Strategic Facilities Plan

September 2002

FERMI NATIONAL ACCELERATOR LABORATORY

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Fermi National Accelerator Laboratory Strategic Facilities Plan

I. Executive Summary

The Fermilab Strategic Facilities Plan (SFP) was developed to identify infrastructure asset management requirements and actions necessary to ensure that Fermi National Accelerator Laboratory continues as an efficient and effective world-class scientific research facility well into the 21st Century.

Recently published objectives for the Department of Energy, Office of Science (SC), Laboratory Complex addresses new modernization improvement guidelines and recognizes the importance of infrastructure management as a critical component to ensure sustainability of the SC laboratory complex. The objectives focus on the following areas of infrastructure management:

- Mission. Facilities will be right-sized to the type and quality of space and equipment needed to meet mission needs and includes co-location of activities, minimization of leased space and adaptability to changing research requirements.

- Working Environment. Creation of a "preferred" working environment to attract and retain high quality staff and users to include the latest advances in information technology.

- Environment, Safety, Health and Security. To satisfy all necessary ES&H and Security elements for workers, visitors and neighbors.

- Operations and Maintenance. Infrastructure including facilities and other systems such as roads, utilities and equipment will be funded, operated and maintained from a life-cycle asset management standpoint.

Following a discussion of Fermilab's mission, the SFP reviews infrastructure issues including inventory and condition assessment. Planning assumptions are then discussed to identify the parameters used in development of the SFP for modernization consistent with the SC objectives and Fermilab's interpretation to satisfy the objectives relative to Fermilab mission. The SFP further identifies the types of projects necessary to satisfy the objectives and the associated resource requirements. The plan concludes with a discussion of current management initiatives at Fermilab to include a capital allocation and prioritization process.

While much of Fermilab's infrastructure had reached or was nearing the end of its original design purpose, infrastructure management initiatives over the past few years have significantly moved Fermilab towards identifying and achieving the very objectives recently published by the Office of Science as guidance for this plan. Most significant is the use of third party investment through partnerships with Fermilab's gas and electric utilities, completion of the Wilson Hall Improvement project, and active comprehensive master-planning efforts. The following table summarizes the $63 million in project requirements necessary for continuing this effort.

Project Requirements

Fy	Fy'04	Fy'05	Fy'06	Fy'07	Fy'08	Fy'09	Fy'10	Fy11	Fy'12
$M	5.5	5.5	5.5	5.5	5.5	11.4	13.3	7.8	2.97

Note: Described in project detail in Appendix A

II. Mission Future of Fermi National Accelerator Laboratory

A. Overall

From its founding in 1967, Fermilab's mission has remained to advance the understanding of the fundamental nature of matter and energy, by providing leadership and resources for qualified researchers to conduct research at the frontiers of high-energy physics and related disciplines.

Core competencies

Fermilab leads the nation in the construction and operation of large facilities for particle physics research, and in developing the underlying technology for high-energy physics research.

The Lab's mission is built on a foundation of eight core competencies:

1. Operation of the world's highest-energy user facility—the Tevatron collider— for university scientists investigating the fundamental structure of matter and energy;
2. Accelerator research, design and development of the frontier machines that are necessary to keep the U.S. among the world leaders in high energy physics;
3. Magnet research, design and development with particular emphasis and expertise extending to leading-edge technology in both superconducting magnets and permanent magnets;
4. Detector design and development for the tracking and recording of trillions of high energy particle collisions;
5. High performance computing and networking to support high-energy physics in on-line data taking, storage, analysis and world-wide data sharing and physics collaboration (the World Wide Web was born from this last requirement by physicists);
6. International scientific collaboration, both at Fermilab and as a contributor to foreign laboratories such as CERN, in particular in assisting in the construction of the Large Hadron Collider and the Compact Muon Solenoid;
7. Construction and management of large scientific and technical projects, including the seven-year, $260 million Main Injector accelerator, completed on time and on budget and dedicated in 1999;
8. Scientific education of graduate students, and additional science education programs for undergraduates and for K-12 students, with major support from non-DOE sources

B. Programmatic

Fermilab, the world's highest-energy particle physics facility, welcomes more than 2,500 users (defined as "qualified researchers") from 214 institutions in 35 states and 29 foreign countries. These users have access to the world's best tools for particle physics research:

- The four-mile-circumference Tevatron, the world's most powerful particle accelerator, creates high energy proton-antiproton collisions and proton beams for fixed-target experiments. The third generation of quarks was discovered at the Tevatron: the Bottom Quark in 1977 and the Top Quark in 1995. The Tevatron is supplemented by the Antiproton Source, the world's largest producer of antimatter, whish is used for proton-antiproton collisions and for research on antimatter; and by the Antiproton Recycler, the world's largest assembly of permanent magnet technology, which also increases the number of possible collisions in the Tevatron by recovering antiprotons that would previously have been discarded.

- The Booster, the first synchrotron in the accelerator chain at Fermilab, is 475 meters in circumference and accelerates protons from 400 MeV to 8 GeV in a period of 0.033 seconds. The Booster provides beam for the MiniBooNE experiment. and protons to feed the Main Injector in the Fermilab accelerator chain.

- The Main Injector, another powerful and efficient accelerator, can supply experiments on its own, as well as dramatically increase the number of collisions possible in the Tevatron. The two-mile-circumference Main Injector supplies beam for the NuMI (Neutrinos at the Main Injector) and CKM (Charged Kaons at the Main Injector) experiments.

- Two 5,000-ton collider detectors, CDF and DZero, each serving as an international collaboration of more than 500 university physicists.

- Fixed-target experiments, including the MINOS (Main Injector Neutrino Oscillation Search) and MiniBooNE experiments resolving the question of neutrino mass.

- The CMS (Compact Muon Solenoid) experiment at CERN, for which Fermilab serves as host for the U.S. component (US

CMS) and as home for the US CMS research program involving nearly
400 scientists.

- The Lattice Gauge Theory Computing Facility, where approximately 60 user theorists work with the theory of quantum chromodynamics using teraflop computing power.

III. Infrastructure Vision and Objectives

Vision Statement: To *establish* and *maintain* a *dependable base* from which Particle Physics and other FNAL programs can be *safely* accomplished *without interruption*.

Objectives:

- *Provide leadership* - Recruit and retain a high level of expertise for infrastructure management with responsibility to:

    - Investigate, analyze, prioritize and execute infrastructure requirements necessary to satisfy the mission in the "best" possible manner, including sustainable design, equipment standardization, and effective operations and maintenance.

    - Continue third party funding for infrastructure improvements to allow an even higher investment in infrastructure funding.

    - Assess and strengthen infrastructure planning and data collection.

- *Avoid unscheduled downtime* - the operating platform used to successfully conduct HEP missions including the facilities, utilities, and other general services shall be operated and maintained at the highest levels.

- *Achieve and maintain an ES&H conscious environment* – create a workplace that eliminates the potential for threat or harm to human, material, and environmental resources.

- *Establish and Improve infrastructure to the identified standards* – get all infrastructure to the desired point of operational effectiveness and modernization consistent with established criteria and guidelines.

- *Operate and Maintain infrastructure for peak performance and sustainability* – is the function of upkeep, preservation and repair ideally once a maintainable state has been achieved that succeeds the establishment of a new or improved system in order to obtain the best operating efficiencies at the least total cost of ownership over the life of a particular system.

IV. Facility and Infrastructure Issues

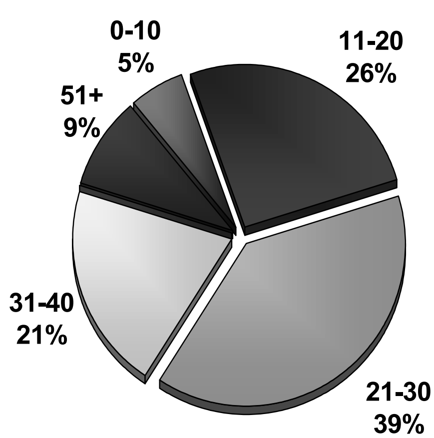
For the purpose of this plan, Fermilab infrastructure includes buildings, trailers, roads and utility systems as described in this section and does not include programmatic equipment. The DOE Facility Information Management System (FIMS) database includes detailed information by infrastructure category and is summarized in this section to show age distribution of facilities and associated square footage and the replacement value (RPV) by infrastructure category.

Existing Infrastructure

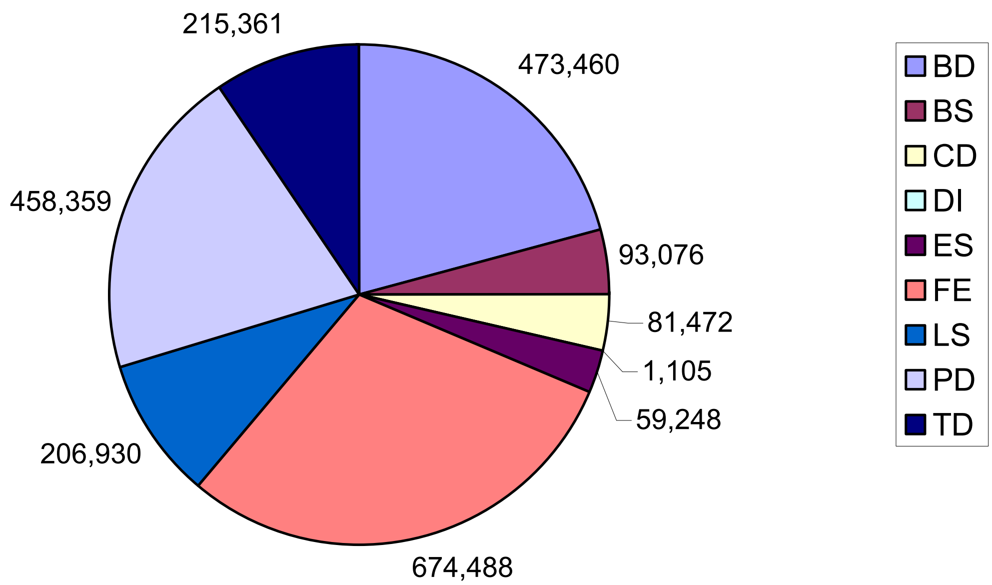
Fermilab has 339 buildings totaling 2,263,499 square feet of space as identified in the following table. In addition to this space, Fermilab has 112 trailers that provide additional space of 84,839 square feet in support of laboratory operations.

The distribution of age for the buildings is shown in the following graph. The buildings less than 30 years old were constructed specifically for laboratory operations while the buildings over 30 years old were predominantly part of the original land acquisition for the site and included a residential village complete with utility systems.

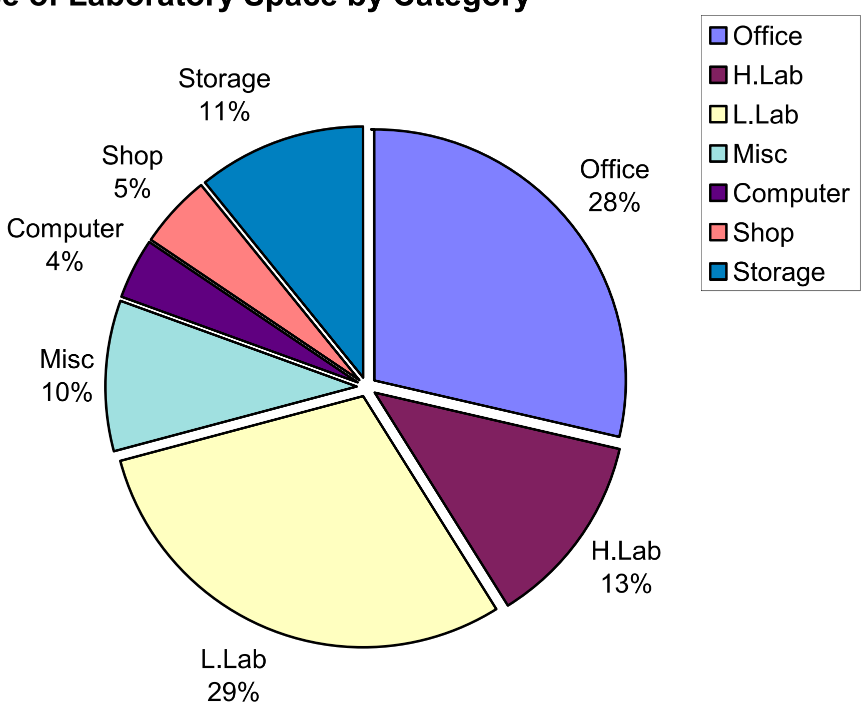
Age of Building Space at Fermi (Years)



Laboratory Space Utilization by Division/Section (in SqFt)



Use of Laboratory Space by Category



Replacement Plant Value (RPV)

The RPV for Fermilab infrastructure is listed at $1.423B and is subdivided into Buildings at $367M and Other Structures and Facilities (OSFs) at $1056M. Fermilab further subdivides the OSFs into Accelerators at $963M (programmatic) and remaining OSFs at $93M (non-programmatic) which includes primarily the utility systems described. The separation of Accelerators is necessary since these figures should not be used for determining the recapitalization period (time necessary to rebuild the lab with current annual investment of GPP and line item funding). The justification for this is that Accelerators including tunnels and equipment would not likely be recapitalized but rather replaced by other more state of the art machines, and none of the projects identified in this plan are programmatic in scope. The Replacement Plant Value, also taken from the FIMs database, is broken down into the following categories.

Infrastructure	Replacement value ($M)
Buildings	367
Utilities (OSFs)	93
Subtotal	460
Accelerators	963
Total	1423

Utility systems. Fermilab utility systems include electrical, natural gas, pond water systems (industrial cooling water), potable water (domestic), and sanitary (wastewater).

Electrical

- Description
  Electric power for the Fermilab Main Site is provided by Commonwealth Edison Company from their 345 kV transmission lines and over 26000 mW of electrical generation and supply contracts for Northern Illinois. Transmission line 11120 is the preferred line between the Electric Junction and Lombard Substations with Line 11119 between the Electric Junction and Wayne Substations serving as the second source of transmission to the site. Between Fermilab-owned and operated high voltage substations, Kautz Road and Master Substation, the 345 kV bus is transformed through seven (7) 40 mVA and one (1) 60 mVA transformers to 13.8 kV for underground distribution through 22 feeder breakers. Fermilab secondary distribution consists of approximately 280 substations with 15

miles of overhead conductors and 100 miles of underground cable. In addition, 34.5 kV lines from Electric Junction serve the Village 12.4 kV overhead distribution system and provide emergency 13.8 kV from the Village and Giese Road. All laboratory transmission and distribution systems are owned and operated by Fermilab.

- Current Condition (reliability)
  The current condition of Fermilab electrical power system is adequate. The new components installed under the Main Injector project and selected feeders upgraded within the last few years are rated as good. Other secondary systems including transformers and conductors, as well as some primary 13.8kV feeders have elements that are rated as poor based on their current condition. These feeder projects are included as requirements in this report. As critical systems are identified as vulnerable or as failures have occurred, those sections have been replaced.

- Available Capacity
  The current available capacity of the Fermilab electrical system is limited by the available high voltage substation capacity of 340 MVA (approx. 320MW). This total capacity offers considerable excess capacity for load growth. Fermilab's peak electric demand has reached an historic high of 80MW with normal operating base loads of between 35MW and 55MW offering substantial increased capacity. This available capacity is only limited geographically by the location, size and condition of feeders. Additional capacity to the Fermilab site beyond the available capacity is as close as the utility owned 345kv transmission lines that cross the Fermilab site. These lines could easily supply any increased electrical capacity that may be needed for future requirements.

Pond Water Systems

- Description
  Fermilab provides its own Industrial Cooling Water (ICW) from site sources and when needed is able to draw make-up water from the Fox River under a State of Illinois permit. The Industrial Cooling Water system at Fermilab has a dual purpose. It is used to supply water to the various fire hydrants and fire protection sprinkler systems located in buildings across the site. In addition, ICW is utilized in many of the experimental areas as a source for conventional magnet cooling. The distribution system for ICW extends from the main pumping station at

Casey's Pond to the Support Area, Wilson Hall and Footprint Area, and most of the Experimental Areas located on the Fermilab site.
The main storage reservoir for the ICW system is Casey's Pond which is located in the northern portion of the Fermilab site.

There are two sources that provide water to the reservoir. A site-wide network of lakes and ditches is used to collect runoff water, as well as heat exchanger and sump discharge water, and return it to the main reservoir at Casey's Pond. Water is also collected in the Main Ring Lake, located within the main accelerator ring, and Lake Law, located in the southeast portion of the site. The water from these lakes is then transferred to the main reservoir by means of a pumping station located at the Main Ring Lake. It is important to note that the entire Fermilab 6,800 acre site provides runoff to this network of ditches and lakes and thus even open areas of the site contribute to the experimental effort of the Laboratory. There is a second source used to supply water to the main reservoir. The State of Illinois allows Fermilab, when water levels are sufficient, to pump water from the nearby Fox River to supplement and maintain capacity at the main reservoir.

- Current Condition (reliability)
  The current condition of the Fermilab Industrial Cooling Water (Pond water) system is adequate. The main reservoir has been expanded in the last few years for increased capacity and gas-fired turbines provide a dual fuel source for a well maintained pumping system that is rated as good. The site has about 105,000 linear feet of piping for this non-potable water distribution system some of which is nearing the end of its useful life. The most critical sections with the highest vulnerability to fail have been identified and have either been replaced or are planned for replacement and are included in this report. The ditch return systems and pond water control systems are in need of repair more from a water conservation standpoint but are satisfying the current capacity needs.

- Available Capacity
  The present total capacity of the on-site ICW supply system is limited by the distribution system piping that is near 12,000 gpm. A maximum cooling demand of near 70 MW is accommodated through the surface pond group of Casey's Pond (main reservoir), Tevatron, Main Injector and CUB ponds with their associated pumping facilities. Building No. 855, the pumping station at the main reservoir, contains 3-5,000 gpm primary pumps with variable speed capacity and 4-1,000 gpm single-speed secondary

pumps which supply water to the site-wide ICW distribution system. The average pumping output of the Casey's Pond Pumping Station is primarily driven by the water temperature of the reservoir supply. This temperature varies with the time of year and the amount of experimental equipment requiring cooling. In the winter months, with minimum cooling demand from equipment, the output may be below 4,000 gpm. In the summer months, with a maximum cooling demand, the output could exceed 11,000 gpm, a level which approaches the upper limit of the distribution system. Additional pond water systems existing on the Fermilab site (not connected to existing 70MW pond system) could accommodate another 150MW of cooling for a total site capacity 220 MW of cooling.

Natural Gas

- Description
  From two separate metered source points, gas is delivered to Fermilab by NICOR and purchased under a supply contract with the Defense Energy Supply Center. The primary gas supply is an 8-inch line metered at the Wilson Road boundary. Two branch lines extend south. One serves the Village while the other terminates at the Central Utility Building. A second 4-inch back-up supply line has been recently completed which supplies gas through a meter station at the west boundary of the site, adjacent to Giese Road. This line is connected to the Central Utility Building gas supply. Through a system of sectioning valves, limited gas supply can be maintained to the site in the event of an interruption of the 8-inch primary supply. The pressure site-wide is regulated to maintain 100 psi. The Village and Site 38 are regulated to maintain 60 psi. Natural gas is primarily used for heating; however, it is also used to drive turbine engines for generating emergency electricity at Casey's Pond, Well #3, the Master Substation, and Wilson Hall. The site has approximately 65,000 linear feet of underground natural gas piping owned by the federal government and maintained by Fermilab. Fermilab currently consumes around 100,000 Deka-therms (MMBTU) per year which equates to one hundred million cubic feet of gas supply. The site gas distribution system is owned and operated by Fermilab.

- Current Condition (reliability)
  The current condition of the Fermilab gas system is good.

- Available Capacity

Fermilab natural gas use is modest using gas industry consumption per facility area standards and will remain in this category even when considering equipment fuel switching from electric to natural gas and a fueling station for alternatively fueled vehicles. The current available capacity of the Fermilab Natural Gas System could supply 4 to 5 times the current consumption and would be restricted at that point only by limitations of pressure drops in the distribution system. Large high-pressure pipelines cross the Fermilab site and could easily supply increased capacity for any future requirement.

Potable Water

- Description

  There are three main and seven minor domestic water supplies that provide domestic water to the various areas of the Fermilab site. The Main Site system supplies domestic water through a piping network to the majority of the facilities on site. The primary water source for this system is Well No. 1 located near the Central Utility Building. Water is pumped from the well into a 50,000 gallon reservoir adjacent to the plant. There it is chlorinated and then pumped through the site-wide distribution system. The secondary source for this system is Well No. 3 located north of Road B and east of Receiving Road. When Well No. 1 is not in use, water is pumped from Well No. 3 into a 50,000 gallon reservoir at that well site. The water system is owned and operated by Fermilab.

  Domestic water is supplied to the Village Residential Area and the Village Technical Area by a direct-metered connection to the community water supply of the neighboring Village of Warrenville. This system, also Fermilab-owned and operated, is a separate distribution system independent of the main site distribution. In addition to potable water, this system provides the source of water for the fire protection systems located in the Village Areas.

  The third public water supply at Fermilab is the water supply located at D0. This system supplies water to the Colliding Beams Experimental Facility at D0. The water is pumped from nearby Well W-5 and is chlorinated at D0 prior to distribution. The D0 site will soon be connected to the main site domestic water supply once the new utility corridor currently under construction is completed.

Seven additional shallow water wells serve individual buildings at outlying sites. These are wells associated with the farm sites that existed when the land was originally acquired by the Atomic Energy Commission. They are kept in service to supply water to the adjacent, former farm residences and storage buildings which are still utilized for various laboratory requirements.

- Current Condition (reliability)
  The current condition of the Fermilab potable water system is adequate. The water wells are well maintained and in good condition. The distribution systems are marginal and projects are included in this report.

- Available Capacity
  The aquifer from which Fermilab wells draw water is in good condition and recharges at a rate sufficient to supply ongoing water requirements to Fermilab and neighboring communities. Wells used to draw domestic water at Fermilab have a combined capacity of 1100 gpm. The site has 32,000 linear feet of piping used for potable water distribution. Total capacity of pumping stations used for potable water is about 2000gpm. Current consumption averages 50,000 gallons per day, which is significantly below the site well capacity and treatment capability. Increased consumption could easily be doubled and satisfy any future increased requirement. Increased capacity would only be limited by the size of the distribution piping to a specific area.

Sanitary Sewer

- Description
  There are two (2) underground sewage collection systems at the Laboratory. One serves the main site, and the other serves the Village area. The main site collection system has six (6) lift stations; the Village system has one. No sewage is treated on site. Sewage from the main site is delivered and treated on a fee basis by the City of Batavia. Sewage from the Village is handled by the City of Warrenville under a similar arrangement. Fermilab owns and operates the sanitary collection system. The sewage system at the site contains 37,000 linear feet of gravity feed sewage line, 12,000 feet of pressure fed sewage line, and septic tanks with a capacity of 14,000 gal.

- Current Condition (reliability)

The collection system serving the main site facilities is in good working condition. A recent inflow and infiltration study has been completed that identified necessary repairs and improvements to this system to increase operating efficiencies and improve the capacity of the collection system. Off site collection of Fermilab's wastewater by the City of Batavia is marginally adequate and being jointly studied to determine alternate solutions.

Infiltration has been substantially decreased in the Village system due to recent repairs; 40% of the Village system has been replaced.

- Available Capacity
  The current collection capacity of the Fermilab sanitary sewer is well above the current monthly average discharge of 3,500,000 gallons. Capacity of both the Batavia and Warrenville wastewater treatment plants are adequate for current requirements and future requirements based on projected growth of their municipalities and can accommodate future increases from Fermilab. A limitation, if any, for future Fermilab sanitary requirements would be in the collection systems of Batavia and Warrenville as sanitary effluent is transferred from the Fermilab collection system to the neighboring municipalities. Fermilab has a good working relationship with both City Engineers and Public Works Departments and continues to share information on many infrastructure related issues. Although not anticipated, other possible options for increased sanitary capacity could consider onsite treatment including a land application treatment as adopted by some neighboring municipalities.

V. Planning Assumptions

The Fermilab Strategic Facilities Plan compliments the Fermilab Institutional Plan, is compatible with the Fermilab Comprehensive Land Use Plan and Sustainable Design criteria. Understanding the dynamics of the infrastructure contribution to establishing and achieving our physics goals was a critical component of establishing the requirements.

The challenge lies in balancing the competing demands of the programmatic requirements relative to our ongoing experiments and experimental goals, and balancing the infrastructure resources to allow for adequate revitalization and modernization. The ability to improve infrastructure reliability, and modernize to the new requirements, while maximizing our scientific results was considered based on the following groups of assumptions:

A. Mission Related

- FNAL will continue to lead the nation in the construction and operation of large facilities for particle physics research, and in developing the underlying technology for high-energy physics research. The Lab's mission is built on the foundation of eight core competencies listed in Section II.A. of this Plan.
- The current major facilities will continue to operate for their intended purpose and provide users reliable access to the world's best tools for particle physics research as listed in Section II. B of this Plan.
- Current Program Strategic goals will remain as stated requiring a high state of infrastructure reliability.
- Future Strategic Goals including a challenge to reclaim the post-LHC energy frontier and continuing our collaboration on the possibility of a linear collider, while stated in Strategic Facilities Plan, were not included in establishing infrastructure modernization requirements consistent with the direction from guidance document.

B. Stated in Strategic Facilities Plan guidance document

- Operating funding grows by no more than inflation.
- New programmatic initiatives are not included.
- Project estimates are based on FY04 dollars.

VI. Plan for Modernization

Development of the Fermilab Strategic Facilities Plan and associated requirements was based on interpretation of the new modernization guidelines as applicable to Fermilab ongoing mission assumptions, current infrastructure inventory and condition, and ongoing management initiatives. The plan addresses known and projected requirements, improves efficiencies of site layout, achieves a preferred working environment, upgrades infrastructure to sustainable and modernized standards and anticipates possible future mission needs.

A. Existing initiatives have helped to move Fermilab toward a plan for infrastructure modernization

The following Fermilab management initiatives have been implemented over the past few years to address infrastructure management at this laboratory. These initiatives directly compliment the guidance issued for development of the Strategic Facilities Plan. As a result of these management initiatives, Fermilab has made progress towards satisfying the new modernization requirements. These management initiatives and associated impact are listed below:

1. Dedicated Infrastructure Management Group
   In October of 1999, Fermilab leadership approved, recruited and hired dedicated resources to allow the Facilities Engineering Services Section (FESS) to take infrastructure management to the next highest level. This Group is lead by a Registered Professional Engineer with 20 years of facilities and utility experience recruited from private industry who brings a proven track record for improving infrastructure at several campus type environments through many best practice infrastructure management approaches.

   The Building Inspection program, Real Property including FIMS activities, and Time and Materials Services work processes were integrated into the Infrastructure Management Group in 2002 to help bring consistency and a consolidated focus on all areas supporting the lab's infrastructure management.

2. Critical Systems Planning
   Under the Critical Systems Plan, utility fault mapping and histories serve as a basis for identifying the most urgent improvements relative to making the accelerators as reliable as possible and the efforts to meet that goal extend throughout the entire site. At the core of the strategy is the Critical Systems Plan, a detailed analysis of each of the individual infrastructure systems that are essential to keep operating with the highest levels of efficiency and reliability. Site maps for each system display utility outages for each failure location on a utility line, and a log book contains a record with each fault recorded by date, and a comprehensive history is taken: each fault is numbered consecutively; the location is described; the action taken is chronicled; and possible causes and other remarks are listed. Using this comprehensive history, The Facility Engineering Services Section (FESS strives to predict when a component will reach the end of its performance expectations, and to repair or replace it before developing into a major problem. Once of the FESS goals is to reduce reactive efforts. Critical Systems Planning marked major successes in developing the upgrade plan with associated projects that have and will continue to dramatically improve reliability of all major utility systems.

3. Building Manager and Inspection Program
   Each building within the Fermilab complex has a Building Manager assigned to be responsible for the day-to-day operations of the assigned facility. Included in this responsibility is management of an ongoing building requirements list and status of each item. To assist in identifying the needed repairs and improvements as driven by general facility use and changing operational needs, dedicated inspection personnel are assigned to conduct building inspections on an annual basis with follow up reporting for requirements status including progress. Quarterly Building Manger meetings are conducted to disseminate information and discuss ongoing activities.

4. GPP prioritization and capital allocation process
   GPP allocations begin with a site wide infrastructure assessment to identify all existing and anticipated requirements from roofs to roads and everything in between. In fact it is this requirements list that serves as the backlog of elements needed to improve Fermilab's infrastructure to the level identified in this plan and has been used to allocate funding from GPP, operating and third party sources. Unfortunately, as overall laboratory funding has declined so has the level of GPP available for infrastructure investment.

5. Third Party Investments
   As considered in the Office of Science guidance document for this Strategic Facilities Plan, third party investment is anticipated to continue to be a critical component of Fermilab's infrastructure modernization plan. Taking advantage of the innovative opportunity to save operating funds, supplement declining GPP funding, improve efficiencies and rebuild Fermilab infrastructure through the Utility Incentive Program (UIP) also known as Utility Energy Services Contracts (UESC), has been a real success.

   The UIP is a procurement vehicle that allows for alternative financing (third party investment) of energy and water efficiency projects including infrastructure revitalization. Through partnerships with utility companies, efficiency improvements and savings opportunities have been identified and implemented through a turn-key (concept to completion) process. This process considers a site-wide systems life-cycle total-cost-of-ownership assessment as opposed to the more typical reactive equipment by equipment approach. Through this program, Fermilab has developed a site-wide multi-year improvement program funded by investments from Nicor Gas and Commonwealth Edison utility companies that will be paid back through the savings created from existing operating budgets. This program contributed $3.5M in FY 1999, $18M in FY 2000, $18M in FY2001 with several additional opportunities being pursued at various steps in the process.

6. Wilson Hall Safety Improvements Project
Wilson Hall, constructed in 1972, is the central laboratory facility for the Fermilab site. It is a 17-story reinforced concrete building. The great majority of the facility's 515,000 square feet of area is devoted to office space. In addition, the building contains a cafeteria, communications center, medical office, light industrial and shop space and an 800 seat auditorium. The Wilson Hall safety improvement project was a comprehensive project to improve the structural integrity and working conditions within one of DOE's premier facilities. This improvement project was completed in 2002 and included elimination of safety deficiencies, updating to current code standards and regulatory requirements, modernizing building components that had reached the end of their intended life and general facility improvements, as well as other ongoing projects such as the installation of fiber optics that make Wilson Hall Fermilab's show case for infrastructure modernization through investments of near $16 million. It should be noted that this facility represents 23% of the lab's total building area (78% of the lab's total office area) and is considered excellent in condition.

B. Trends cited for expected impact on facilities

The changing nature of research cited in the SFP guidance considers collaborative research, technology evolution, technology zoning and integrated work place concepts. Through the planning process, Fermilab concluded that technology evolution and zoning as described in the guidance has taken place at Fermilab to the extent necessary to conduct the type of research planned and projected in the foreseeable future. However, collaborative research and integrated work place guidance facilitated further development of several key initiatives at Fermilab. The following initiatives with Fermilab's Particle Physics and Technical Divisions are well underway in the Master Planning stage the results of which will be modernization projects funded through GPP or Line item. Master Planning efforts for Computing Division, Beams Division, and Technical Division have also recently been initiated.

1. Collaborative Research

One concept and associated projects that offer modernization advantages to accommodate the advancements in science and the way modern research is conducted is the Fermi Technology Campus master plan.

The existing Lab A - Lab G complex was constructed in the mid-1970's as a research area for fixed target neutrino experiments. Associated modest support functions, including machine shops, technical shops and offices were included from the beginning. After the original experiments in the facilities were concluded, additional rounds of experiments were done with the Tevatron fixed target beams. As the Tevatron Fixed Target program wound to a close in 1997-1999, Fermilab management recognized the need for a master plan for the area which set the long term vision of the area. In 1998, this master plan, termed the Fermi Technology Campus, identified and documented this vision. The plan provides for a systematic conversion and adaptive re-use of the existing buildings and infrastructure for the detector research, design and construction uses currently envisioned to support physics research. Since detector improvements in the field of high energy physics are constantly changing, each new and renovated space is being designed for maximum flexibility in order to accommodate new as-yet-unknown uses.
It was recognized early in the developmental stages of the plan that the implementation would be funding driven and driven by real programmatic needs. In other words the "master plan" was to serve as a <u>guide</u> for development of the area. Several projects (Lab C-D Connection, parking revisions) have already been designed and constructed in accordance with the master plan to fill the Particle Physics Division's need for space associated with a Silicon Detector assembly area. The next phase (Lab A-B Connection) has been designed and will be used to move technical facilities out of Wilson Hall, thereby allowing scientists to utilize Wilson Hall for collaborative interactions between experimental groups.

2. Consolidating Operations

Technical Division Industrial Building 5

Technical Division, within Fermilab, is responsible for the development of super conducting magnets, the key component of the accelerator. It took several decades for the Technical Division to develop its magnet technology to the present level. The current Technical Division was originally organized as the Technical Support Section in 1983. At this time the Technical Services (consisting of the Conventional Magnet Facility and the Machine Shop) and the Energy Saver Section (consisting of the Super conducting Magnet Facility and the Magnet Test Facility) were combined to create the Technical Support Section. In the mid 1990s the Technical Support Section became the "Technical Division." Although research was a part of the work as a Section, the change to become a full-fledged Division made R&D a major portion of the mission of the organization. Consolidation of older facilities with facilities required for new mission has been started through funding of a Master Plan for Technical Division that will likely result in the new facility for the reasons described below:

- Alleviate the space/safety problems associated with Lab 4 (Something needs to be done to fix the known problems).
- Provide room for expansion to accommodate high precision machines in a controlled environment.
- Allow for a consolidation of activities.
- Incorporate the Wilson Hall and IB4 shops. (This frees up valuable space in both buildings and allows consolidation of supervisor activities).
- Provide the capacity to absorb additional satellite shops (as required).
- Locate the main shop in a more convenient and centralized site. (Should allow a better coordination of machine shop operations and also result in cost savings just due to transit time to and from the shops).

The existing machine shop facilities in the village are among the oldest at the Laboratory that requires high maintenance.

3. Eliminating excess

Fermilab's excess facility program is relatively new and in development as part of the sitewide master planning initiative. Fermilab initiated this effort through submission of projects in support of the Particle Physics Divisions Master Planning. It should be noted that of the near two million dollars in project requests, a majority of this request was to remove obsolete beamline enclosures. This request when funded will remove 19,605 SF from the Fermilab inventory. As part of the lab's Master Planning process, Fermilab will be investigating space consolidation and additional excessing actions to support the newly established requirement commencing in FY03 for offsetting demolition square footage for each new construction project that adds building space. The Fermilab excess facility project demolition submittals are shown below:

Project title	FIMS number	Demolition costs
Neon Compressor building - funded	625	$ 53,000 (FY02)
Muon Beam enclosures (22)	701030125	$ 1,151,000
Muon Beam enclosures (pilot-3)	701030125	$ 178,000
Lab G trailer	T-060	$ 31,000
Bubble Chamber equip. removal	602 (equip.)	$ 233,000
PCenter trailer	T-009	$ 18,000
Laser Building	602 (annex)	$ 67,000
Lab G concrete slab	NA	$ 70,000
Shed B Site 50	945	$ 26,000

4. Employing cost efficiencies

An Integrated Workplace (SMART Lab) feasibility study was recently completed under a DOE FEMP direct funded project that supports the SMART Lab master plan concept currently being developed at Fermilab. The foundation for this initiative is information sharing between existing control and communication systems and a plan to move towards the latest technology for systems integration. The initiative seeks to develop data highway infrastructures (fiber optic networks in most cases) to facilitate site services that are labor intensive, to support automatic process control of various electrical and mechanical systems, and initiate automated data collection from and between the multiple lab databases. The graphic below represents this initiative.

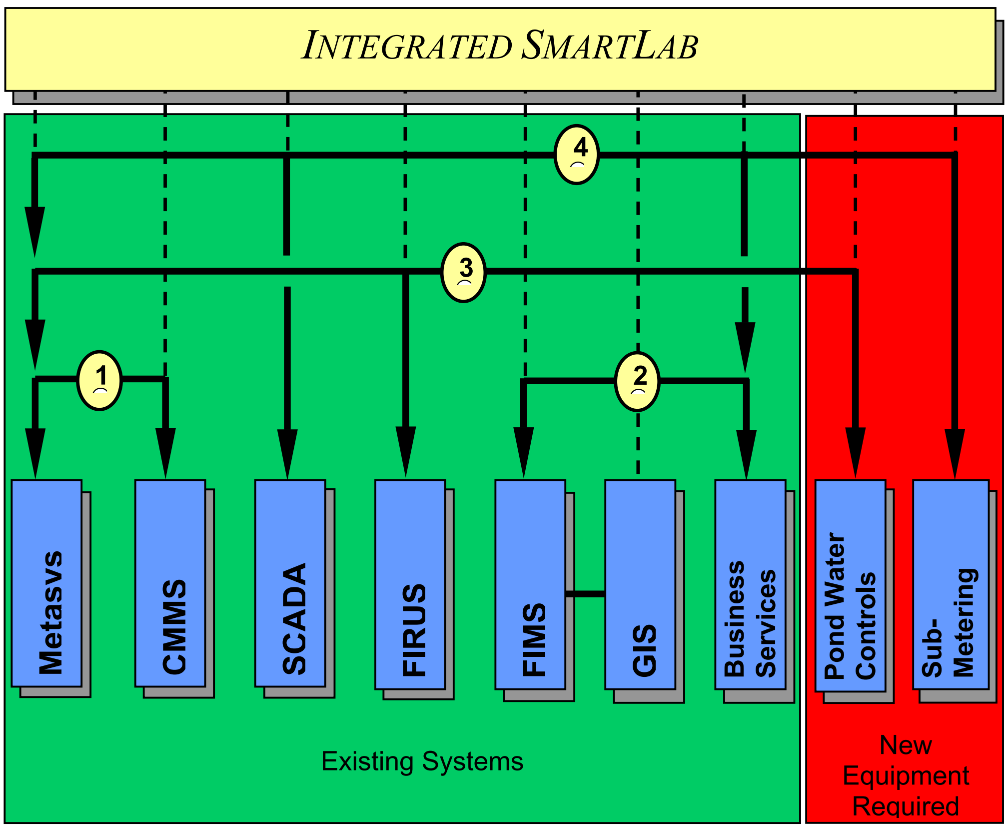


FIGURE 6.1 - IDENTIFIED SMARTLAB PILOT PROJECTS

1. Link Metasys and CMMS to facilitate predictive maintenance
2. Link FIMS to other programs to eliminate manual data entry
3. Install automated pond water level monitoring system
4. IMPLEMENT ELECTRICAL SUBMETERING AND REPORTING

C. Repairs and Improvements for Existing Infrastructure

Despite funding shortfalls, Fermilab has made progress over the past several years in improving infrastructure. While the most critical utility systems have been improved or repaired, nearly $40M dollars in existing and projected requirements have been included in this plan. The management initiatives discussed earlier in this section have contributed to this progress.

There are currently no requirements for Office of Science funded environmental restoration or remediation. Fermilab has recently implemented a building reuse policy to ensure that space requirements are met in the most economical manner and to minimize use of operating budgets for unoccupied spaces.

Using the Critical Systems Planning process, the prioritization and capital allocation process in combination with GPP funding and third party investments, the most critical portions of utility systems have been improved. However, the majority of the current requirements listed in this plan are utility related projects necessary to improve reliability to the required levels. These projects are identified in Appendix A and are grouped in the following categories:

Infrastructure Category
• High voltage structures
• High voltage feeders (13.8 kv)
• Cooling water upgrades
• Village domestic water upgrades
• Sanitary sewer upgrades
• Master substation upgrades
• Main site domestic water wells
• ICW water and distribution
• Natural gas system upgrades
• CUB system upgrades
• Pond water system upgrades
• Building roofing systems
• Roads and trails
• Building improvement

VII. Resource Needs Summary

To satisfy the requirements identified in Section VI, Plan for Modernization (including Collaborative Research projects, Integrated Workplace projects) and existing and projected Infrastructure projects, Fermilab has identified the funding requirements over the 10 year period of this plan (2004-2013) in the areas of GPP and operating funds as described and included in the spreadsheet included herein. Appendix A identifies projects for the Utility categories.

A. Line item funding

Fermilab currently has no line item projects. However, the ongoing site wide master planning efforts are expected to generate line item candidate projects not currently covered by this plan. The order of magnitude is shown in the chart below.

B. General Plant Projects (GPP)

With the exception of some of the projects under $100,000 (identified in Appendix A) that will be funded from Real Property Maintenance funds, all projects requirements are proposed for GPP funding. Through GPP funding and continued third party investment, all requirements can potentially be satisfied.

Master Planning potential (Line item)	Cost ($Millions)
Particle Physics Division	5-8
Technical Division	8-13
Computing Division	3-5

Integrated Workplace potential	Cost ($Millions)
Smart Laboratory	1-3

Utility Category	Cost ($Millions)
High voltage structures	2.8
High voltage feeders (13.8 kV)	6.1
Cooling water upgrades	3.6
Village domestic water upgrades	0.6
Sanitary sewer upgrades	2.2
Master substation upgrades	3.2
Main site domestic water wells	2.7
ICW water and distribution	4.8
Natural gas system upgrades	2.6
CUB system upgrades	4.2
Pond water system upgrades	3.6
Total	36.4

Other Categories	Cost ($Millions)
Building roofing systems	4.4
Roads and trails	2.9
Building improvements	18.8
Total	26.1

Grand Total	62.5

C. Real Property Maintenance

Funding for this infrastructure element includes annual real property maintenance and repairs including structures and utilities, roofing, chiller/boiler replacement, and other mechanical, electrical and lighting, including preventative maintenance, cyclical maintenance, and service calls.

Funding for Real Property Maintenance based on FY02 budgeted maintenance is at 1.34% of the replacement value of Fermilab's non-programmatic infrastructure (buildings and utilities with an RPV of $460M). The SC guidance for the FY2000 Strategic Facilities Plan stated that sites should trend towards 1.5% by 2010. This is based on the Federal Facilities Council recommendation of 1.5%. Fermilab is expected to achieve the 1.5% in FY04 as shown in appendix A (Resource needs). Recent discussion on increasing this level to 3% is believed to be more of an investment level that should include GPP and UIP type funding and further discussion on the RPV denominator will be necessary.

D. Operations funding

There are currently no environmental reclamation or remediation projects requiring operating funding, and no currently identified decontamination. A wetlands delineation has been completed to enhance the planning process and offer a higher degree of project certainty.

VIII. Vetting process for 10-Year plan development (identifying and prioritizing)

The following offers a brief summary of the process used to develop the plan and establish priorities.

- The process started with interpretation of the guidelines based on Fermilab's mission as stated in the Fermilab Institutional Plan and known programmatic changes since the last plan update.

- A review of existing deficiencies from the building inspection program, latest infrastructure assessment and site wide utility energy/water audits (performed under the UIP initiative), was completed to identify new requirements necessary to meet the flexibility and versatility guidelines.

- Collaborative Research and Integrated Workplace requirements were identified that needed integration into the plan. Technology zoning and evolution were determined to be satisfied at the necessary level based on existing and projected mission requirements.

- Brief scope descriptions and order of magnitude cost estimates were developed for the identified requirements and updated for existing infrastructure requirements. Different approaches were then considered for funding including continuation of third party investment through the Utilities Incentive Program.

- Since Fermilab is basically one large machine and one large office building (Wilson Hall), and since the Wilson Hall multi-year modernization improvement project is completed, the majority of the projects listed in this plan were determined to fall within the utility system category with a focus on reliability. Projects developed from the master-planning efforts now underway will be included in future updates as applicable.

- Prioritization of these utility system projects was based on risk levels associated with safety, mission and environment and the probability of failure of a particular system. Projects were ranked and placed in a particular year for funding using the following approach.

•Criteria is based on:

Safety -	What is it the threat to personnel safety?
Vulnerability -	Is it mission critical?
Reliability -	Will its loss impact the mission?
Redundancy-	Does the equipment have a back up?

•Ranking: level of risk and probability of failure

Risk Level To Safety Mission Environment (↑) vs. **Probability of Failure** (→)

Risk Level	Low	Medium	High
1	C	B	A
2	D	C	B
3	E	D	C
4	E	E	D
5	E	E	E

Repair Code

- A - Immediately
- B - Within a Year
- C - As Soon As Possible
- D - Maybe Yes/No
- E - Never

IX. Summary

The Fermilab Strategic Facilities Plan brings together modernization guidelines and existing infrastructure requirements to identify in a comprehensive manner all known needs to continue progressing towards achieving recognition as a "model" Office of Science laboratory for the 21st century. This Strategic Facilities Plan focuses on rebuilding Fermilab to best satisfy the current mission requirements while considering the various future activities that have high utility reliability and capacity.

Most significant are the completion of the Wilson Hall Improvement project and the Fermilab third party investment successes through the Utility Incentive Program. Use of such programs have the potential to reduce overall revitalization costs by creating a platform for detailed infrastructure analysis in conjunction with utility company expertise, while creating real incentives to reduce costs and maximize return on investment. One of the advantages of using third party funding is that it allows immediate implementation of detailed infrastructure assessments and optimization planning together with initial renovation work at relatively low costs. This could allow more time for SC to develop direct funding sources without delaying critical infrastructure needs.
The identification and prioritization process that is described in this plan is one of several ongoing management initiatives used to develop this plan. These initiatives will continue to be critical management components for ensuring Fermilab continues to be operated and maintained with the focus of sustainability through flexibility and versatility thereby ensuring taxpayer investments are used to create the highest value and associated contribution to science.

X. Appendices

Project Requirements List