

# Fermilab National Accelerator Laboratory

## Section 7: Infrastructure

### Overview of Site Facilities & Infrastructure

The Fermilab real property is sited on 6800 acres of land located 42 miles west of Chicago in Batavia, Illinois. Assets include 355 buildings comprising 2.4 million gross square feet and hundreds of miles of utility infrastructure, including electrical, natural gas, industrial cooling water, potable water and sanitary systems with a total real property replacement plant value (RPV) of \$1.5 billion, including its programmatic accelerator and tunnel assets. The detailed property information and capitalized value detail associated with each of these assets is maintained in the United States Department of Energy’s (DOE) Facilities Information Management System real property database. All of the Laboratory’s buildings are used and owned by DOE; the usage is predominately divided among research and development space and administrative areas. The buildings are in excellent condition with the most significant infrastructure need being the lab’s underground piping systems that are categorized as poor. Planned investments over the next several years are proposed through GPP and SLI. Fermilab’s April 2008 RPV snapshot, used as the baseline RPV in this Plan, is \$705M, for buildings, utilities and the conventional portion of the accelerator (OSF 3000) assets. Additional RPV data and discussion, including projections for the 10-year planning period, is included in the table in section **Trends & Metrics**.

At the administrative center of the Fermilab campus and comprising 22% of the building RPV is Wilson Hall. This 16-story office building is 22% of the total Fermilab gross square footage and 77% of the site’s office space. Fifteen percent of the remaining square footage – about 1/3 of all Fermilab buildings – is accelerator service buildings, with grade level access and mechanical support along the length of the accelerator chain. A table of key infrastructure data is shown below.

Fermilab Infrastructure Data Summary

Total Replacement Plant Value (\$M)		\$1,500
Conventional Replacement Plant Value (\$M)		\$705
Total Deferred Maintenance (\$M)		\$35
Asset Condition Index	MC	0.93
	MD	0.98
	NMD	N/A
Asset Utilization Index	Office	0.99
	Warehouse	0.92
	Laboratory	1.00
	Housing	1.00
Prior Year Maintenance (\$M)		\$12

MC = Mission Critical, MD = Mission Dependent,  
NMD = Non-Mission Dependent

**LAND USE PLAN:** Fermilab’s Ecological Land Management (ELM) Plan (available electronically at <http://www.fnal.gov/cgi-bin/ecology/frame?TYPE=PLAN&YEAR=NOW>) is

updated annually. The ELM Plan identifies near term goals and long term objectives for cost effective planned management and fulfillment of Fermilab’s stewardship responsibility for the undeveloped portions of the Laboratory’s 6,800 acre campus.

**Facilities & Infrastructure to support Laboratory Missions**

The business lines shown below represent the current mission whose specific infrastructure needs are being met within the existing facilities whose condition is excellent. Future Mission needs will be assessed as programs and projects develop. It is expected that some level of new facilities will be required but reuse of existing facilities will be considered as well. Known real property needs for both the current mission and future are in the General purpose business line for support of both current and future missions.

<b>Business Lines</b>	<b>Facilities &amp; Infrastructure</b>	<b>Summary Condition Evaluation</b>	<b>Planned Investment</b>
<b>Collider Physics</b>	Service buildings, CDF and D-Zero Assembly buildings, Tevatron and Main Injector tunnels	The facilities and infrastructure in support of this area are considered adequate including the conventional portions of the underground asset	No known or anticipated infrastructure investments over \$2M
<b>Neutrinos</b>	MI 65 & MINOS service buildings, NuMI tunnel	The facilities and infrastructure in support of this area are considered excellent including the conventional portions of the underground assets	No anticipated infrastructure investments over \$2M necessary at this time, facility and infrastructure investments will be needed for future experiments such as
<b>Rare Decays</b>	External beam lines and service buildings	The facilities and infrastructure in support of this area are considered adequate.	No known or anticipated infrastructure investments over \$2M necessary at this time
<b>Dark Matter &amp; Dark Energy</b>	Technical Division Assembly buildings, and computing facilities	The facilities and infrastructure in support of this area are considered adequate.	No known or anticipated infrastructure investments over \$2M
<b>Accelerator R&amp;D</b>	Meson Detector bldg., New Muon buildings	The facilities and infrastructure in support of this area are considered adequate.	No known or anticipated infrastructure investments over \$2M
<b>Theory</b>	Office building and Computing facilities	The facilities and infrastructure in support of this area are considered excellent.	No known or anticipated infrastructure investments over \$2M

<p><b>General Purpose</b></p>	<p>Wilson hall, Industrial facility complex, Computing facilities, High voltage, industrial water and domestic water systems, other utilities, roads and parking lots, pond systems</p>	<p>Condition of Wilson Hall is considered excellent. Industrial facilities are inefficient and condition of older machine shops and laboratory facilities are poor. Computing facilities at FCC, GCC and LCC are considered adequate except for cooling capacity and water piping at FCC. A master plan has been initiated to further assess the computing requirements. Underground piping infrastructure is considered poor and high voltage electrical condition has improved but still requires investment.</p>	<p>SLI investment is planned for the industrial cooling water system, high voltage electric system and industrial facilities consolidation. Additional GPP investment in these areas is also planned as shown in the appendix in the IFI cross cut budget.</p>
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The age of Fermilab’s buildings varies widely. Of the total Fermilab square footage, 65% represents buildings more than 30 years old, with 6% over 100 years old (20 buildings). The buildings less than 40 years old were constructed specifically for Laboratory operations in the early 1970s, while the buildings older than 40 years were part of the original land acquisition for the site and included a residential village complete with utility systems. These older facilities present different operational and maintenance challenges in comparison to the buildings less than 40 years old (127 buildings or 37% of total number of buildings). Generally, these newer buildings fare well when the ratio of deferred maintenance to RPV, or the Facility Condition Index (FCI), is considered. The April, 2008 overall site building FCI was 1.05%, with 78% of buildings scoring as Excellent. When measured by gross square footage, rather than number of buildings, 85% of the facilities rate Excellent (<2% FCI).

The existing building facilities are meeting the current operational and experimental needs of the site, which is currently operating with an overall Asset Utilization Index of 0.989 (Excellent)... Recently, a series of enhancements were accomplished at the Meson Detector Building to enable reuse of the building as a test beam area for Superconducting Radiofrequency cavities. The former Wide Band Counting House Building has been enlarged and converted to a state of the art computing facility. In similar situations, Laboratory management works to identify and satisfy facility needs through re-assignment and modernization. However, as future mission opportunities continue to develop, additional new experimental facilities will likely be needed.

Similarly, the Laboratory’s utility infrastructure may require expansion as future mission is identified. Deferred maintenance requirements of the Laboratory’s utility infrastructure currently comprises 83% of the site’s total FY07 Deferred Maintenance backlog, or \$29M of the \$35M. Most significantly, the underground piping and electrical systems are in need of additional investment. While substantial GPP efforts are identified in the FY10 Integrated Facilities and Infrastructure crosscut budget plan, investment via the Office of Science’s SLI Modernization Initiative will definitively improve the reliability of the most critical utility

systems. Finally, when siting future projects, Fermilab's Facilities Engineering Services Section (FESS) works closely with experimental planning groups to efficiently utilize existing utilities or easily expand such facilities.

The General Purpose business line includes the following assets:

- Electric – 345kV power is received from utility grid at two primary substations, 280 secondary substations, 110 miles of cable (80 miles underground)
- Natural Gas – 14 miles of underground piping
- Cooling Pond Water – 140 acres of ponds with return and supply channels
- Industrial cooling water – 21 miles of piping and two pumping stations; also serves as the site's source of fire protection water
- Sanitary System – 12 miles of sewer collection piping and lift stations
- Roads and Parking lots – 36 miles of paved roads and 42 acres of parking lots

Recent success in working with the Fermi Site Office has resulted in a potable water purchase agreement with the neighboring City of Warrenville. Fermilab installed new domestic water supply mains between the east and west side of the campus, providing site-wide water from the City of Warrenville municipal water service. The Fermilab wells and treatment facilities have been disconnected from the domestic water system. This provides a reliable long term supply agreement for Fermilab.

Additionally, the Batavia Initiative, a public utility easement consummated by the Fermi Site Office and City of Batavia resulted in replacement of high voltage infrastructure for the lab and reduction of deferred maintenance in an amount of near \$5M. In exchange, Batavia was able to cross the lab with new high voltage transmission lines.

### **Strategic Site Investments**

#### *SLI Modernization Initiative*

Three Fermilab projects are slated for funding as part of the Office of Science initiative to address infrastructure modernization needs at its laboratories. Each of these projects general infrastructure requirements and solidifies Fermilab's potential mission capabilities.

- Industrial Cooling Water Upgrade; TPC of \$20.8M with FY 11 start
- High Voltage Electrical System Upgrade; TPC of \$14.1M with FY11 start
- Industrial Facilities Consolidations; TPC of \$33.8M with FY14 start

#### *GPP*

The IFI crosscut represents the Laboratory's best understanding of outyear GPP funding levels based on information from the HEP program office and the laboratory's planning for infrastructure improvements.

In addition to mission requirements, infrastructure needs and plans, FY09 through FY19, are summarized in the appended FY10 IFI crosscut. GPP investments are directed toward the utilities which present the highest vulnerability to the scientific operation as well as those in the greatest need of repair. Significant GPP investment is also directed toward expanded computing capacity.

The increased GPP values in the outyears represent both unconstrained needs as well as the potential GPP increase commensurate with the completion of UIP payments.

Future submissions will likely include additional projects as planning continues for future mission as described Section 2. Additional project detail is included in the Integrated facilities and Infrastructure cross-cut budget attached in the Appendices.

#### Maintenance

The Facilities Engineering Services Section provides preventive and corrective maintenance for Fermilab's conventional electrical and mechanical equipment. Occupant organizations identify, fund, and accomplish the remainder of facility sustainment requirements, including those activities accomplished in concert with other GPP or line item projects.

Future maintenance expenditures, based on 2% of conventional replacement plant value are planned. Should actual replacement plant values differ from those currently projected; Fermilab's planned maintenance expenditures will be also adjusted.

#### Deferred Maintenance Reduction (DMR)

Fermilab's total deferred maintenance (DM) decreased \$4.8M from \$39.4M reported in FY06 to \$34.6M for FY07. Seventy percent of Fermilab's FY07 DM rests with Mission Critical Other Structures and Facilities, and 58% of the total site DM, \$20M, is in the electric and industrial water distribution systems of which nearly \$17M will be eliminated with the two FY11 SLI projects.

Routine maintenance responsibilities for OSFs are assigned to specific system owners, typically the Facilities Engineering Services Section. OSF assessments are periodically updated to represent their current operating condition. This is an ongoing process, which considers system or component age, efficiency, safety and environmental compliance, maintainability, failure history, locations and conditions found during repairs, current mission needs, and future requirements. Deferred maintenance on utility systems has increased dramatically during recent years due to detailed assessments of the aging infrastructure systems. Utility system deferred maintenance is due in large part to ongoing inspections validating increased deterioration of these systems. Requirements for deferred maintenance are identified and scoped by the system owner, and, if appropriate, prioritized for GPP funding by the Chief Operating Officer. Prioritization of these projects is based on risk levels associated with safety, mission, and environment and the probability of operational impacts from a particular system.

Fermilab recognizes that continued additional reinvestment will be required to control deferred maintenance growth. Many of the GPP projects identified in Block 2.2 of the appended FY10 IFI Crosscut submittal reflects the current plans for this reinvestment, which will improve the overall condition of building components and infrastructure systems, specifically with respect to ACI. As a single-program laboratory with a single source of funding, Fermilab's GPP infrastructure expenditures support general purpose assets. SC 31.2, in discussion with the Fermilab FIMS Administrator, agreed that Fermilab's GPP expenditures that reduce deferred maintenance *can* be counted as part of Fermilab's DMR efforts.

Fermilab's partnership with the neighboring City of Batavia has recently resulted in the replacement of Fermilab's aging Pi-poles. This FY08 DMR contribution will significantly reduce the overall site deferred maintenance, and help insure uninterrupted electric utility service in the future.

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While Fermilab acknowledges the DMR targets set forth by the Office of Science, the laboratory posits that these investments duly reduce the deferred maintenance backlog and achieve the ACI target of 0.98 for mission critical assets by FY12. Fermilab’s mission dependent assets currently meet the target ACI of 0.96.

**Trends & Metrics**

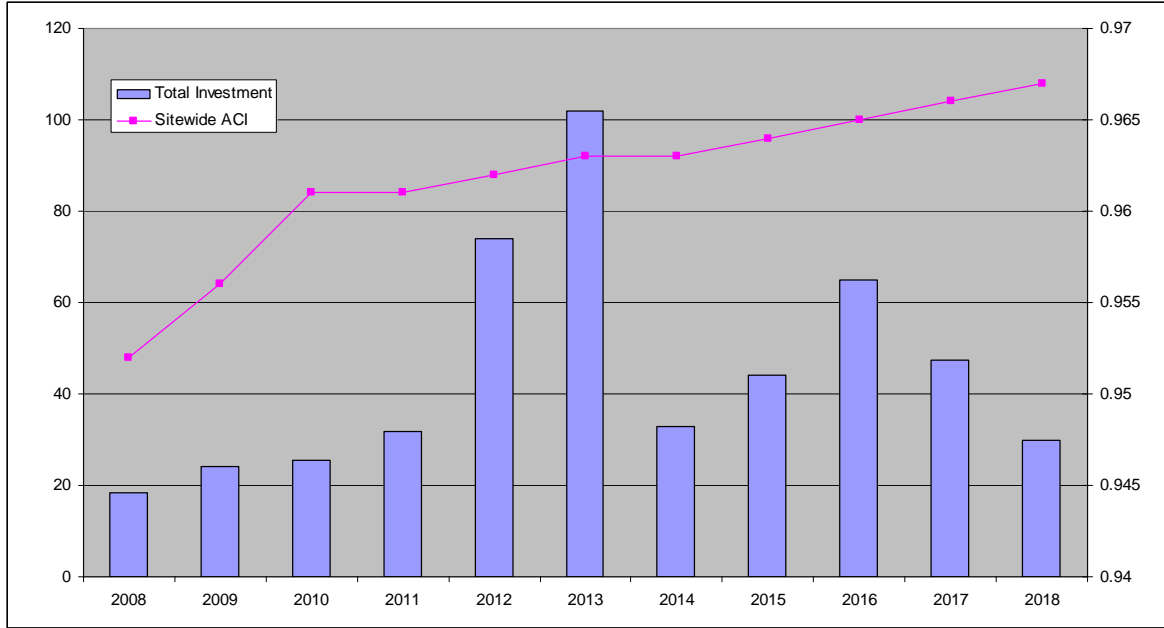
The infrastructure performance measures contained in the PEMP include Maintenance Investment levels; limited downtime of the Tevatron caused by high voltage electric and industrial cooling water systems, General Plant Projects identified in prior year Ten Year Site Plan, and planned maintenance activities.

A new measure for FY08 was assigned to develop a strategy to increase infrastructure investment which minimizes the cost of doing business. This strategy is being developed but will likely include redirecting the third party financing annual payments to infrastructure projects when the third party funding is complete in a few years. All measures have been met in prior years and are expected to be met in FY08. The only exception may be the level maintenance investment due to the reduced level of funding in FY08.

The projected trends for infrastructure investments and asset condition are presented below as submitted in the FY10 IFI cross-cut budget.

Facilities and Infrastructure Investments (\$M) - Impact to Asset Condition Index

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Maintenance	12	13.5	13.8	14.2	14.5	14.8	15.2	15.5	15.9	16.2	16.6
DMR*	1.9	2.8	3.7	0	0	0	0	0	0	0	0
Excess Facility Disposition (overhead)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
IGPP	0	0	0	0	0	0	0	0	0	0	0
GPP	3.9	7.2	7.4	10.8	14.2	14.7	15.1	14.6	15	12.7	12.7
Line Items	0	0	0	6.3	44.8	71.8	2.1	13.4	33.4	18	0
Total Investment	18.3	24	25.4	31.8	74	101.8	32.9	44	64.8	47.4	29.8
Estimated RPV	691.7	707.6	723.8	740.5	757.5	774.9	811	829.7	848.7	868.3	888.3
Estimated DM	33.5	31.5	28.5	29	29	29	29	29	29	29	29
Site-Wide ACI	0.952	0.956	0.961	0.961	0.962	0.963	0.963	0.964	0.965	0.966	0.967



**Sustainability**

Fermilab is in the process of developing the executable plan that will provide a status of initiatives being reviewed to comply with DOE Order 430.2B. The chart below reveals the most current opportunities and possible results.

Although not specifically mentioned in the order, it is hoped that the initiative started in FY07 under the TEAM initiative to develop a laboratory corporate portfolio approach is still possible. This would allow all science labs to pool their achievements to meet the same goals but from a corporate standpoint.

**DOE Order 430.2B Goals**

Requirement	Goal	Funding Source	Cost	Mile stone	Progress to Date
Energy Reduction of 30%	TBD	ESPC		FY09	Initial proposal received
	TBD	GPP		FY15	Vendor meetings
	TBD	SLI		FY10	
Renewable Energy On-site	TBD	ESPC		FY10	NREL site visit to assess opportunities ESPC BAMF assessment Fuel cell backup power visit to be set
	TBD				
Renewable Energy Off-Site	5%	REC		FY10	
Water Reduction	TBD	ESPC		FY10	Leak detection strategy Fixture replacements being set
Sustainment	15% of space	TBD		FY15	15% identified for assessment of guiding principles.

Fermilab has aggressively pursued energy and water efficiency in its facilities, with two complete energy audits of the entire site completed in 2000 by competing utility companies. Through these and other similar efforts over \$58M in Utility Energy Service Contracts (UESC) work was awarded through 2001 to rebuild critical infrastructure while improving energy and water conservation. In addition, other remaining life-cycle cost effective opportunities identified in these audits which were not implemented under UESC have been funded and completed recently as FEMP retrofit projects. These activities represent significant progress already reflected in the FY2003 baseline year for energy reduction as was confirmed by the limited scope of the ESPC.

Further complicating matters are the recent alterations in future Fermilab programs, as reflected in changes recent mission changes. Many program initiatives have been suspended or cancelled, and the character of future operations on site remains in the balance. This makes it difficult to recommend further retrofit investment at this time.