**Summary Condition Evaluation**	**Planned Investments**
All Business lines *	Steam & Distribution System Electrical distribution system General Use Buildings and facilities	The steam and condensate utility service has experienced several failures in the past few years and it is in need of replacement. The electrical distribution system is aging as are several HVAC systems throughout the Lab. Window assemblies, and utility control system components are also areas that require additional investment to improve energy efficiency in Laboratory operations. Several additional general facilities are associated with high deferred maintenance costs and require systematic resolution via GPP funding.	A GPP project is planned to upgrade the steam and condensate utility service. The electrical distribution system will be upgraded as part of a 2-year SLI project starting in 2016. The project will replace or refurbish 30-50 year old critical components of the electrical power distribution system, thereby providing essential and reliable electrical services throughout the Laboratory. Vulnerabilities associated with transformers, switchyards, and circuit breakers will be corrected. The Building Automation System will be upgraded to maximize energy efficiency and tie-in several key components and facilities to the system. The project will also upgrade and modernize HVAC, cooling water, control systems and window assemblies. Several GPP projects have been scheduled to correct specific short-term facility needs, to reduce deferred maintenance, modernize the facility, reduce energy costs, and support multiple research projects. The GPP projects are prioritized based on DOE CAMP ratings. Planned GPP projects include: C-Site rectifier upgrades, replacing the elevated water tower riser, upgrade of the LSB main entrance, upgrade of the D-Site cooling tower, drainage improvements to the computer center drainage, upgrading the cafeteria, replacing the LSB roofing system, consolidating of waste management operations, upgrading the C-Site fire alarm system, improvements to C & D Site roadways, and roofing system replacements.
* The “All” business line captures facilities and infrastructure that support the entire laboratory and therefore each business line.			

Strategic Site Investments

The highest priority facilities and infrastructure project for supporting the mission of the Laboratory is the SLI Project for Construction of the New Science and Technology Center, and Conversion of the Laboratory and C-Site MG Buildings. This project consists of construction of the new Science and Technology Center building, conversion of the Laboratory Building into modern office and collaboration space for NCSX theorists, experimentalist, and collaborators; conversion of the C-Site MG building into a centrally located main machine shop and fabrication area; and demolition of the CAS, RESA, Theory and Module 6 buildings, as well as 75% of the Administration Building.

Major mission related and programmatic benefits of this project include:

- Providing the Plasma Science and Technology Department with modern space and facilities to support basic physics and innovative fusion experiments a new state-of-the-art Science and Technology Center.
- Rehabilitation and conversion of an inadequate 50 year-old facility that hinders progress and requires continuous maintenance and repair into newly refurbished and modern lab/office space for collocating. NCSX Experimentalists, Theorists, and Collaborators.
- Consolidating engineering technical support (shops and fabrication areas) to a refurbished facility in better proximity to NCSX and engineers.
- Relocating ES&H, Quality, and Environmental Management personnel near the projects and activities that they support.
- Demolition of 50 year-old facilities that require continuous maintenance and repair efforts.
- Demolition of an energy inefficient Butler-type building that is on the C-Site periphery.
- Demolition of a 20-year-old "temporary" module-type building that requires frequent repairs and maintenance.
- Demolition of an obsolete nearly 50 year old motor generator facility presently abandoned-in-place but still requiring periodic oversight and maintenance.

The total estimated costs of this SLI project are $40.4 million, with a funding profile of $2.8M in FY10, $19.3M in FY11, and $18.3M in FY12. This project will modernize nearly 20% of the PPPL facility and will reduce maintenance, deferred maintenance and operating costs. The average age of PPPL facilities will be reduced by 9 years and the deferred maintenance backlog will be reduced by $3.1 million. In addition, the PPPL energy use profile will be reduced by 13% ($200K per year); the PPPL buildings footprint will be reduced by 31,000 square feet; over 100,000 gsf will be rehabilitated; and ongoing maintenance costs will be reduced by 7% ($330,000/year). The cumulative savings in overhead costs due to the reduction in energy and maintenance costs over a ten-year period is estimated at $5.3 million. The PPPL Director has agreed to provide an additional annual contribution of $100,000 per year to further reduce the deferred maintenance backlog and modernize facilities. The cumulative amount of $6.3M will be redirected to increase current GPP program funding and reduce deferred maintenance to meet and exceed DOE-SC goals; resulting in a PPPL ACI of .99.

This project is being conducted in accordance with the project management requirements of DOE O413.3A and DOE M413.3-1, *Program and Project Management for the Acquisition of Capital Assets*, and all appropriate project management requirements. New construction and major renovations will be performed in accordance with LEED Gold certification standards.

Programmatic Justification for the Science and Technology Center

A broad range of research activities is covered in the Plasma Science and Technology Department: basic plasma physics, laboratory astrophysical plasma research, innovative fusion concepts and technology, and application research. One goal of the Department is to develop strong connections to other fields of science (*e.g.,* astrophysics, high energy physics) making use of university and industrial collaborations. Another goal is to train students; over half of the students graduated in the last four years from PPPL were trained in this department. The Department can contribute cost-effectively to basic science by taking

advantage of the Laboratory's experienced research and engineering staff and unique infrastructure. Presently, its eight experimental projects are housed in a 50-year-old building, with small rooms and low ceilings. The low ceiling prevents the use of a crane to move large experimental components. The rooms' small space prevents the expansion of the existing projects and the start of new larger scale projects. Presently, there are three projects in the Plasma Science and Technology Department that cannot grow because of their limited space and low ceilings: MRX, LTX, and FRC/RMF.

The construction of a new Plasma Science and Technology Center will significantly improve this. The Center will have a large high-bay experimental hall that is partitioned with movable concrete blocks to adjust the space for each project. There will be an overhead crane and a staging area to allow for efficient construction and maintenance of experimental facilities. The Center will provide the space and the facilities to embark on new physics studies. The two areas of grand astrophysics challenge under consideration are magnetic reconnection and collisionless shocks.

Magnetic reconnection has been studied for ten years at PPPL on MRX identifying the possible causes of fast reconnection. It has identified the role of two fluid MHD physics plays in reconnection physics and has verified the Hall Effect in magnetic reconnection. The experiment has been prolific in its publication rate, successful in training future leaders in the plasma physics community, and has received the APS Division of Plasma Physics Excellence in Plasma Physics Award. The remaining challenge is to examine reconnection in the collisionless regime that is most relevant to reconnection in astrophysical plasma. The PS&T Department requires the space and the facilities that the Center provides for these collisionless regime studies of reconnection.

The pursuit of collisionless shocks by the Department is impossible without the new Center. A shock experiment requires some 10 meters of linear path. None of the experimental areas in the Department can accommodate the experiment. Astrophysical shocks in planetary bow shocks have Mach numbers of order 10. In supernova the Mach number of shocks approaches several hundred and is larger in pulsar winds and gamma ray bursts.

In the area of innovative plasma confinement systems, the Department has two very successful experiments whose future upgrades are limited by their present location: Liquid Tokamak eXperiment (LTX) and the Field Reverse Configuration (FRC). LTX studies the interaction of a liquid lithium boundary to tokamak plasma. The beneficial properties of liquid lithium plasma facing components may be needed to make fusion practical. With hydrogen pumping by utilizing a tray of liquid lithium, the plasma confinement was observed to improve six fold in previous experiments. These beneficial results have motivated the present experiments to examine the improvement in confinement. The next step will be an opportunity to examine the interaction of the liquid lithium plasma facing component with high performance plasma and examine its confinement properties at higher density and temperature. Major upgrades to the LTX device cannot be completed in its present location, the new Center is required to enable substantial heating to the plasma. The larger space with an overhead crane is required for this next step. The FRC also has attractive features based on its coil simplicity. Next steps in this experiments progression will also require large heating systems and high magnetic fields that will necessitate substantial shielding. These steps will also require the new Center.

In summary there are many exciting physics experiments that presently cannot be performed in the PS&T Department facilities. A new Center that has the space, access, room for power systems, and an overhead crane will allow for these exciting experiments to proceed. They will make significant impact on the grand challenges in astrophysics and significant progress in the quest for fusion energy.

SLI Project 1 Features

The new PPPL Science and Technology Center will be a modern laboratory structure, 33,000 GSF in size that will house all of the research devices operated by the Plasma Science and Technology Division, which will be relocated from the extremely outdated, crowded, and inefficient 50 year-old Laboratory

Building. The building will not only provide experimental areas, but will also provide research, laboratory, office, classroom and collaboration space. Flexible experimental research bays will be provided with adequate power, ventilation, overhead crane, and necessary amenities to facilitate safe and efficient operation, maintenance, repairs, and modifications to research devices. Researchers, post-doctoral students, and graduate students will be located in offices that have close and safe proximity to their research devices. The building configuration and area layouts are designed to stimulate active collaboration and encourage sharing of ideas among experimentalists working on different devices.

The PPPL Laboratory Building will be converted from its current primary use as an experimental and shop area for Plasma Science & Technology activities to a thoroughly modernized office and collaboration center for theorists (relocated from the existing Theory Wing and Administration buildings), and NCSX experimentalists (relocated from the Lyman Spitzer Building), and collaborators. The revitalization of the Laboratory building will result in significant improvements to working conditions for the theoretical physicists and will improve communications among staffs as these individuals will be co-located close to experimentalists and collaborators who will be supporting NCSX.

Commencement of work on the Laboratory Building will be closely coordinated with the execution of the new Science & Technology Center. The conversion will be followed by the planned and orderly move of experiments, shops, and personnel from the PPPL Laboratory building into the new Science and Technology facility. Vacating of the Laboratory building will allow for the extensive rehabilitation and conversion of the building into modern office space. The refurbished building will be provided with energy efficient and ergonomical lighting, electrical supply, HVAC, windows, and finish materials. Rehabilitation of this building will reduce deferred maintenance by approximately $800,000. The modern Laboratory Building will provide facilities that are conducive to improved collaborations and interaction among scientists and engineers.

Following completion of the Laboratory Building conversion, the 5,267 sq. ft. Theory Building, which is in poor condition, and seventy-six percent of the 25,743 sq. ft. Administration Building will be demolished. These buildings have high deferred maintenance costs, and are inefficient to operate and maintain. Their demolition will eliminate nearly $700,000 of deferred maintenance.

Support staff from the Quality Assurance, Materiel and Environmental Services, and ES&H organizations will be relocated from the existing Module 6, to the Engineering Building, Shop Building, and areas of the LSB that are vacated by engineering and research staffs. This relocation will place the Quality Assurance, Materiel and Environmental Services, and ES&H personnel in closer proximity to the projects and activities that they support on both C- and D-Sites. Module 6, an aging 8,164 sq. ft. modular building that has an increasing maintenance and repair burden, will then be demolished; thus eliminating an additional $200,000 of deferred maintenance. Completion of these demolition activities will result in the elimination of a total of 33,000 sq. ft. of inefficient and deteriorating building space and elimination of more than $900,000 of deferred maintenance. Should conversion and rehabilitation of the Laboratory not be funded, PPPL will be faced with unnecessary increases in deferred maintenance and energy costs, potential impacts to employee morale, hindrance to recruitment of new talent, and increasing burden to maintain and operate the Laboratory, Theory, Module 6, and Administration buildings in a safe manner.

Conversion and refurbishment of the 64,857 sq. ft. C-Site MG Building into a centrally located main machine shop and fabrication area will allow for the relocation of fabrication and machine shop equipment and facilities from their current remote location in the CAS and RESA buildings. It will also allow for the demolition of an obsolete 50 year old motor generator facility presently abandoned-in-place but still requiring periodic oversight and maintenance. The C-Site MG building is conveniently located adjacent to experimental operations, is equipped with a roll-up door, roadway access, and an overhead crane. The relocation will be followed by the demolition of the 15,000 sq. ft. CAS and 20,570 sq. ft. RESA buildings, and will eliminate over $1 million of deferred maintenance while greatly reducing

energy costs. Rehabilitation of the MG Building will reduce deferred maintenance by approximately $400,000.

A modern machine shop and fabrication building in close proximity to NCSX and the experiments located in the PS&T Center will provide better logistics and more efficient use of technician, engineering, and scientific resources by eliminating the need to transport material, equipment, and personnel between the remotely located CAS/RESA shops and experimental areas. This will also reduce security and transportation risks associated with the current remote locations and will locate fabrication activities closer to quality assurance and safety oversight personnel. Consistent with DOE objectives and those cited in the PPPL Ten-Year Site Plan, funding of the MG building conversion will result in centralizing of buildings and activities, eliminating outlying and inefficient structures, and providing modern and sustainable facilities that support state-of-the art research and engineering activities.

A site map is attached (appendix B) depicting the laboratory at the end of the five-year planning period and identifying new, refurbished, and demolished facilities that will result from SLI Line Item funding.

The impact of the SLI Project 1 will be to thoroughly modernize the Laboratory's facilities and provide the building infrastructure to support the scientific program described here.

SLI Project 2 Features

"Critical Utility Infrastructure Systems Upgrade & Modernization" is the other PPPL project that has been accepted for SLI funding. This project will result in a significant improvement to the reliability, availability and maintainability of the electrical, mechanical and HVAC systems that distribute services throughout the 34 buildings on-site and affect all Projects throughout the Laboratory. Critical components of the electrical power distribution system, which are 30-50 years old, will be refurbished and upgraded. Vulnerabilities associated with transformers, switchyards, and circuit breakers will be corrected. The Building Automation System will be upgraded for the purpose of maximizing energy efficiency and adding several key components and facilities to this system. Deteriorating mechanical systems that threaten experimental operations (including HVAC, cooling water, steam, control systems, and window assemblies at C-Site and D-Site) will be replaced and modernized. This project will reduce deferred maintenance by $3.1M, annual energy consumption by $65K, annual maintenance costs by $100K. The project has a total estimated cost of $12.4M will begin in FY16 and be completed in FY18.

Trends and Metrics

The overall condition of the Laboratory's facilities continues to be good. PPPL has demonstrated an effective management system for planning, delivering, and operations of Laboratory facilities and equipment. Maintenance of active conventional facilities against DOE corporate Maintenance investment goals was excellent in FY07. In a facility that is over 50 years old, all facility support systems were maintained in an operational state ensuring no impact to experimental operations, while deferred maintenance was significantly reduced, and the maintenance investment index goal was met. PPPL has also exceeded all energy reduction goals established by Presidential Executive Orders. When comparing energy consumption for FY07 to FY03, the Laboratory exceeded the 20% reduction required by the Energy Policy Act by 2015, as well as the 30% reduction called for by Executive Order (EO) 13423. Energy consumption was reduced by 34.8% when compared with the FY03. The Laboratory will continue to meet the additional EO requirement of reducing consumption by 3% annually through 2015. Infrastructure system reliability, as measured by a reliability index, indicates total system reliability for electrical and building support systems. There were no situations in FY07 that resulted in a building or facility being without critical services (or being unusable) during times the normal population for those buildings. This resulted in an overall reliability index of 100%.

The Maintenance and Operation Division developed and implemented an aggressive construction schedule in FY07. The Infrastructure Recapitalization Program, comprised primarily of GPP work, expedited work to meet the needs of the laboratory mission. Facilities projects were managed efficiently

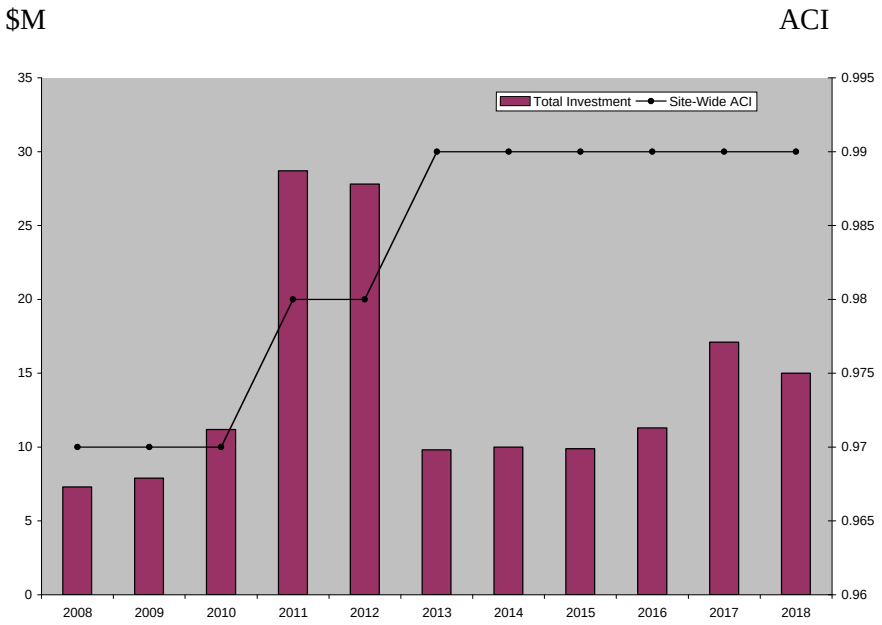
with regard on time completion, budget performance, and meeting baseline scope requirements. The FY07 GPP expenditure as a percentage of the Replacement Plant Value yielded a Recapitalization Investment Index of 0.87%, which was excellent and met the highest performance rating. PPPL also received the highest possible rating for managing real property assets through performance-based approaches to Real property life-cycle asset management. This planning activity was documented by the PPPL Ten Year Site Plan (TYSP), which was the first DOE Laboratory under the Office of Science to submit its 2007 TYSP. Submitting the plan by this date allowed the Office of Science to meet a commitment to the DOE Office of Engineering and Construction Management.

The PPPL deferred maintenance backlog decreased from $10.6 million in FY06 to $9.5 million in FY07 for a decrease of $1.2 million. Since FY04, when PPPL's deferred maintenance backlog was $12.2 million, the backlog has been reduced by $2.8 million for a 23% reduction. DOE guidance is to reduce the deferred maintenance backlog so that the average ACI for all buildings is above 0.98 prior to FY15. The current PPPL ACI is 0.97. PPPL funding plans, depicted in the table, show that the Laboratory will exceed the DOE guidance timeline by reaching the 0.98 ACI goal in FY11 and will reach 0.99 in FY13 and sustain that level thereafter. This significant accomplishment will be the direct result of a focused campaign, led by the DOE Office of Science (DOE-SC), to reduce deferred maintenance backlog and the impact of the SLI funding. PPPL responded to the DOE-SC challenge by committing significantly more funds from the Laboratory's overall budget as well as strategically leveraging GPP and operating funds to also reduce deferred maintenance to the maximum practical extents. The following table shows the future plans for funding for facilities maintenance and improvements and the resulting projected changes in deferred maintenance and asset condition index (ACI). It should be noted that if funding is not be provided per the projections in the table, achieving the ACI goals may not be possible or will suffer delays. Most notably, the SLI project scheduled to begin in FY10 is a key component not only to the Laboratory's modernization plans, but also to the plans to reduce deferred maintenance. Without funding for this project, the Laboratory will not be able to contribute the planned additional $530,000/year from the resultant energy and maintenance savings, toward increasing GPP funding aimed at reducing deferred maintenance.

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Maintenance	5.5	5.6	6.1	6.2	6.3	6.5	6.7	6.6	6.8	7.0	7.1
DMR*	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0	0	0
Excess Facility Disposition (overhead)	0	0	0	0	0	0	0	0	0	0	0
IGPP	0	0	0	0	0	0	0	0	0	0	0
GPP	1.6	2	2	2.9	3	3.1	3.1	3.2	3.3	3.4	3.4
Line Items	0	0	2.8	19.3	18.3	0	0	0	1.2	6.7	4.5
Total Investment	7.3	7.9	11.2	28.7	27.8	9.8	10	9.9	11.3	17.1	15.
Estimated RPV	310	317	325	333	332	340	348	357	365	375	391
Estimated DM	9.5	8.9	8.4	8.1	6.8	3.7	3.6	3.6	3.8	3.4	3.4
Site-Wide ACI	0.97	0.97	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99

* This line is for those sites that have a focused Deferred Maintenance Reduction program (DMR) funded from overhead to help reduce DM to acceptable levels based on the Asset Condition Index (*e.g.,* .975 for Mission Critical facilities). This line does not include DMR resulting from line items, GPP, IGPP, excess facility disposition or normal maintenance.

The following chart shows how the planned investments listed in the table will positively affect the site-wide Asset Condition Index over the eleven years timeline.



Sustainability

PPPL is actively working to meet the sustainability goals established by Executive Order (EO) 13423 and DOE Orders 450.1A and 430.2B. Between FY03 and FY07 PPPL achieved a reduction in energy intensity (Btu/sf) for non-experimental energy use of 36.8%. This was achieved through careful facility management, energy conservation and equipment upgrades.

PPPL continues to emphasize energy management as part of its facility operations and will leverage the success in non-experimental energy management to examine experimental energy uses for conservation opportunities. In addition, implementation of infrastructure improvement projects that were identified in the FY07 Ten Year Site Plan are expected to further reduce the non-experimental energy intensity of site operations. PPPL is under consideration for an on-site renewable energy generation project (solar panel array) that could represent as much as 4% of non-experimental energy use via a long-term power purchase agreement through the Office of Energy Efficiency and Renewable Energy (EERE).

PPPL has made significant progress in reducing its use of both potable and no-potable water in recent years achieving and overall water use reduction of 76.9% between FY00 and FY07, and continues to pursue additional water savings opportunities. Given the reductions already achieved additional savings may be incremental over a number of years, as the larger opportunities have already been addressed.

PPPL is currently pursuing certification of its main office building, the Lyman Spitzer Building (LSB), to the U.S. Green Building Council's Leadership in Energy and Environmental Design – Existing Buildings (LEED-EB) standard. The LSB represents approximately 16% of the current building space and certification of this building to the LEED-EB standard will achieve the goal of having at least 15% of building space meet the Guiding Principles for High Performance and Sustainable Buildings. New construction and major renovation projects will be designed and built to meet the applicable LEED criteria, thus increasing the amount of sustainable building space at the Laboratory. A tabular summary of this information is presented below.

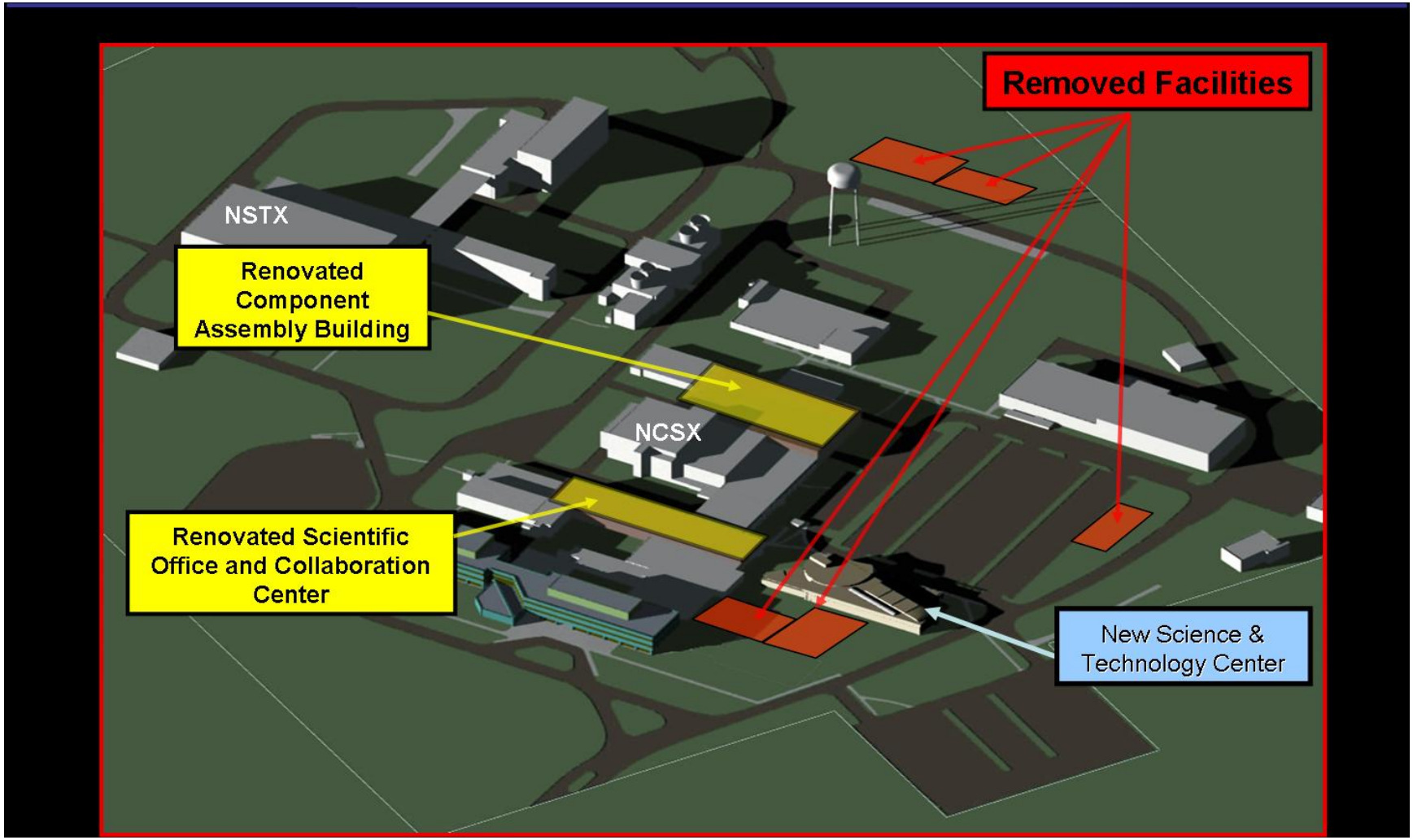
Requirement	Goal	Funding	Cost	Milestone	Progress to Date
Energy Reduction of 30%	30%	Operating	$340K	FY 2015	Operation changes and equipment upgrades achieved 36.8% reduction in house energy intensity between FY03 and FY07.
	10%	SLI	$40M*	FY 2012	Plasma science & technology support infrastructure project planned for FY10-12.
	4%	SLI	$12.4M	FY 2018	Critical utility infrastructure systems upgrade and modernization project planned for FY16-18.
On-Site Renewable Energy	4%	PPA		FY 2015	Installation of an on-site solar electric generating system via power purchase agreement is under consideration if it is life-cycle cost effective.
Off-Site Renewable Energy	4%	Operating		FY 2012	Purchase of renewable energy credits is under consideration
Water Reduction	20%	Operating		FY 2015	Operational improvements and low-flow fixture installation
Sustainable Buildings	15% of space	Operating		FY 2009	LEED-EB certification of LSB represents 16% of building portfolio
	20% of space	SLI	$38M	FY 2012	Replacement and renovation of older buildings via the SLI project would add more than an additional 13% of sustainable building space

** Total SLI project costs are listed for both energy reduction and sustainable building goals, as the proposed project impacts both goals; costs are not counted twice.*

Beginning in early 2007 PPPL began an initiative to improve the sustainability of Laboratory operations and improve environmental performance. “Sustainable PPPL” is a program that capitalizes on PPPL’s existing Environmental Management System, energy management, environmentally preferred purchasing and facility operation programs to reduce environmental impacts and improve performance. Several sustainability efforts have been implemented and others are underway. PPPL will continue to proactively implement sustainability practices aimed at meeting, or exceeding, the environmental performance goals in its EMS, DOE Orders and Executive Orders.

Appendix A: IFI Xcut (Separate file)

Science & Technology Mission Support Infrastructure (SLI funded from FY2010-2012)



Appendix C: PPPL Building Names, Numbers, and Locations