Fermilab

Master Planning Task Force

October 9, 2012

*Members (**P**= Present, **A**=Absent)*

P	Pier Oddone	**P**	Jack Anderson	**A**	Steve Holmes	**P**	Greg Bock
P	Vicky White	**P**	Bob Kephart	**A**	Giorgio Apollinari	**P**	Mike Lindgren
A	Roger Dixon	**A**	Steve Wiesenthal	**P**	Randy Ortgiesen	**P**	Young-Kee Kim
A	Patricia McBride	**P**	Paul Czarapata	**P**	Stuart Henderson	**P**	Katie Yurkewicz
A	Carl Strawbridge	**P**	John Bakken	**P**	Rob Roser	**P**	Steve Dixon

Guests

E. Gottschalk, G. VanZandbergen, M. Bollinger (DOE)

A. Experimental Operation Center (XOC) Presentation

G. Van Zandbergen (GV) provided an overview of the XOC status (see attached presentation). The following observations were noted:

- The revised plan addresses comments and concerns identified during a series of users meetings held in the summer of 2012 by E. Gottschalk (EG);
- The typical experiment is expected to utilize two (2) consoles. There are a total of twelve (12) consoles in the space;
- The revised plan includes code-compliant exiting;
- Compared with the existing LHC Remote Operations Center, the XOC is approximately 30% larger;
- It was noted that the role of the XOC Operations Manager would be an assignment from a rotating group of experiments using the space and not a new hire;
- The plan calls for the fiber optic equipment in the west stairway to remain;
- A moveable glass dividing wall would be used to separate the active experiments from those experiments that are in the commissioning process;
- The issue of telephony was discussed. EG indicated that the current plan assumes standard telephone service as is typical in Wilson Hall. J. Bakken indicated that the preference is for new construction to include voice of internet protocol (VOIP). R. Ortgiesen (RO) indicated that the use of VOIP carries with it a number of issues that may need to be addressed separately;
- There was a discussion concerning the possibility of a video link to the Main Control Room to encourage communication. Additional investigation is warranted;
- Schedule:
    - Final Design currently underway
    - Construction funding early in the second quarter of FY13
    - Construction complete by December 2013

A. Master Plan

G. Van Zandbergen (GV) provided an overview of the steps required to produce a master plan document, including a straw-man version of a potential master plan. The following observations were noted:

- In general, the master plan will consolidate existing information and work the plan towards the deliverable of achieving the DOE PEMP notable for FY13;
- Appendices will be used in order to keep the document a manageable size,
- The format of the document should allow for both a printed version and a web-based presentation;
- Young-Kee Kim (YKK) suggested that the plan address a long term vision with perhaps a 50 year time horizon. S. Henderson (SH) suggested that the approach be more timeline based (10 years, 20 years and 50 years);
- Pier Oddone (PO) felt that the near term focus should be thought of in the context of the big picture. M. Lindgren (ML) stated that the master plan should be so compelling that the audience would be excited about the next step;
- The document will have a number of different audiences, including DOE, other funding agencies, Fermilab users and the public;
- Possible funding agencies could include Science Laboratory Infrastructure (SLI) group, the high energy physics group and well as state of Illinois;
- B. Kephart (BK) noted that the document should include not only a strategy for new construction but also recommendations for the location of new construction;
- J. Anderson suggested that the data gathering phase include discussions with a young post-doc or other appropriate choice that would allow a perspective on the expectations of the next generation of users;
- BK suggested that perhaps the master plan exercise be expanded to incorporate the work in the context Argonne National Laboratory in order to provide a uniform presentation. After discussion, PO noted that the plan should be sharply focused on Fermilab for now;
- P. Czarapata (PC) noted that while the idea of consolidation was admirable, there will still remain facilities that will be remote to the central campus;
- PC noted that the master plan should include support facilities for new planned projects;
- R. Roser (RR) commented that the master plan should consider the master plan of DuPage and Kane counties;
- BK stated that the Lab should consider an investment in developing the design of selected projects in the event that new funding should become available like was the case with the American Recovery and Reinvestment Act work;
- PO stated that new facilities should incorporate the planning principals evident in Wilson Hall (views to the outside, informal meeting spaces, public spaces, etc..) since Wilson Hall is perceived as an example of a successful facility that meets the needs of the science community.

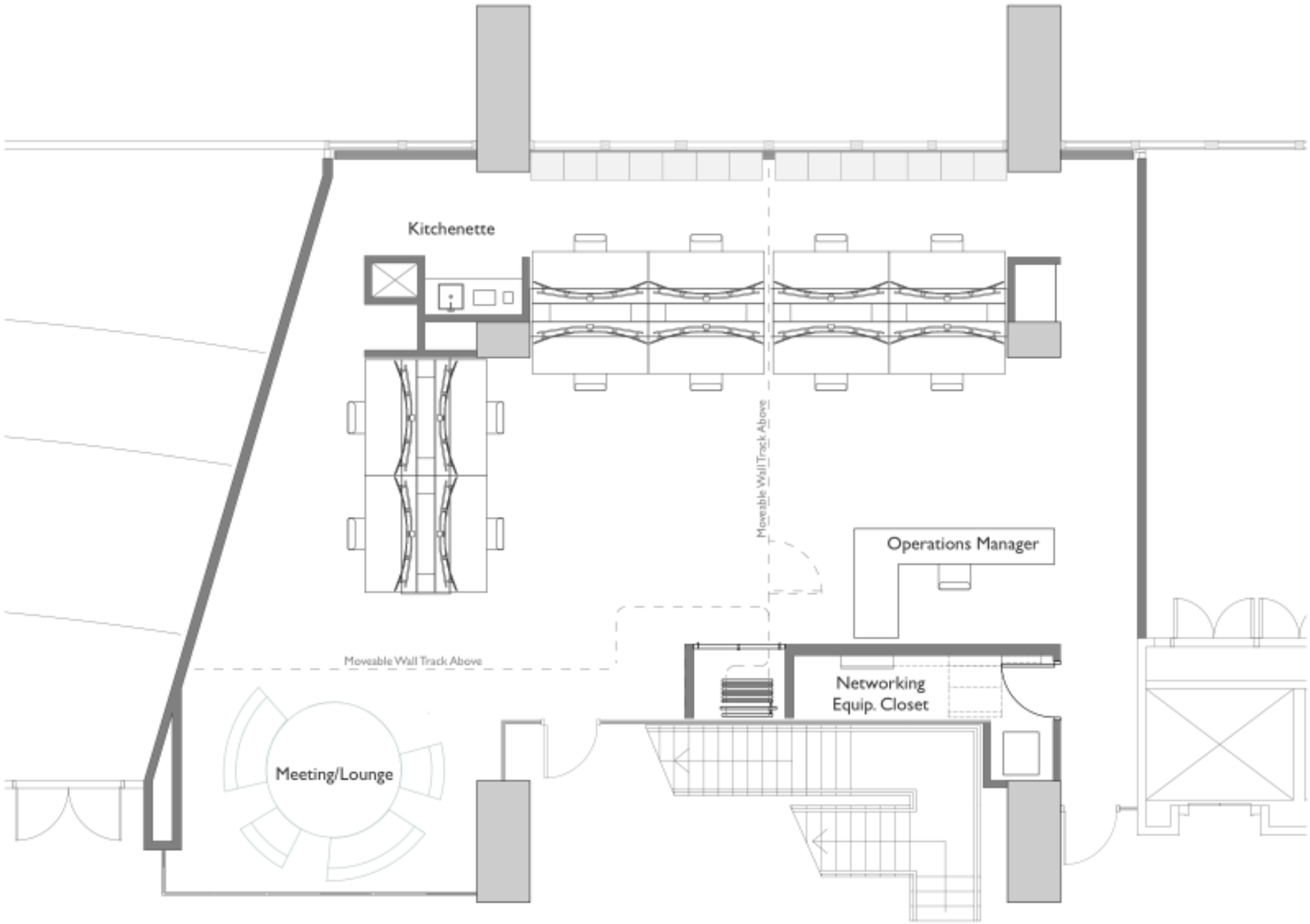
C. Action Items from This Meeting

None noted

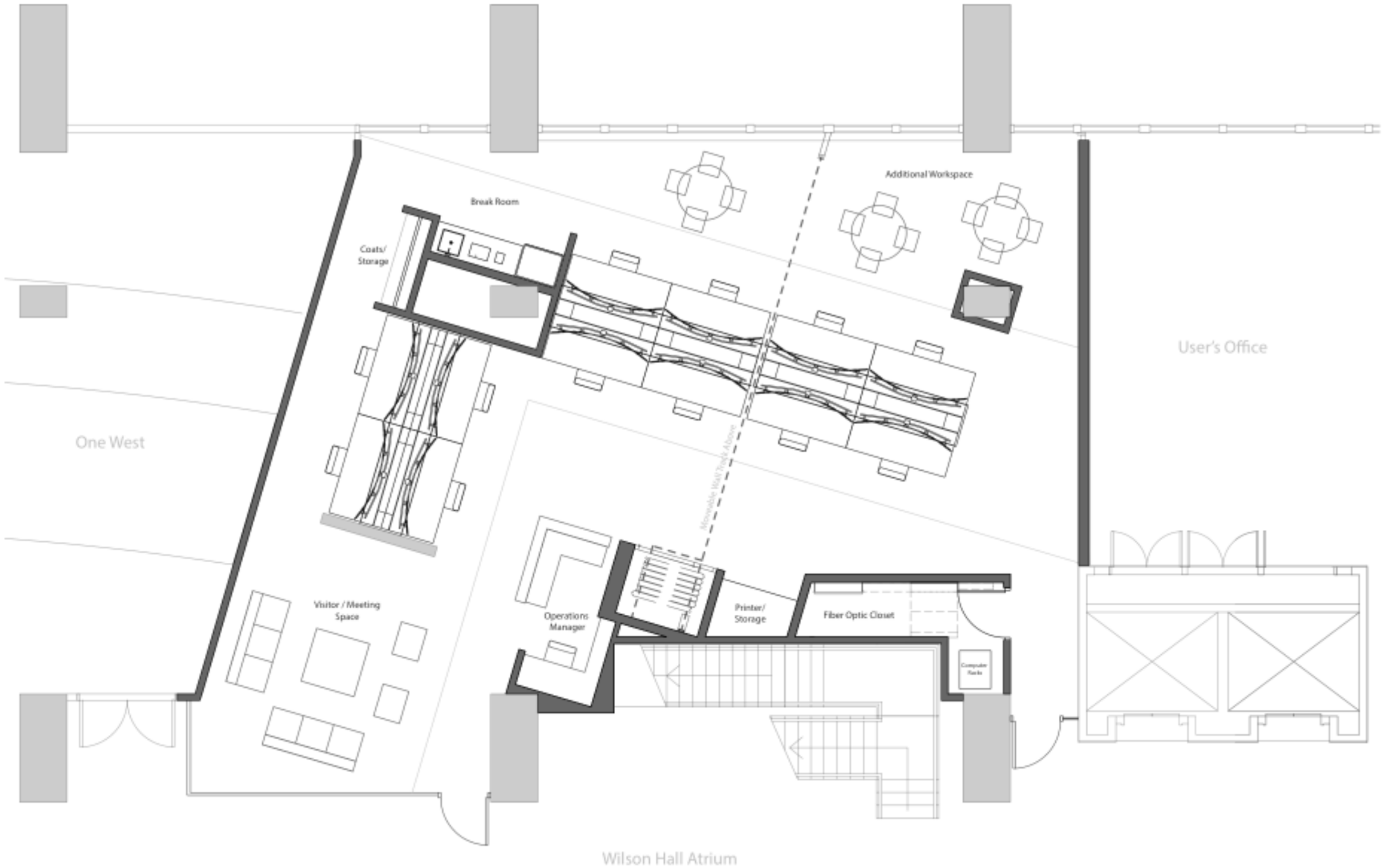
D. Next Meeting

To be scheduled

XOC


Kitchenette
Moveable Wall Track Above
Operations Manager
Moveable Wall Track Above
Networking
Equip. Closet
Meeting/Lounge

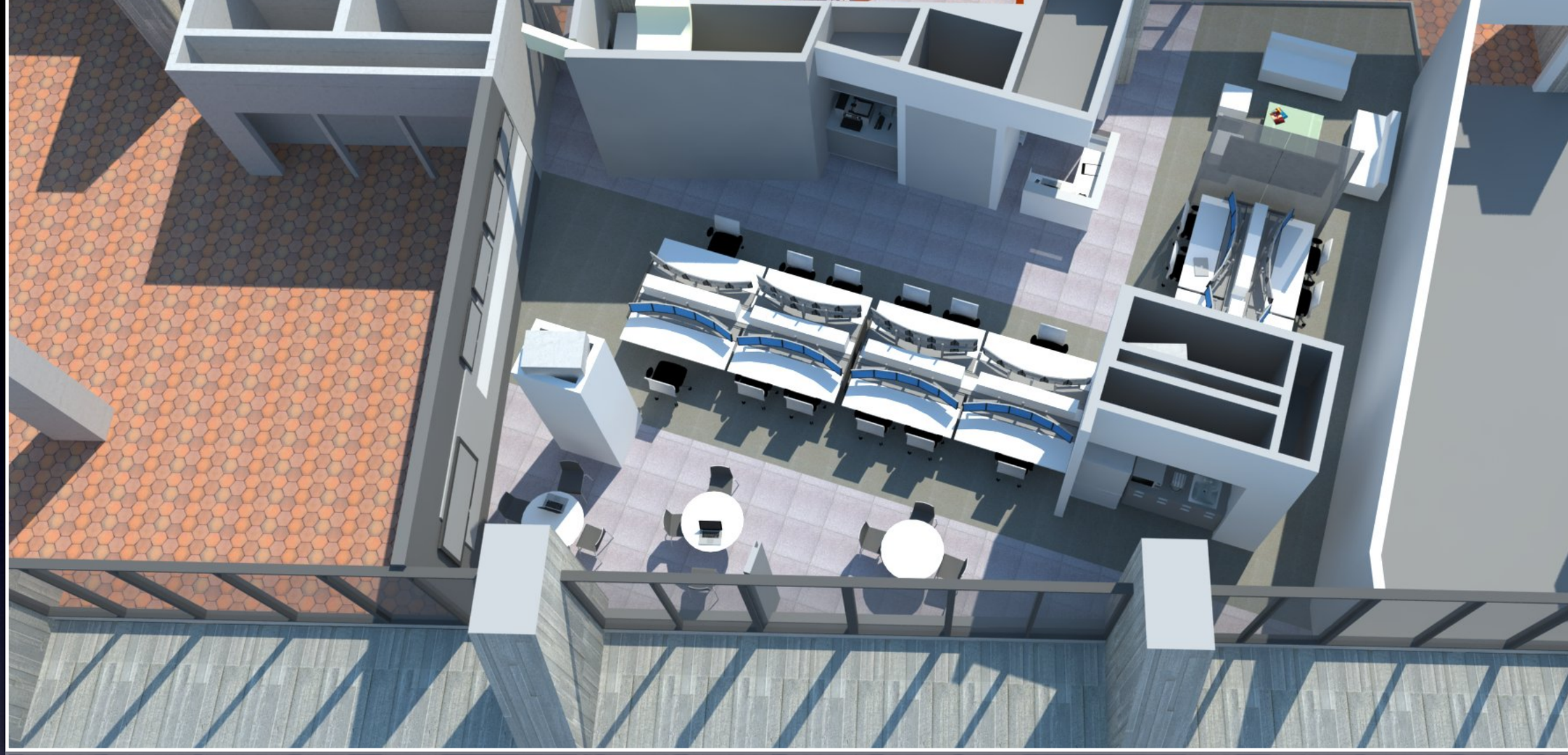
XOC


Break Room
Coats/
Storage
Additional Workspace
User's Office
One West
Visitor / Meeting
Space
Operations
Manager
Printer/
Storage
Fiber Optic Closet
Wilson Hall Atrium

XOC

XOC

XOC



XOC

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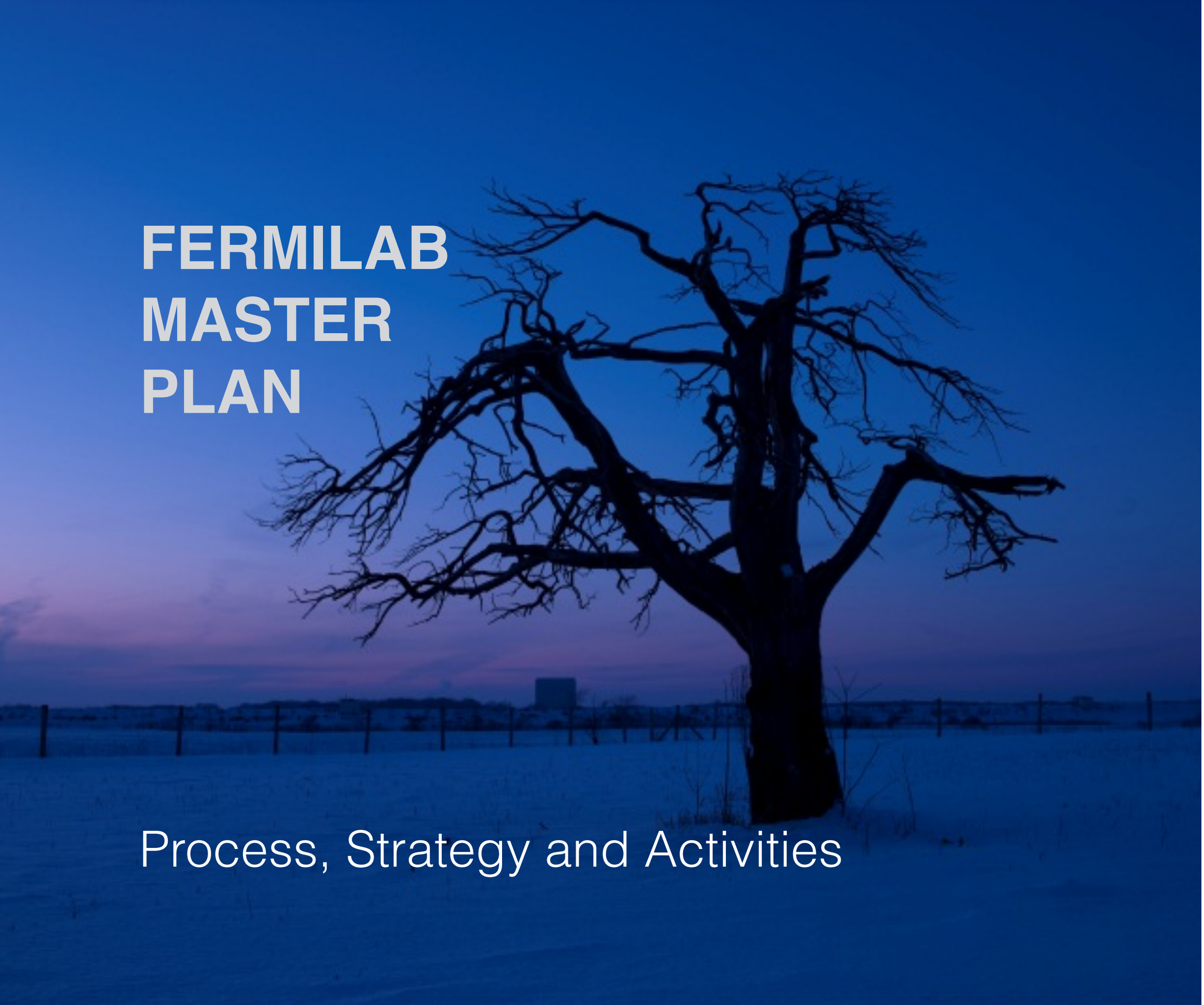


FERMILAB MASTER PLAN

Process, Strategy and Activities

1 Mission Objective Strategy

- Focus on documenting the Laboratory's mission strategy for the future.
- This will likely be broken down into short term (NOvA-era), mid- term (Muon Campus era), and long term (LBNE and Project X era).
- The information will be consolidated from the various sources currently available and will serve as the basis for subsequent work on the master plan.
- This phase will require the input of the Master Planning Task Force with an initial presentation and a close out presentation.
- The outcome of this activity will be documentation of the mission objective, formatted as a section of the master plan.

2 Consolidate Existing information

- This activity will consolidate the existing information concerning Laboratory Operations, Background and Metrics into the Master Plan.
- The information will be vetted to ensure the latest and most accurate information is incorporated.
- Examples include Design Guidelines, Annual Lab Plans, Land Use Plans, etc.

3 Information Gathering

- Based on the established Mission Objective, this phase will include interviews with Division / Section / Center heads to understand and document the facilities, infrastructure and services required to meet the Laboratory's Mission

- This process will include a functional analysis of the anticipated needs as well as a physical analysis of the existing condition (quality and effectiveness) as well as investigate opportunities for improvement and consolidation.

- The outcome of this phase will include preliminary programming documents for facilities, infrastructure, and services required to meet the Mission Objective. In addition, a summary report to the Master Planning Task Force will be provided.

4 Programming Development

- This activity will will develop the programming documents for those facilities, infrastructure and services identified in Activity 3 and agreed upon by Laboratory Management. This will include conceptual drawings and diagrams required to communicate the mission need and suggested budgets.

- The deliverable for this phase will include programming documents for facilities, infrastructure and services required to meet the Mission Objective including drawings and suggested budgets.

5 Master Plan Document

- This activity will will develop a master planning document based on the preceding phases. This document should be able to be viewed electronically via a web page as well as in printed form.

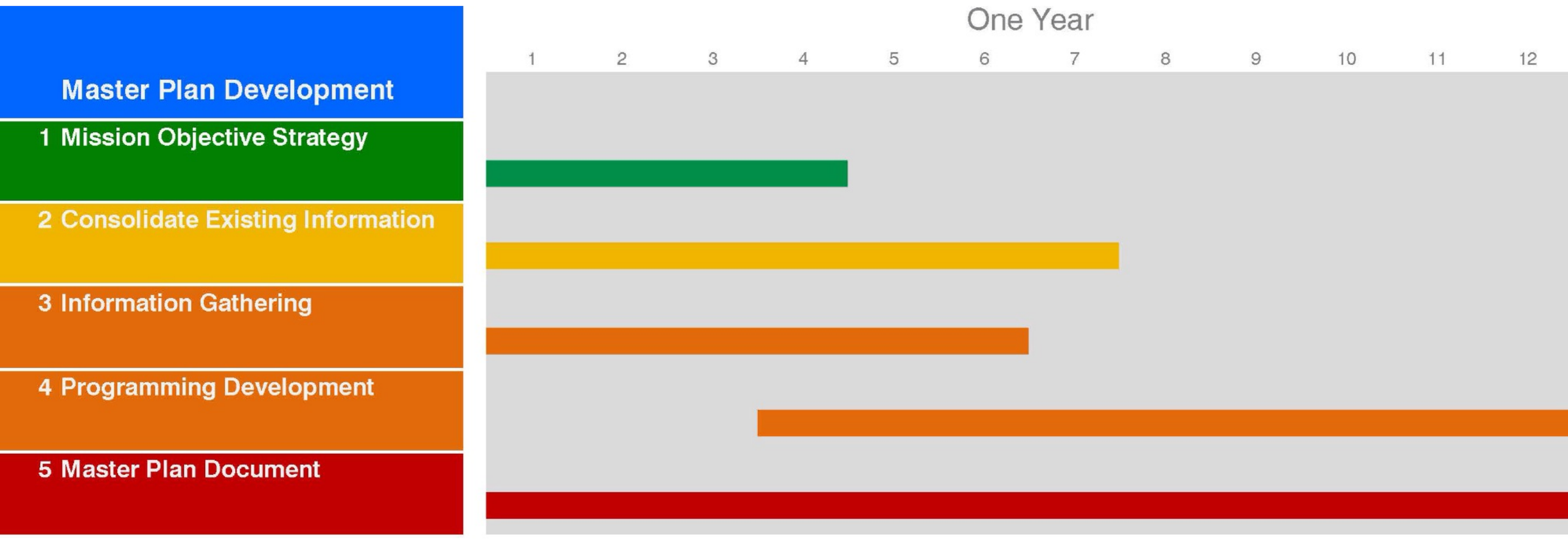
- The deliverable for this phase will be a website and printed documentation.

6 Maintenance

- The Master plan is intended to be a living document that will be updated to reflect changes in mission strategy. This activity will provide for the annual maintenance and updating of the master plan.

- The deliverable for this phase will include annual updates to the Master Plan website and printed information..

Activity Schedule

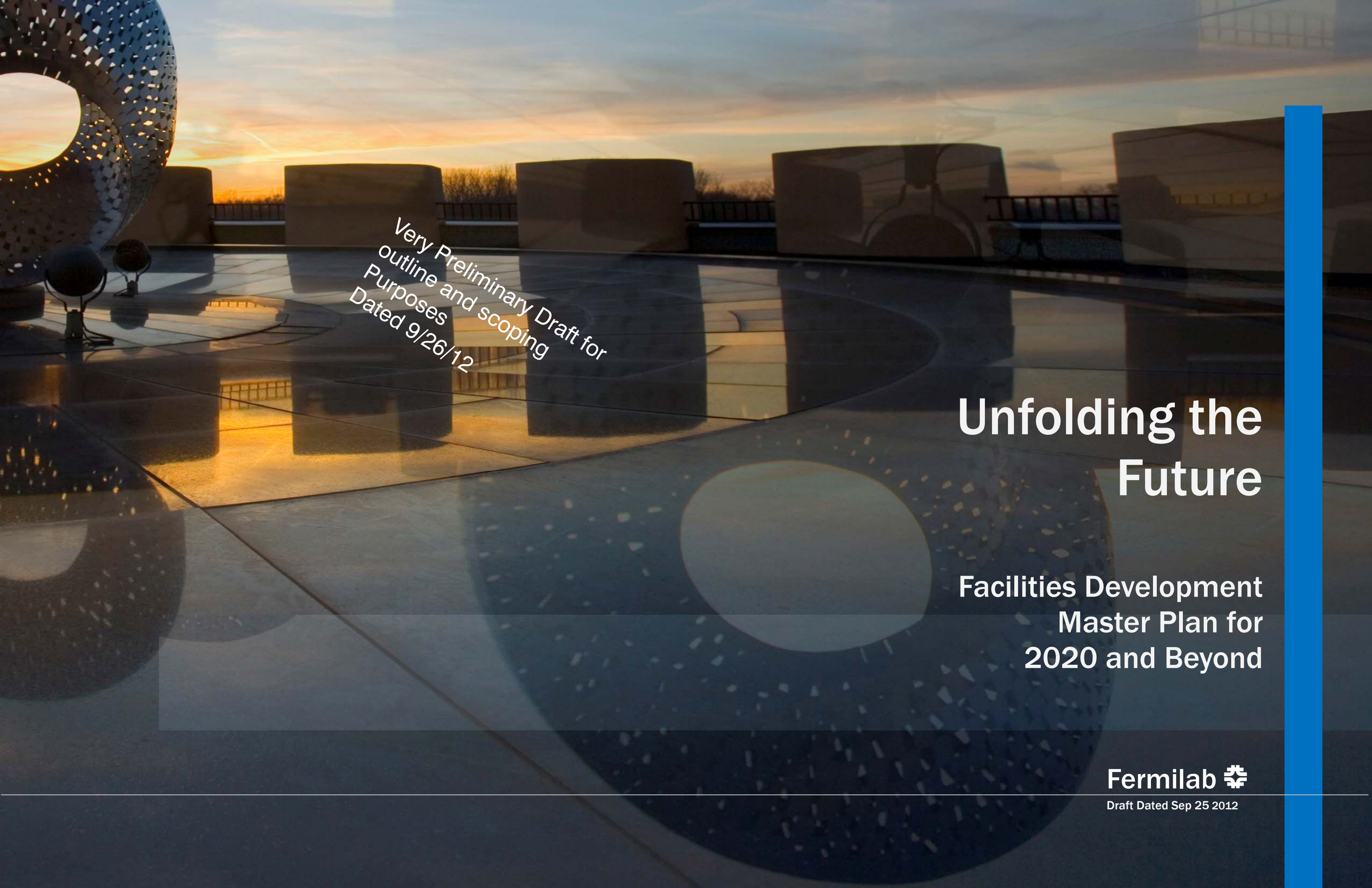


Appendices

- Existing building and facilities assessments.
- Sustainability
- Lab annual plans
- Mission readiness documentation

Big ideas

- New Experiments
- Retired experiments
- Building quantity and consolidation; energy, proximity, maintenance, roads, parking
- Efficient use of space
- Assumptions, presuppositions about the future
- Geographic centralization, walkability, vitality and efficiencies.
- Support systems adequacy and durability,
- Concept, context



Very Preliminary Draft for
outline and scoping
Purposes
Dated 9/26/12

Unfolding the Future

Facilities Development Master Plan for 2020 and Beyond

Fermilab

Draft Dated Sep 25 2012

“My fantasy of a utopian laboratory clearly required a setting of environmental beauty, of architectural grandeur, of cultural splendor...”

A utopian place where physicists from all parts of the country, and from all countries, would be doing their creative thing in an ambiance of well-functioning and yet beautiful instruments, structures and surroundings that would reflect the magnificence of their discoveries and theories....

“ I have always felt that science, technology and art are importantly connected; indeed, science and technology seem to many scholars to have grown out of art. In any case, in designing an accelerator Iproceed very much as I do in making a sculpture. I felt that just as a theory is beautiful, so, too, is a scientific instrument – or that it should be. The lines should be graceful, the volumes balanced. I hoped that the chain of accelerators, the experiments, too, and the utilities would all be strongly but simply expressed as objects of intrinsic beauty.”

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EXECUTIVE SUMMARY

INTRODUCTION

In the year 2009, becoming increasingly aware of the importance of the process of long range master planning, the Fermilab Directorate, in 2009 assemble the Master Planning Task Force. Following are selected portions of the Task Force Charter that provide the setting for the master plan document that follows.

Charter / Laboratory Director's Task Force on Master Planning (selected portions)

Master planning is of critical importance as a process to help define and best use all laboratory resources to most effectively meet Fermilab's future mission.

There are many new requirements and activities that interact with planning which include:

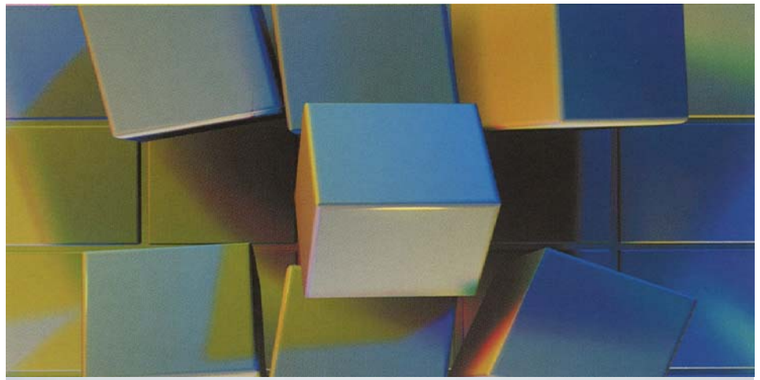
- Fermilab Steering Group Report
- Office of Science Annual Lab Plans
- Missions Readiness Peer Reviews
- American Reinvestment and Recovery A
- New Construction Grants from the State of Illinois
- Anticipated mission need (CD-0) approvals on several projects
- Congressionally mandated space offsets
- Anticipated long lead environmental permitting
- High interest community involvement, and
- Preservation of the lab's scientific/architectural heritage

These requirements and activities make high level planning, coordination, and communication critical to ensure the laboratory is best prepared to successfully meet the challenges of this transition moving rapidly into the next era of High Energy Physics. **The purpose of the Task Force is to ensure proper coordination, guidance, and oversight is provided for all the identified activities that in turn allow the laboratory to most efficiently use its existing resources to effectively meet the identified future mission while preserving Fermilab's rich scientific and aesthetic heritage.** This will be accomplished with informational briefings of all known requirements and activities, status updates on the same, developing clear guidance, and communicating milestones to monitor progress. Ultimately development of a site wide master plan to guide these efforts is the objective.

MASTER PLANNING: WHAT, WHY AND HOW

Planning involves an imagined journey into the future, where all outcomes are uncertain and where opportunity and peril co-exist. The only thing more dangerous than planning is not planning; facing the future without preview or preparation. Master plans are like road maps. They chart a hopeful course between the present and some intended destination, with milestones along the way. However, road conditions are unpredictable and detours are common. Planning is an adventure in communication as well as in design and policy development. It is a process of compromise and collaboration in support of valued goals. It is a frustrating yet hopeful and fruitful search. Planning documents are not blue prints. Any plan as specific and inflexible as a blueprint is doomed to failure. Good plans are flexible, living guidelines and polices, self-correcting and adaptable to change.

Consider these descriptive and/or definitions to begin to visualize the "what" of a master plan:



MASTER PLANNING ISSUES

- Land use changes
- Future expansions
- Identification of system components and needs
- Evaluation of Alternatives
- Technical issue
  - Identification of solutions
  - Evaluation of process alternatives
  - Site and facility location and general arrangement
  - Ease of operation and Maintenance
- Financial Issues
- Construction Costs
- Operation and Maintenance Costs
- Cost effectiveness
- Regulatory Constraints
- Environmental Impacts
- Safety
- Program Development
- Graph the future projects, timeline costs, etc
- Master Plan Updating
- New technologies
- New Experiments

... Ultimately, development of a site-wide master plan to guide these efforts is the objective.

INTRODUCTION

- One may consider master planning as the process whereby we go about setting a clear framework for the later detailed design of a development area or large site.
- A master plan is the orderly planning of a systems future improvement program. It is the initial step before specific designs of parts of the system.
- The master plan is often incorporated into the long range capital improvement program.
- The master plan identifies the present and future needs and direction for developing the systems facilities.
- A plan to achieve a vision (i.e. science for the 2020's and beyond).
- Is a "contract" or agreement between interested parties as to where they are going together.
- Looks at the big picture, the forest not the trees(concentrates on a set of projects not one project or program.
- A roadmap to bring pieces together, (brings all projects together to serve one vision)

WHY DO PLANS FAIL?

Planning may have unfairly acquired a tarnished reputation. Master plans fail when:

- They are unrealistic and unachievable
- They aren't supported by implementation plans.
- They are superimposed from above without the involvement and support of those responsible for their implementation.
- When their chief supporters leave the institution.
- When they can't adapt to changing times.
- When a poorly managed process leads to "planning paralysis", unnecessarily delaying needed actions.

When is Planning Needed?

Planning is an essential tool of responsible management. It should be unde1taken or updated whenever needed. For example:

- At times of major change, such as when your institution acquires a new director, changes in mission, funding, etc.
- When new opportunities present themselves.
- Other reasons?? (**this would be a place to develop our specific reasons**

Some institutions update or reconvene their master plans eve1y five years or more frequently to maintain an atmosphere or culture of change and renewal in response to a rapidly changing world.

INTEGRATED PLANNING

(THIS SECTION IS TO PROVOKE THOUGHT ABOU THE PROCESS. IN THE END THIS COULD SUMMARZE THE PROCESS THAT WE USED TO REACH THIS PLAN)

Many so called "master plans" are in fact only physical development plans. Some institutions have invested in detailed plans only to find they were not supportable. An integrated approach yields a successful document.

THE PROCESS

The process may begin with the vision workshop to set basic goals, philosophy, priorities and direction. The draft concept plan (physical development) is prepared outlining major new facilities and improvements. The draft process is compared to and tested in the context of the strategic plan. The various physical, strategic and research goals are rationalized, coordinated and completed. This process also incorporates ongoing funding and related timeline planning and coordination. This process can lead to a unified master plan for facilities but informed by and informing the research and funding plans, assump-

BENEFITS OF PLANNING

Planning will enable Fermilab to make the most use of all our resources. Benefits include the ability to:

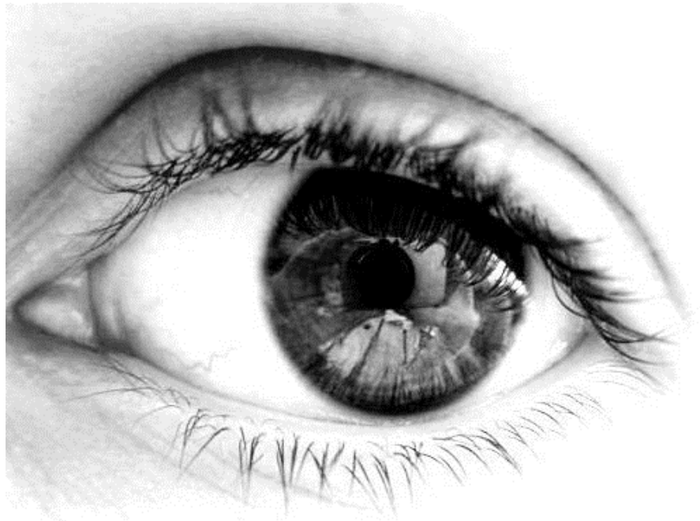
- Anticipate and shape their future
- Prioritize actions
- Budget time and dollars
- Improve internal communications,
- Improve coordination and cooperation,
- Gain consensus on our agenda internally and externally
- Focus funding efforts
- Evaluate our programs

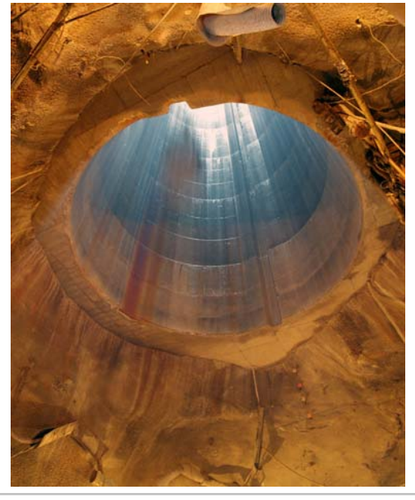
> Planning involves an imagined journey into the future, where all outcomes are uncertain and where opportunity and peril co-exist.

INTRODUCTION

tions and priorities.

- **Vision Workshops** gather key stakeholders and are best done while sharing good food and wine in memorable and compelling venues. "Visioning retreats" are not uncommon. They focus upon creating a shared vision for the future in 10-20 years.
- **Concept Plans** provide 80% of the decision making with 20% of the effort of a full master plan. The idea is to do an extensive rather than an intensive study. That is to look at all relevant subjects without getting lost in the details of any one subject. Maintain balance while confirming which subjects and issues are critical to your own situation. Many institutions prefer concept plans to full master plans because they make less cumbersome, more flexible working documents. They feel the more detailed work can be done as part of new projects as they come along. Sometimes concept plans "spin off' new projects even though the institution will continue on to develop full master plans; why wait?
- **Physical Development Master Plans** outline staged development guidelines and usually include sections on site analysis, public areas and circulation, various functional facilities both new and renovated, etc. Phased development budgets are also included.
- **Comprehensive Master Plans** integrate physical development, program development, operations, business and other activities into a strategic roadmap for institution-wide renewal and growth. Comprehensive master plans are useful in our institution as we need ongoing support from the Department of Energy for our ongoing series of major projects.
- **Update Plans.** All of these types of plans must keep ahead of changing economic, market, social and environmental trends. Update plans are intended to check progress, validate and update existing plans. Think of them as mid-course corrections. These are relatively inexpensive ways to get the most out of previous investments in planning.





Simply stated the Fermilab objectives are to:

1) Do science

2) Sustain the laboratory for the long term

3) Host good experiments for satisfied users and visitors

FERMILAB OVERVIEW

OVERVIEW / MISSION

Fermi National Accelerator Laboratory is the only U.S. national laboratory primarily dedicated to particle physics and accelerator science research. Fermilab's 1,894 employees and 2,317 scientific users advance humankind's understanding of matter, energy, space and time by carrying out a world-leading program of discovery at the frontiers of particle physics. Fermilab is home to one of the largest accelerator facilities in the world, including a complex of eight accelerators, test accelerators, and infrastructure for the development of accelerator technologies. The laboratory's accelerator complex produces intense particle beams that are used by scientists around the world to explore neutrinos and ultra-rare processes in nature. Its staff and users build, operate and lead experiments to investigate dark matter, dark energy and ultra-high-energy cosmic rays. Fermilab is a U.S. hub for research at the Large Hadron Collider and for R&D for the next generation of particle accelerators and detectors for use in science and society.

CORE SKILLS

The laboratory's core skills include experimental and theoretical particle physics, astrophysics, and accelerator science; R&D for accelerator and detector technologies; the construction and operation of large-scale facilities; and high-performance scientific computing. The laboratory, which has an annual budget of $395M in FY12, operates particle accelerators and particle detectors; test beams for detector development; test facilities for accelerator research and development; and large-scale computing facilities.

MANAGEMENT

Fermi Research Alliance manages Fermilab for the Department of Energy. FRA is an alliance of the University of Chicago and the Universities Research Association, a consortium of 86 universities. Fermilab's 6,800-acre site, much of which is open to the public, is located 42 miles west of Chicago in Batavia, Illinois. The laboratory, which was founded in 1967, was designated a National Environmental Research Park in 1989
.

MISSION READINESS

Fermilab is sited on 6,800 acres 42 miles west of Chicago in Batavia, Illinois. Laboratory assets include 356 buildings and 70 real property trailers comprising 2.4 million gross square feet and hundreds of miles of utility infrastructure including roads, electrical, natural gas, industrial cooling water, potable water and sanitary systems. The total real property replacement plant value (RPV) is $1.7B, including the Laboratory's programmatic accelerator and tunnel assets. Detailed property information associated with all assets is maintained in the DOE's Facilities Information

Management System real property database and available onsite through Fermilab's Geographic information System.

All of the Laboratory's buildings are used and owned by DOE; the usage is predominately divided among research and development space and admin-

> The laboratory's accelerator complex produces intense particle beams that are used by scientists around the world to explore neutrinos and ultra-rare processes in nature.

FERMILAB OVERVIEW

istrative areas. Fermilab's most significant infrastructure needs are the high voltage electrical system and underground piping systems, with their overall facility conditions categorized as poor. Investments over the next several years have been proposed through GPP, SLI and third-party investments. The delay of SLI funding for the Utility Upgrades initially slated to start in FY 2011 created a mission readiness status of "Partially Capable" for utility infrastructure. This Utility Upgrades Project is included in the FY13 President's Budget Request for funding in FY13 and FY14.

SCIENCE

Particle physics is entering a rich new age of discovery. Deep and long-standing questions about matter, energy, space and time are closer than ever to being answered, thanks to powerful new scientific tools. This search for answers is expected to reveal something profound, just as physicists in the early twentieth century penetrated within the atom and discovered the quantum theory, an epochal event that created new sciences and enabled technologies that shape the modern world. The new scientific tools can be arranged into three interrelated frontiers: the Intensity Frontier, the Energy Frontier, and the Cosmic Frontier. These three approaches ask different questions and use different techniques, but answers to challenging questions about the fundamental physics of the universe will come from combining powerful insights and discoveries at each of the three frontiers.

As the only U.S. national laboratory devoted to particle physics and the only U.S. laboratory that provides accelerator facilities for particle physics research, Fermilab's mission is to enable the U.S. scientific community to tackle the fundamental particle physics questions. Facilities for particle physics, in particular those at the Energy and Intensity Frontier, are global and ever more challenging to design, build and operate. Using existing accelerators with enhanced capabilities and using current neutrino experiments and next generation neutrino and
rare-process experiments, Fermilab's primary activities in this decade are to operate and improve world-leading accelerator and detector user facilities at the Intensity Frontier, and to fully exploit the data for discovery in partnership with its users. During this time period, Fermilab will also develop accelerators and experiments at the Intensity Frontier that will become world-leading user facilities for 2020s and beyond. At the Energy Frontier, Fermilab will support the user community to fully exploit the large datasets collected by the experiments at the Tevatron that completed its operations in September 2011. The laboratory will use its scientific, computing and technical leadership to maximize the discovery potential of the experiments at the LHC and will play key roles in upgrades to the LHC detectors and accelerator. As a pioneer of particle physics at the Cosmic Frontier, Fermilab has continued to develop the connection between the very large and the very small. Fermilab serves as the host institution for global Cosmic Frontier experiments, providing scientific, technical and administrative support for widely distributed international scientific collaborations

VISION FOR MAJOR INITIATIVES

Facilities for particle physics are global and ever more challenging to design, build and operate. A laboratory with a singular focus and consolidated particle physics facilities will give the U.S. a competitive advantage in the future and provide opportunities to bring strong international partnerships and contributions to the U.S. Fermilab is currently operating world-class user facilities

> Particle physics is entering a rich new age of discovery.
> Deep and long-standing questions about matter,
> energy, space and time are closer than ever to being answered, thanks to powerful
> new scientific tools.

PURPOSE OF THE PLAN

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PLAN AT A GLANCE

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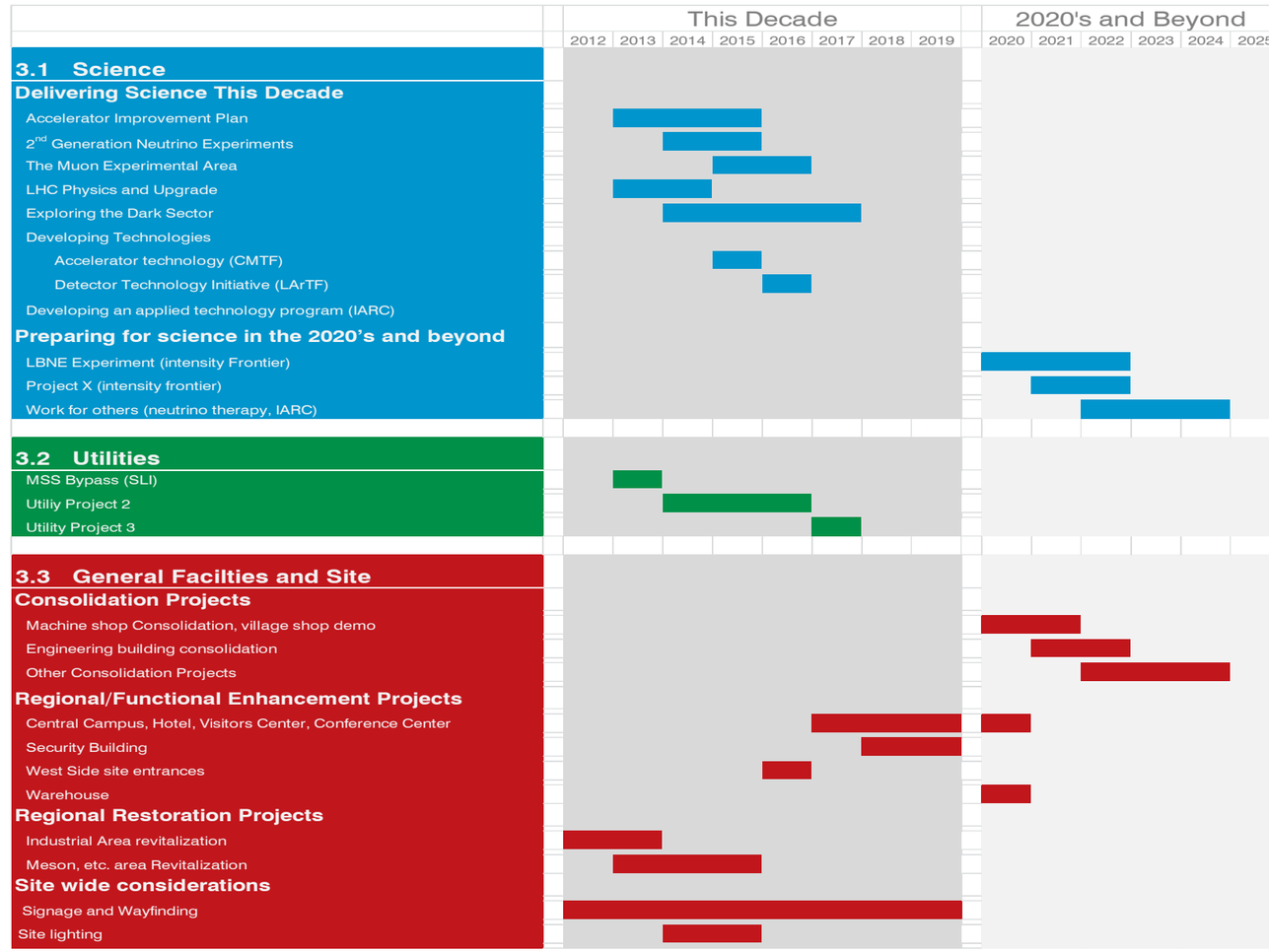

PLAN AT A GLANCE / MAP

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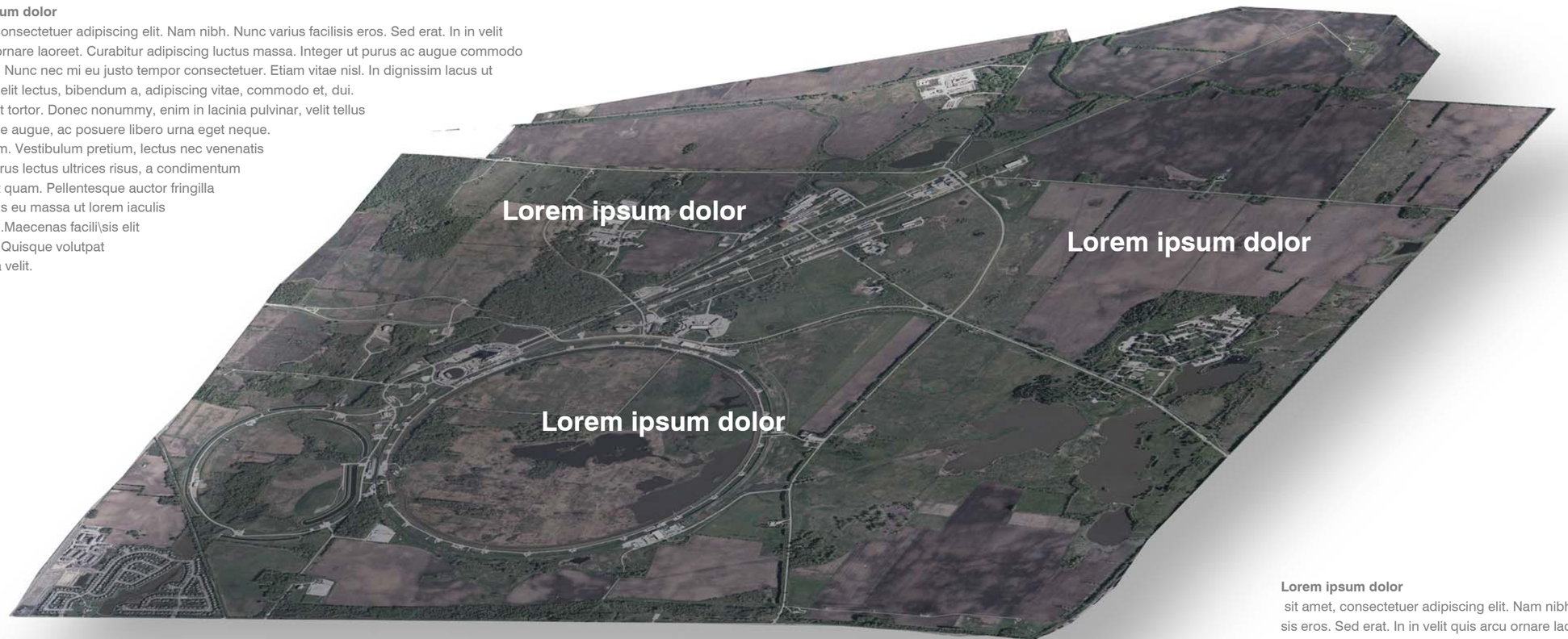

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The Fermilab Master Plan brings together the existing conditions, the three frontiers, the core competencies, and the Fermilab Annual Lab planning into an integrated facility plan for the future .

PLAN OUTCOME

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Section 1

PLANNING FRAMEWORK

OVERVIEW

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Lab-at-a-Glance

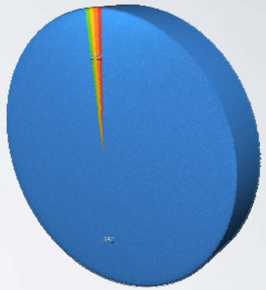
Location: Batavia, Illinois
Type: Single-program Laboratory
Contractor: Fermi Research Alliance, LLC
Responsible Site Office: Fermi Site Office
Website: http://www.fnal.gov/
Physical Assets*:

- 6,800 acres and 356 buildings
- 2.3 Million GSF in buildings
- Replacement Plant Value: $1,701 M
- 0 GSF in 0 (number) Excess Facilities
- 0 GSF in Leased Facilities

Human Capital:

- 1,894 Full Time Equivalent Employees (FTEs)
- 10 Joint faculty (if applicable)
- 62 Postdoctoral Researchers
- 4 Undergraduate Students
- 13 Graduate Students
- 2,317 Facility Users
- 47 Visiting Scientists

FY 2011 Funding by Source: *(Cost Data in $M*
FY 2011 Total Lab Operating Costs (excl. Recovery Act): $397.2 M



FY 2011 Total DOE/NNSA Costs: $ 395.2 M
FY 2011 WFO (Non-DOE/Non-DHS) Costs: $ 2.0 M
FY 2011 WFO as % Total Lab Operating Costs: 0.5%
FY 2011 Total DHS Costs: $ 0
Recovery Act Costed from DOE Sources in FY 2011: $39.7 M

The planning framework consists of: urna eget neque. Cras ipsum. Vestibulum pretium, lectus nec venenatis volutpat, purus lectus ultrices risus, a condimentum risus mi et quam.

CORE CAPABILTIES

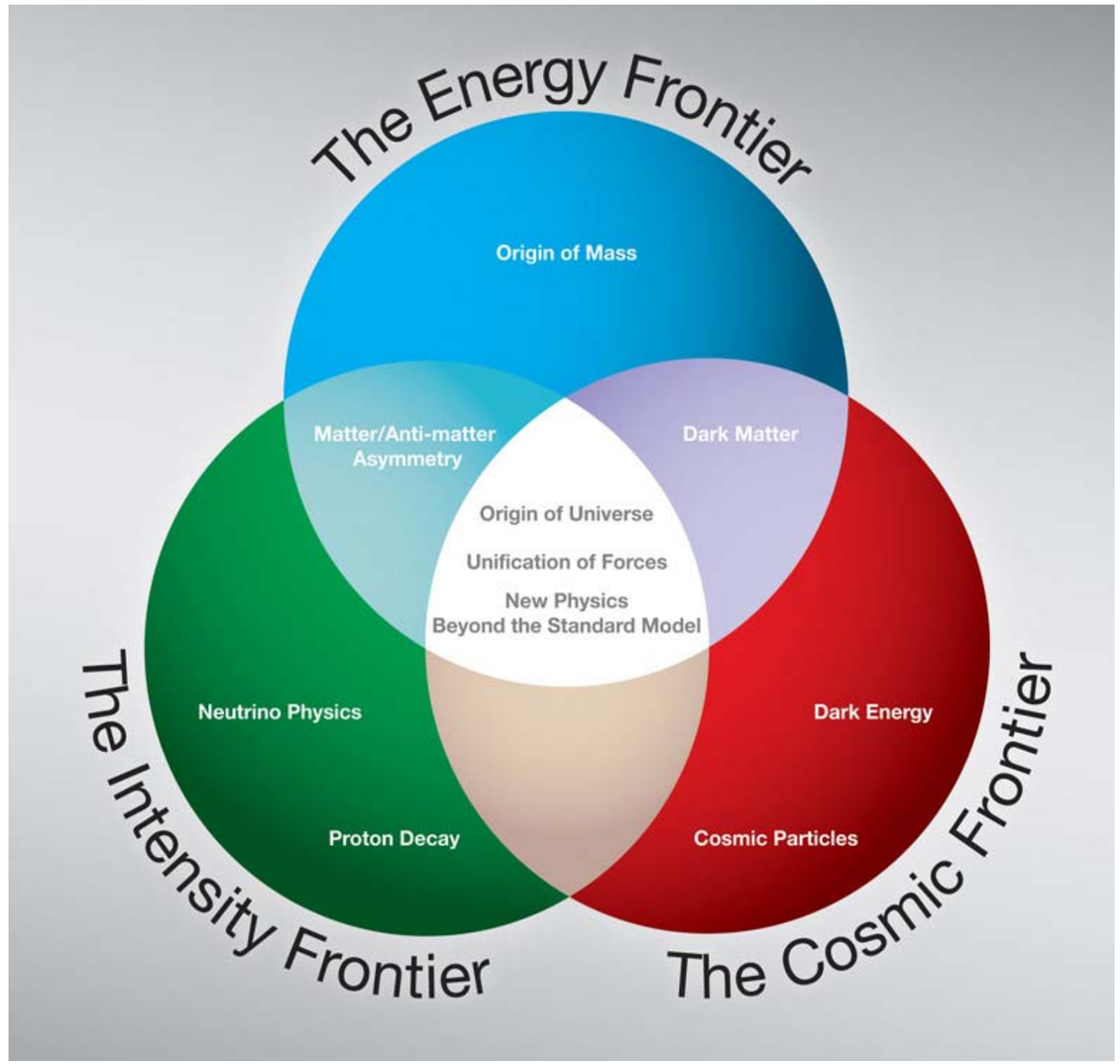
CURRENT LABORATORY CORE CAPABILITIES

As the national particle physics laboratory, Fermilab's mission is to enable the U.S. scientific community to tackle the most fundamental physics questions of our era, and to integrate universities and other laboratories fully into national and international particle physics programs. Fermilab provides the only accelerator facilities in the U.S. for particle physics research. Particle physics is a central component of the physical sciences, focused on the fundamental nature of matter, energy, space and time. Discoveries in particle physics change our basic understanding of nature. The Standard Model of particle physics provides a remarkably accurate description of elementary particles and their interactions. However, experiment and observation strongly point to a deeper and more fundamental theory that breakthroughs in the coming decade will begin to reveal. To address the central questions of particle physics and thus to deliver on the missions of the DOE's Office of High Energy Physics, Fermilab uses a range of tools and techniques at the three interrelated frontiers of particle physics:

 The Energy Frontier, where high-energy particle colliders are used to discover new particles and directly probe the architecture of the fundamental forces of nature.

 The Intensity Frontier, where intense particle beams are used to uncover properties of neutrinos and observe rare processes that will tell us about new physics beyond the Standard Model.

 The Cosmic Frontier, where underground experiments and ground-based telescopes are used to reveal the natures of dark matter and dark energy, and high-energy particles from space are used to probe ne physics These three approaches ask different questions and use different techniques, but answers to challenging questions about the fundamental physics of the universe will come from combining powerful insights and discoveries at each of the three frontiers. Three core capabili-



> Fermilab's mission is to enable the U.S. scientific community to tackle the most fundamental physics questions of our era, and to integrate universities and other laboratories fully into national and international particle physics programs.

CORE CAPABILITIES

ties (Particle Physics, Accelerator Science, and Large Scale User Facilities / Advanced Instrumentation / Computing) support activities at Fermilab and enable Fermilab to deliver the DOE OHEP's mission. Each core capability is comprised of a combination of experts, facilities and equipment as listed below.

Facilities for particle physics are global and ever more challenging to design, build and operate. A laboratory with a singular focus and consolidated particle physics facilities will give the U.S. a competitive advantage in the future and provide opportunities to bring strong international partnerships and contributions to the U.S.

3.1 Particle Physics

Fermilab's scientific program supports the U.S. scientific community with world-leading research at all three interrelated frontiers of particle physics.

At the Energy Frontier, after a very successful 26 year program, Fermilab's Tevatron collider and the CDF and DØ experiments ended data taking in September 2011. Despite a fast ramp up of the LHC collider at CERN in Geneva, Switzerland, the Tevatron remains the leader in a number of high profile physics analyses. Fermilab, in partnership with its users, will fully exploit the large datasets collected by the Tevatron experiments. Over the next two decades the laboratory will use its scientific, computing and technical leadership to maximize the discovery potential of the CMS experiment. Fermilab's Remote Operations Center and LHC Physics Center make the participation of U.S. institutions in the LHC and in CMS more effective. Fermilab will play key roles in planned upgrades to the LHC detectors and accelerator, with significant CMS upgrade activities being carried out on the laboratory site. Fermilab's accelerator and detector R&D programs will create technologies that will enable the next generation of particle colliders such as the International Linear Collider and the Muon Collider.

At the Intensity Frontier, Fermilab experiments at the Intensity Frontier provide critical and unique tools to address some of the central questions in particle physics that cannot be answered at the Energy Frontier. These experiments aim to uncover properties of neutrinos and to probe new physics from rare processes involving muons, kaons, and nuclei, and they are the laboratory's primary focus in this decade. The discovery of neutrino oscillations was the first experimentally observed phenomenon that departed from the very successful Standard Model of particle physics. This discovery strongly suggests a connection between neutrino physics and physics on a very high mass scale and identifies a number of key questions that could open a path to new discovery.

Using the NuMI neutrino beam, the most powerful in the world driven by 120 GeV protons from the Main Injector accelerator, Fermilab's long-baseline neutrino experiments MINOS (operating) and NOvA (under construction for operations starting 2013) address the masses, mixings, and mass ordering of the three known neutrinos in the neutrino Standard Model. The 8 GeV Proton Booster Ring drives a second beam of neutrinos for short-baseline experiments MiniBooNE (operating) and MicroBooNE (under construction for operations starting 2013) to probe questions beyond the neutrino Standard Model. The current MINERvA experiment with the NuMI beam focuses on precision measurements of cross sections for neutrinos and anti-neutrinos that are critical to extract physics of long-baseline and short-baseline experiments. The Booster Ring will also provide beams of muons for two future

> Three core capabilities support activities at Fermilab and enable Fermilab to deliver the DOE OHEP's mission: (1) Particle Physics, (2) Accelerator Science, and (3)Large Scale User Facilities / Advanced Instrumentation / Computing,

experiments which would operate late this decade: Mu2e, a major new experiment that searches for the conversion of muons to electrons, a critical signature for any unified theory of particle physics; and the g-2 experiment to precisely measure the muon anomalous magnetic moment. Beam intensity improvements and neutrino and muon research in this decade are platforms for the next generation projects, LBNE and *Project X,* that the Laboratory is developing for operations in 2020s and beyond. LBNE will address ultimate questions in neutrinos, matter-antimatter asymmetry and new interactions, and *Project X,* a multi-megawatt proton accelerator, will be the most powerful and flexible facility at the Intensity Frontier anywhere in the world providing intense beams of neutrinos, muons, kaons and nuclei simultaneously.

At the Cosmic Frontier, Fermilab is a critical partner in a number of world-leading experiments. Fermilab manages the construction and operation of the Cryogenic Dark Matter Search (CDMS) and the Chicagoland Observatory for Underground Particle Physics (COUPP) that search for particles of dark matter; the Dark Energy Survey (DES) that
probes the properties of dark energy; and the Pierre Auger Observatory that studies the source and nature of ultra-high-energy cosmic particles.
Theoretical work in particle physics and particle astrophysics are an essential part of the laboratory. Theorists guide the development of experiments and elucidate their results, emphasizing the connection between theory and experiment to advance cutting-edge science. As Fermilab addresses the defining questions in particle physics and delivers the DOE's high energy physics mission, it pays special attention to educating future generations of scientists. Fermilab trains about 250 postdoctoral research associates and 540 graduate students each year, resulting in more than 100 Ph.D. degrees awarded each year based on research performed at laboratory facilities. Fermilab contributes to science, technology, engineering and mathematics (STEM) education with a broad program for undergraduate university students and K-12 students and teachers.

This core capability enables the laboratory to support the DOE's Scientific Discovery and Innovation mission (SC 4, 5, 21, 22, 23, 24, 25, 26, 27, 29, 34, and 35).

3.2 Accelerator Science

Particle accelerators are key resources for DOE's program of scientific discovery. Fermilab's accelerator science capabilities—operation, design, development and research—form the foundation of the present and future accelerator based activities at the lab and in the U.S. particle physics community. Fermilab is home to one of the largest accelerator facilities in the world, including a complex of eight accelerators, test accelerators, and infrastructure for the development of accelerator technologies. Nearly half of the lab staff are directly engaged in accelerator activities.
Fermilab's world-leading accelerator R&D efforts focus on the areas of superconducting radio-frequency (SCRF), superconducting-magnet, ionization-cooling, high-intensity proton accelerator and advanced beam manipulation technologies. Fermilab's unique capabilities in superconducting magnet development are currently focused on upgrades to the LHC and the development of high-field solenoids for the Muon Collider. Fermilab provides U.S. leadership in the development of high-gradient SCRF technology for a future multi-megawatt proton source, *Project X*, the Next Generation Light Source (NGLS), and the ILC, and Fermilab develops integrated design concepts and technologies for *Project X*. Fermilab leads U.S. technology development for ionization cooling required for muon-storage-ring based facilities, supplies integrated design concepts for the Muon Collider and a neutrino factory, and advances fundamental understanding of beams and their manipulation in dedicated test facilities. In addition, Fermilab pursues comprehensive integrated theoretical concepts and simulations of complete future facilities at both the Energy and Intensity Frontiers of particle physics. These activities, while focused on particle physics, can be applied widely across other fields of science, serving the broader goals of the DOE's Office of Science.

From 2013, facilities built for the development of SCRF technology will simultaneously be used for SCRF technology tests and as an accelerator science user facility. Together with the A0 Photo Injector, this user facility will be a center for AARD (Advanced Accelerator R&D) activities including novel beam manipulation techniques, high-performance electron source and diagnostics development, and advanced beam cooling tests, conducted in collaboration with other laboratories and universities.

Activities in accelerator and beam physics include advanced beam studies at the laboratory's operating accelerators in support of optimizing accelerator performance; energy deposition simulations, including the upgrade, maintenance and distribution of the MARS code, a resource to the worldwide community; theory of beam instabilities in current and future accelerator facilities; development of new techniques for compensation of beam-beam effects; experimental studies of ground motion effects in accelerators and electron cloud effects in high-intensity proton beams; as well as theory and experimentation on new collimation and cooling methods.

Fermilab, together with BNL, LBNL, and the SLAC, provides joint leadership

of the national Muon Accelerator Program. MAP manages the development of future facilities including a neutrino factory at the Intensity Frontier and the Muon Collider at the Energy Frontier. Fermilab is developing design concepts and major subsystem technology simulations and demonstrations for these muon-based facilities. This work also features strong cooperation with companies funded by the DOE's Small Business Innovation Research (SBIR) program.

Fermilab leads the ComPASS (Community Petascale for Accelerator Science and Simulation) collaboration which develops a comprehensive computational infrastructure for accelerator modeling and optimization and advances accelerator computational capabilities from the terascale to the exascale to support DOE priorities for the next decade and beyond. This project is funded by the DOE's Offices of HEP, NP, BES and ASCR.

Fermilab carries out a comprehensive program for training of the next generation of accelerator scientists and engineers. The program includes hosting the U.S. Particle Accelerator School, a national consortium, which holds two sessions a year for undergraduate and graduate students; the Lee Teng Internship in accelerator science and technology for undergraduate students; a Joint University-Fermilab Accelerator Ph.D. program; the Bardeen Fellowship in accelerator engineering for M.S. and Ph.D. students; and the Peoples Fellowship in accelerator science for post-graduates. The new Illinois Accelerator Research Center, to be constructed in 2012 and 2013 with funds from a State of Illinois grant, will significantly enhance the accelerator science education program at Fermilab.

This core capability enables the laboratory to support the DOE's Scientific Discovery and Innovation mission (SC 4, 5, 24, 25, 26, and 35).

3.3 Large Scale User Facilities, Advanced Instrumentation, and Computing

Large Scale User Facilities

For more than four decades, Fermilab has conceived, planned, designed, constructed, managed and operated large-scale user facilities and hosted international scientific collaborations for particle physics and particle astrophysics. Research at these facilities has led to many discoveries, including the top quark, the bottom quark, the tau neutrino, and the matter-antimatter transition in the *Bs* system, and numeorous precision measurements. Current user facilities include NuMI and Booster, which create the world's highest-power neutrino beams, and the MINOS, MINERvA, and MiniBooNE neutrino experiments. NOvA, a second-generation long-baseline neutrino experiment, and the Dark Energy Survey, a third-generation dark energy experiment, are currently under construction. Fermilab has established design concepts and begun technology development for a third-generation long-baseline neutrino experiment; Mu2e and Muon g-2 experiments to study rare processes with muons; and *Project X*, a multi-megawatt proton facility for Intensity Frontier physics. Efforts are underway to establish design concepts for a multi-TeV Muon Collider and a neutrino factory.

Advanced Instrumentation

Fermilab develops cutting-edge particle detector technologies and applies them to the construction of detectors for a variety of scientific disciplines. In the area of semiconductor-based detectors, Fermilab pioneered dedicated-readout integrated circuits and pioneered the construction of very low-mass silicon detectors for the collider experiments. Fermilab currently pursues three-dimensional vertical integrated silicon technology and silicon-based multi-pixel photon detectors. The Fermilab SiDet facility played a major role in the development and assembly of the CCD detector for the camera for the Dark Energy Survey (DECam). In the area of cryogenic detectors, Fermilab uses an ultra-cold bolometric detector for dark matter searches and is developing liquid argon technology for neutrino and dark-matter detectors. The laboratory made additional innovative contributions to the development of scintillators and their applications, now used in a wide array of particle physics experiments. Fermilab's test beam facility, which operates simultaneously with the neutrino program, is used by the international particle physics community for the development of detector technologies. The laboratory advances the instrumentation of its test beams through the development of picosecond time-of-flight systems and versatile, integrated data acquisition systems

Computing

Fermilab's computing leadership and resources enable the particle physics community to deliver scientific results at the Energy, Intensity and Cosmic Frontiers. Fermilab has internationally recognized experts in programming languages, high-performance computing and networking, distributed computing infrastructure, petascale scientific data management, physics simulations and scientific visualization. Fermilab supports large-scale computing, data management, and data analysis facilities for CDF and DØ experiments; the

CORE CAPABILITIES

CMS experiment and the LHC Physics Center; the Sloan Digital Sky Survey; the Dark Energy Survey; neutrino and rare-process experiments; and computational cosmology. Fermilab hosts the CMS Tier-1 center, the U.S. Lattice QCD computing project, the campus grid FermiGrid, leads the ComPASS collaboration for accelerator modeling and simulation, and is a leader in the Open Science Grid.

 CMS Tier-1 Center: The scientific challenges of particle physics require data storage, networks and processing power on an extreme scale. The CMS experiment uses a distributed computing model, in which seven national Tier-1 centers and more than 40 university- and laboratory-based Tier-2 computing and storage facilities distribute, process, and serve data. Fermilab's CMS Tier-1 center is the most powerful Tier-1 center for the CMS experiment.

 Lattice QCD Computing: Quantum Chromodynamics describes how quarks and gluons interact via the strong force and predicts the properties of hadrons. Such predictions require the numerical simulation of QCD on a lattice of space-time points, known as Lattice QCD, which uses massive computing resources. Fermilab builds and operates large clusters of computers for Lattice QCD as part of the national computational infrastructure for the Lattice QCD project established by DOE. Fermilab is also a participant in a DOE SciDAC-2 program devoted to the improvement of software for lattice gauge computing.

 FermiGrid: Grid computing evolved as an extension of distributed computing to satisfy growing computing needs from science, industry, government and commerce. Grid computing involves the distribution of computing resources among geographically separated sites, thus creating a "grid" of computing resources. Fermilab operates a large Grid Computing Facility with shared computing and storage resources provided to the Fermilab experiments for data processing, storage and analysis. The laboratory makes these computing facilities available to other scientific organizations in a secure manner through the Open Science Grid.

This core capability enables the laboratory to support the DOE's Scientific Discovery and Innovation mission (SC 4, 5, 21, 22, 23, 24, 25, 26, 27, 29, 34, and 35).

MISSION READINESS

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Infrastructure/ Mission Readiness Chart

FY11 Site Infrastructure Data Snapshot

Total Bldg, Trailer, and OSF RPV ($) (Less 3000 Series OSF's)	$812,463,938.86
Total OSF 3000 Series RPV($)	$888,057,044.82
Total RPV($)	$1,700,520,983.68
Total Deferred Maintenance ($)	$47,957,420
Total Owned Acreage	6,800
Total Leased Acreage	0
Site-Wide A C I (B, S, T)	.972

Asset Condition Index (Buildings, Structures, Trailers)	Percentage Utilized	# Building Assets	# Trailer Assets	# OSF Assets	GSF Building	GSF Trailer
Mission Critical	0.968	127	9	23	919,301	11,697
Mission Dependent	0.987	229	65	18	1,375,822	72,624
Not Mission Dependent	0	0	0	0	0	0

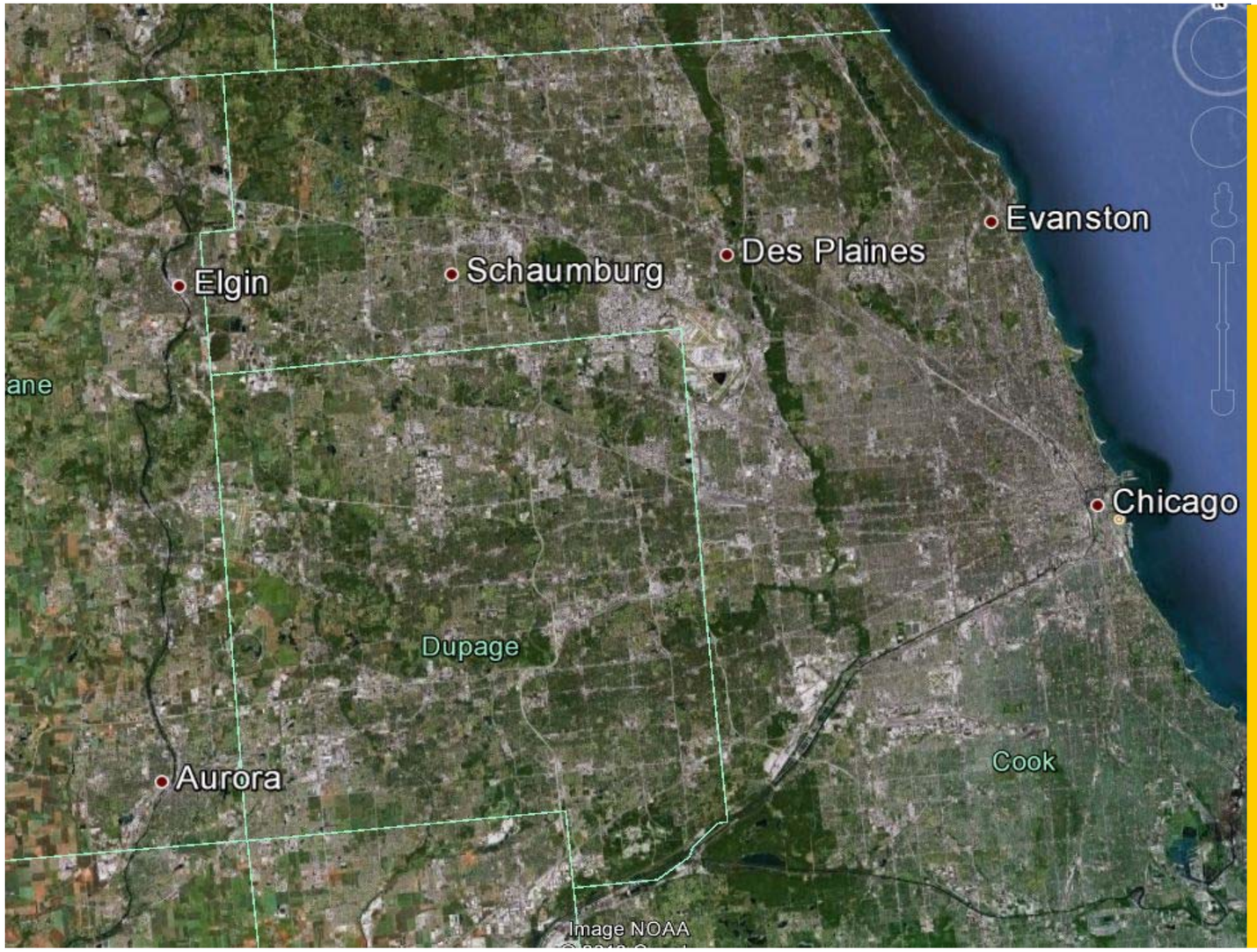
Asset Utilization Index (Buildings,Trailers)	Percentage Utilized	# Building Assets	# Trailer Assets	# OSF Assets	GSF Building	GSF Trailer
Office	98.22	37	61	-	610,839	77,573
Warehouse	97.12	86	10	-	379,356	5,412
Laboratory	100	122	0	-	712,118	0
Hospital	0	0	0	-	0	0
Housing	100	62	0	-	138,462	0

Section 2

EXISTING CONDITIONS

REGIONAL AND LOCAL CONTEXT

Regional and Local Context
Site History/ Background
Natural Environment
Land Use Management
Developed Regions
Utility Systems
Transportation
Security and Safety
Environment Sustainability
Cultural Resources



Numerous national and international organizations are located near Fermilab along the corridor created by Interstate Highway 88

REGIONAL AND LOCAL CONTEXT

Regional and Local Context
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The Fermilab site lies about 30 miles west of downtown Chicago, as shown in Figure 1-1 Regional Map. The site is located in western DuPage and eastern Kane Counties. Bordering Cook County to the east, DuPage is the fastest growing collar county in both population and employment.

Fermilab is a member of the East West Corporate Corridor Association (EWCCA). The corridor is viewed as an intellectual and economic resource to the Chicago area, the Midwest and the nation. Numerous national and international organizations are located near Fermilab along the corridor created by Interstate Highway 88. Among these organizations are the Amoco Research Center, AT&T Bell Laboratory, Argonne National Laboratory, Commonwealth Edison Company, the IBM Corporation, McDonalds Corporation and Nalco Chemical Company. More than 125 companies and organizations along the Illinois Research and Development Corridor comprise the membership in EWCCA. They represent more than 100,000 employees in the Chicago suburban area. The growth of these organizations and their ability to attract similar organizations to the area are among the major forces behind DuPage County's recent rapid growth. EWCCA recognizes that people are a most valuable business asset, and is dedicated to insuring the continuity and quality of area workers through networking and educational programs. Fermilab, along with many other research oriented institutions in the corridor, employ several thousand people holding advanced technical degrees. This concentration of scientific and technical talent offers a wide range of opportunities to bring different levels of experience and points of view to bear on important scientific issues.

Two organizations concerned with local and regional planning for the Fermilab area are the Northeastern Illinois Planning Commission (NIPC) and the DuPage County Regional Planning Commission. Fermilab maintains close ties with both groups to ensure that future plans for the region and the Laboratory are compatible and complementary. Throughout the years Fermilab has been considered a good neighbor by the local communities. Both planning commissions class the Fermilab site in the favored "office/research/ development" land use category.

The Chicago metropolitan area contains about 6.5 million people, making it by far the most populous inland area in the United States. Its population rivals those of the major coastal population centers, such as the New York-Boston- Washington urban complex in the east and the San Diego-Los Angeles-San Francisco region in the West.

In recent decades, many of the region's heavy manufacturing industries have been going through the painful economic transitions needed to maintain their ability to compete successfully in national and international markets. While other areas, such as the sunbelt states, have grown more rapidly than this region in industry and population, the Chicago area, in general, and DuPage County, in particular, has continued to grow. DuPage is currently ranked as one of the fastest growing counties in the nation. Because of its large population and strong economy, the Chicago area offers an enviable range of business services and cultural, educational and recreational opportunities. The region is endowed with exceptionally strong colleges and universities, which work actively with Fermilab in scientific and educational programs. It has a skilled, well-educated labor force. These strengths and many others ensure that the region will continue as a major contributor to the nation's economic, cultural and intellectual growth.

SITE HISTORY AND BACKGROUND

In the early 1960's, the High Energy Physics community came to the conclusion that new frontiers would require an accelerator capable of producing energies on the order of 200 BeY (billion electron volts; also called GeV). It was considered highly desirable to have even higher energies, but machines at these levels would cost more and take longer to build. The peak energy attainable would be set by economic consideration only.

It was also concluded, by a group of university presidents convened by the National Academy of Sciences (NAS), that the next large high-energy accelerator would have to be managed by a national association of universities. This group would work with and be funded by the government to meet the needs of the scientific community on research at these energy levels. In June 1965, Universities Research Association was incorporated and became the management body for the facility (i.e., National Accelerator Laboratory). Universities Research Association, Inc. (URA) of Washington, D.C., was a consortium of 56 major research-oriented universities with 55 universities in the United States and one in Canada.

The U. S. Congress Joint Committee on Atomic Energy declared in 1965 that it was in the national interest for the United States to support a search for the secrets that lie buried in the heart of the atom. Congress authorized $250 million in 1969 for the construction of the world's largest proton synchrotron (i.e.,.200 GeV) at Batavia, Illinois, a giant microscope which uses beams of sub-atomic particles to study the "world of the small. "

When dedicated in May, 1974 and named in honor of Enrico Fermi, a famous pioneering scientist, Fermilab's accelerator had reached 400 GeV. Following the construction of the Superconducting Energy Saver and Tevatron projects in the 1980's, Fermilab's accelerator is currently operating at 800 GeV for fixed-target beam and 900 GeV for colliding beam. The immediate focus continues to be on the 1000 GeV level.

High-energy physics research presently carried on in this country is funded primarily by the U. S. Department of Energy (DOE) at Fermilab and other DOE institutions such as Brookhaven National Laboratory, Long Island, New York and the Stanford Linear Accelerator Center, Palo Alto, California. The CERN Laboratory in Geneva, Switzerland, is Europe's counterpart to Fermilab. The USSR, Japan, and the People's Republic of China also engage in high-energy physics. High-energy physics is a field in which scientists from all over the world work together in a common endeavor. Of the approximately 150 institutions that have participated in the Fermilab research program over the years, about half were American based institutions, and half were international. American High Energy Physicists also participate in the research in other countries.

The size requirements for a 200-GeV accelerator laboratory were originally established by a site evaluation committee to be a minimum of 3000 acres with additional land up to a total of 5000 acres desirable for future expansion. The additional land would be reserved for such uses as a greater buffer area for radiation protection, beam extensions not foreseen at that time, extension of the scope of the Laboratory and for growth in areas other than high-energy physics. The committee noted that it would be unwise for a laboratory facility of the size contemplated to be without room for significant future expansion. In a later report, the committee recommended selection of a site with at least 5000 acres of usable land. They further noted that it would be prudent to acquire even more land to provide for the needs of possible

a giant microscope which uses beams of sub-atomic particles to study the "world of the small"

SITE HISTORY AND BACKGROUND

future larger accelerators.

The State of Illinois, in response to this, proposed a 6800 acre site, commonly referred to as the Weston Site (one of six finalist sites), about 5 miles east of Batavia, Illinois. When the government accepted the site, a letter from Dr. Glen T. Seaborg, Head of the U. S. Atomic Energy Commission (AEC), confirmed the "statement of understandings" between the State of Illinois and the AEC that the State would be offered first choice to re-acquire title to all, or portions, of the site in the unlikely event the Government might abandon the National Accelerator Laboratory.

The choice of this additional land was endorsed by the early group of scientists who had gathered to undertake the planning of Fermilab. They were confident of reaching 200 GeV and had options for attaining up to 400 GeV within the original accelerator configuration. They further realized that it would be possible to build a 1000 GeV accelerator which would fill the boundaries of the 6800 acre Weston Site using the magnet technology then available. Fermilab's accelerator was successfully built, and began operation at 200 GeV in 1972. In 1973-74, a full program of fixed target high-energy physics experiments was underway. The program was carried out in three external experimental areas - the Meson, Neutrino and Proton laboratories, and in one experimental area located inside the Main Accelerator enclosure called CO. By the mid-1970's, the accelerator was routinely operated for research at 400 GeV, and reached a high of 512 GeV in a brief test run.

In the early 1970's, a steadily growing program of superconducting magnet technology research was undertaken at Fermilab. In 1978, Fermilab had demonstrated that it was technically feasible to construct a 4-mile ring of superconducting magnets in the Main Ring tunnel. In 1979, the Energy Saver Project was approved by the U. S. Department of Energy and the construction of the superconducting accelerator was begun. By July 1983, the new ring of superconducting magnets was fully installed, and commissioning tests of the world's first superconducting synchrotron were complete. After demonstrating that a beam could be accelerated to 800 GeV, the superconducting accelerator, renamed the "Tevatron", was operated initially at 400 GeV in 1983 in order to complete the program of 400 GeV experiments begun in 1975. In 1982, the U.S. Department of Energy approved a major upgrade program for the fixed-target experimental facilities to pave the way for operations with 800-1000 GeV accelerated protons. Early in 1985, the 800 GeV fixed-target program was begun.

Simultaneously with the construction of the superconducting magnet ring Fermilab also undertook the design of a high-intensity antiproton source so that the Tevatron could be used as a collider. In 1982, the U. S. Department of Energy gave the go-ahead to the Tevatron I project which enabled Fermilab to transform the Tevatron into the world's highest energy colliding beams facility. The Antiproton Source was finished in 1985 and the effort culminated in the first test run of the 1.8 GeV proton-antiproton collider in the fall of 1985 and of the Collider Detector at Fermilab, the first of two large general purpose collider detectors which was put into full operation in 1987.

Since 1987 the Tevatron has been operated for both collider and fixed target experiments. The present plan is to alternate the fixed-target and collider programs in beam usage, with about 25% of the running time going to the Fixed Target program. In 1992 the collider was set up to operate for the CDF and DO detectors. The running period, extending from mid-1992 to mid-1994,

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and will cover about two years of operations in the collider mode. The goal is to reach an integrated luminosity of 100 inverse picobarns. The program represents the most extensive search for the Top quark ever carried out. Late in 1994, the program will revert to fixed target operation to provide secondary beams for a variety of fixed target experiments.

In addition to its high-energy physics programs, Fermilab has performed work for others. Highlights include the Neutron Therapy Facility, utilizing the Fermilab Linac, which is used for the treatment of certain types of cancer. Fermilab was also involved in the construction of a 250 MeV proton synchrotron for the Lorna Linda University Medical Center (LLUMC) for the treatment of · cancer patients with proton therapy.

Fermilab has engaged in extensive outreach activities in the areas of technology transfer to industry, and of technical science education at all levels from elementary school students to post-doctoral graduate researchers. A new Science Education Center was built in 1990 to provide for a focus of these continuing (and growing) educational outreach efforts.

Fermilab has maintained an aggressive policy toward the responsible management of health, safety, and environment protection concerns. The Fermilab site was dedicated in 1989 by DOE as a National Environmental Research Park (the only one in the Midwest), and an extensive program of both manipulative and non-manipulative research is anticipated in the coming years. A more complete description of the scientific, technical, educational and environmental programs at Fermilab, and of the plans for the next phases of these programs, may be found in the Fermilab Institutional Plan.

One of Fermilab's strengths is a diverse and experienced technical staff. Among the approximately 2,300 regular Fermilab employees, about 1000 are college graduates, some 330 of whom hold a Ph.D. degree. The professional staff covers a wide variety of scientific and engineering specialties. Some 900 visiting scientists from universities and other national laboratories, and from many foreign institutions, are active participants in Fermilab's high-energy physics research programs, providing valuable opportunities for specialists from different organizations to interact, share ideas, and collaborate in their areas of expertise.

NATURAL ENVIRONMENT

VEGITATION

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TOPOGRAPY

The site is relatively flat as a result of past glacial action. The highest area, with an elevation of 244 m (800 ft) above mean sea level is near the northwestern corner. The lowest point, 218 m (715 ft) above mean sea level is toward the southeast. The drainage of most of the surface water is to the southeast toward the DuPage River. A smaller amount of the surface water flows toward the southwest toward the Fox River. There are three watersheds that collect water on site: Kress Creek (located in the north portion of the site), Indian Creek (located in the southwest portion of the site) and Ferry Creek (located in the southeast portion of the site). Kress and Ferry Creeks are tribut

GELOGOY

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NATURAL ENVIRONMENT

FLOODPLAINS

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WETLANDS

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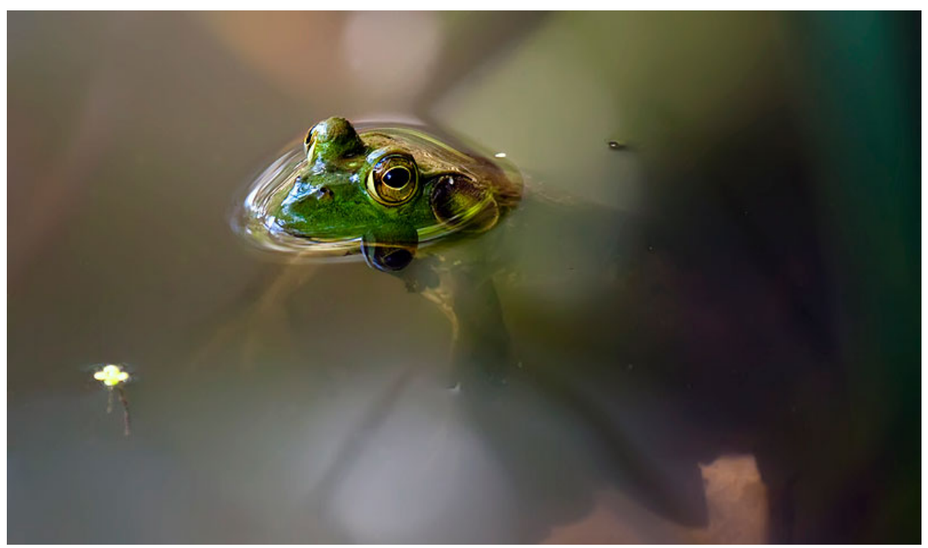

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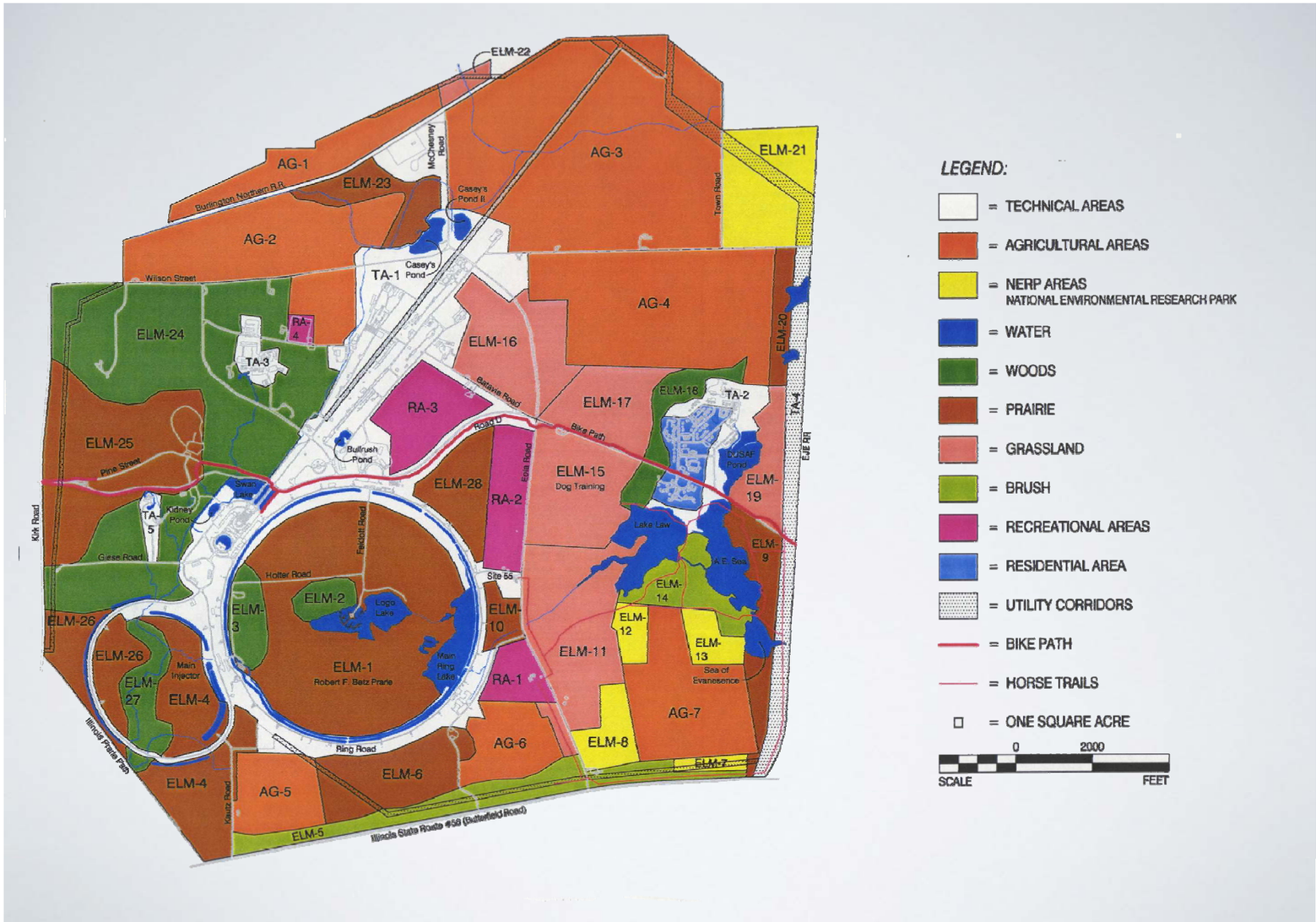
LAND USE MANAGEMENT



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Transportation
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Environment Sustainability
Cultural Resources

DEVELOPMENT AREAS

The development of permanent facilities has generally followed the initial site planning which was accomplished in the late 1960's and early 1970's. The main accelerator enclosure is located in the south central portion of the site with the adjacent linear and booster accelerators located to the west. Three major fixed target beam lines extend from the northwest side of the main accelerator enclosure in a northeasterly direction. Later development of the site has consisted of refinements and additions to the original configuration as well as additional support facilities.

All of the facilities on the Fermilab site are clustered within one or another of the areas listed below. (See Figure 1-8 Existing Land Use Map).

- Technical Areas
- Support Area
- Village Technical Area
- Village Residential Area
- East Area
- West Area
- Prairie Reconstruction Area
- National Environmental Research Park (NERP) Areas

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Technical Areas

The Technical Areas contain the greatest concentration of buildings on the Laboratory site. Most of these facilities are used to conduct research in high- energy physics which is the basic mission of the Laboratory. Other facilities in the Technical Areas provide space for various support functions· such as light laboratory, fabrication and assembly of experimental components, office areas, and storage. Because of the large number and varied nature of the facilities in this area, six separate subsections have been identified for the purpose of the development plan. It should be noted that the area was divided geographically rather than functionally in order to maintain distinct areas of reference on the overall site. These individual buildings can be identified by referencing their locations as shown on Figure 2-1, Grid Coordinate System with the corresponding Tables at the end of this section

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Wilson Hall Footprint and Antiproton Areas

(The buildings located in this subsection are primarily support facilities for the adjacent experimental and laboratory areas. Each building provides space for a variety of functions. There are two exceptions. Building 001 (Wilson Hall and Auditorium) is the main administrative center for the site. The greatest majority of its area is devoted to office space for some of the management and clerical needs of the various Divisions, Sections, and Groups contained within the organization of the Laboratory. Many of the functions of the Business Services Section, including Accounting, Purchasing, Contracts, and Emergency Services are located in this building. In addition, the building contains a cafeteria, stockroom, communications center, light laboratory and industrial shops, computer areas, and an auditorium with a seating capacity of 834.
The other. exception is Building 214. This building serves as the central utility plant for the footprint area. Equipment housed in this building generates hot. water and chilled water for the heating and cooling needs of the surrounding buildings as well as low conductivity water for experimental requirements. This building also contains a chlorination system for the domestic water supply system.

The remaining buildings in this subsection provide direct support for specific experimental areas. Buildings 201, 202, 203, and 205 house equipment, technical laboratory and control areas, offices, and storage for the Antiproton complex. Buildings 206, 207, 208, and 212 serve a similar function in support of the LinearAccelerator, Booster Accelerator, and the Beam Transfer Line to the Main Accelerator Ring.

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Main Ring Area

The majority of the buildings in this subsection provide direct support to the two principle accelerator rings used in the particle research effort at Fermilab; namely, the Main Accelerator and the Tevatron. Buildings 218, 220 through 228, 230, 231,233, through 235, 238, through243,245,246,248, through 253, 256, and 257 were the original service buildings constructed in conjunction with the Main Accelerator. They also provide access to the Main Ring Enclosure. These buildings contain power supplies and other equipment required for the operation of the magnets that comprise the Main Accelerator. Buildings 229,232,237, 244, 247, 254, and 255 serve a similar function in support of the Tevatron. The Tevatron differs from the Main Accelerator in that it is comprised of superconducting magnets. Therefore, in addition to its conventional equipment requirements, the Tevatron also requires cryogenic cooling capacity around its entire path. Buildings 299 through 322 are used for this purpose. Each building contains satellite refrigeration equipment which supplements the Central Helium Liquefier (located in another subsection) and links a system of supply and return piping that provides liquid helium to the Tevatron.

There are eight (8) additional buildings located within the Main Ring Area. Building 204 is an experimental target hall which controls the partide beam transfer from the Main Accelerator to the Antiproton experimental area. Building 283 is a service building that contains equipment that directs the particle beam to the various fixed-target experimental areas. Buildings 323, 324, and 325 (located at B0, C0, and D0 respectively) arelarge experimental halls devoted specifically to high-energy physics research using colliding antiproton and proton beams. The majority of space within these buildings is dedicated to experimental equipment; however, each building also has offices,

DEVELOPMENT AREAS

technical areas, computer rooms, and control rooms which support the experimental effort. Building 236is a pumping station used to transfer water from the pond system within the Main Ring Area to the adjacent experimental buildings for cooling purposes. Buildings911 and 912 are a barn and shed remaining from one of the original farm sites (Site 17). They are currently used for general storage along with Building *002.*

The A-0 Laboratory (217) is located directly south of Building 218 and provides additional office and technical space for accelerator personnel. The A-0 Kicker Building (216) is located to the east of Building 212 and provides additional space for experimental support equipment related to the Beam Transfer Line.
Proton Experimental Area

There are a variety of buildings and functions located in the Proton Experimental Area. The majority of buildings located in this subsection are directly related to the fixed-target experimental program of the Proton Beam Lines. Buildings 324, 500, 508, 510, 512, 514, 516, 518, and 628 are service buildings which contain power supplies, control system electronics, water pumping systems and other equipment required for beam line operation and monitoring. There are three major experimental laboratories associated with the Proton Beam Lines, Buildings 504, 506, and 626. Equipment for specific fixed-target experiments is located within each of these buildings as well as technical space, offices, and monitoring areas related to the overall experimental program. Buildings 502, 520, and 809 comprise a small complex of support buildings which provide space for the fabrication, testing, repair, and storage of magnets and other experimental components used in the Proton Beam Lines. In addition, Building 613 serves as the Research Division T&M shop which provides storage space for T&M operations in the fixed target research area.

In addition to the facilities directly related to the Proton Beam Line, there are a number of other facilities and functions located in the general subsection indicated as the Proton Experimental Area. Building 851 is the Central Helium Liquefier. Four (4) large two-stage, reciprocating compressors and related equipment within this building produce liquid helium required to meet the needs of the Tevatron and other cryogenically-cooled experimental components used in the research program. Building 003 is the recently completed Feynman Computing Center. It will be devoted exclusively to meeting the overall scientific and administrative computing needs of the Laboratory. Most of the computing hardware and mainframe equipment for the site will be located in this building as well as other computer-related functions such as tape storage, equipment repair, and administrative offices. There are eight (8) buildings in this area that remain from one or another of the original farm sites and continue to be utilized by the Laboratory. Buildings 943, 944, 945, 946 and 947 (Site 50) are used as offices and storage by the T&M Operations Group. Building 951 is a waste storage building also used by the T&M group. Building 994 (Site 67) is used by the ES&H Section for the handling and sorting of radioactive waste materials that are generated on the site. Building 996 (Site 68) is currently being used for storage by the ES&H Section. (

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Neutrino Experimental Area

The Neutrino Experimental Area is similar in many respects to the Proton Experimental Area. The majority of the buildings located in this subsection are related directly to the fixed-target experimental program of the Neutrino Beam Lines. Buildings 613, 615, 616, 618, 620, 622, 623 and 624 are service buildings which contain power supplies and other equipment required for beam line operation and monitoring. Building 625 houses compressor and air purification equipment used to support the adjacent experimental facilities. There are three (3) major experimental laboratories associated with the Neutrino Beam Lines, Buildings 608, 610, and 614. Equipment for specific fixed-target experiments is located within each of these buildings as well as technical space, offices, and monitoring areas related to the overall experimental program. Building 942 is a barn complex that remains from one of the original farm sites (Site 49) and provides storage space for magnets and other experimental components used in the Neutrino Beam Lines. Other buildings in the Neutrino Area are used for various equipment construction tasks as required: Buildings 600 (Lab A), 602 (Lab B), 604 (Lab C), 606 (Lab D), 612 (Lab G), and 700 (Muon Lab).

There are three other facilities located in this subsection. Building 522 serves as the Experimental Area Operations Center. It contains offices, technical areas, and a control room that monitors and directs the operation of the various beam lines for all three of the experimental areas -- Proton, Neutrino, and Meson. The Master Substation, Building 834, is the main electrical power distribution center for the site. The 345 KV electrical power supply from Commonwealth Edison is transformed at the Master Substation to 13.8 KV and distributed throughout the Fermilab site. The last building in this subsection is Building 855. This building contains the pumping equipment and controls for the site-wide industrial coldwater (ICW) system which supplies water for fire protection as well as airconditioning and conventional magnet cooling.

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Meson Experimental Area

All but one of the buildings located in this subsection are directly related to the fixed-target experimental program of the Meson Beam Lines. Buildings 402, 404, 406, 414, and 418 are service buildings which contain power supplies and other equipment required for beam line operation and monitoring. There are four (4) major experimental laboratories associated with the Meson Beam Lines, Buildings 400,408,416, and 420. Equipment for specific fixed-target experiments is located within each of these buildings as well as technical space, offices, and monitoring areas related to the overall experimental program. Building 422 is directly to the west of Building 420 and is devoted specifically to the monitoring of the experimental equipment within the adjacent laboratory. Building 410 houses compressor equipment that produces liquid helium to meet the .requirements of the superconducting magnets located in the Meson Area. Building 412 is an assembly building that provides space for the fabrication, testing, and repair of magnets and other experimental components used in the Meson Beam Lines.

The only other facilities in this subsection are Building 850 and Building 853 (SeeFigure 1-9 Outlying Facilities). They are located in the Railhead Storage Area at the extreme northwest end of the Technical Area and are used for low level radioactive storage.

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Technical Campus Area

The Technical Campus Area is a complex made up of five (5) major facilities andtwo smaller support facilities. All of the magnets, both conventional and. superconducting, as well as many of the other experimental components required for the research effort at Fermilab, are produced in this complex. Each of the five (5) major buildings -800, 801, 804, 805, and 806 -- contain one or more of the functions required to design, fabricate, assemble, and test the various components. These functions include office areas for design and administration, machine shops, assembly areas, testing facilities, and storage areas. lluilding 807 houses compressor equipment that produces liquid helium in small amounts that .is used in the testing process of superconducting magnet production. Building 803 is used for the demolition and reworking of conventional magnets and other experimental equipment.

Two additional buildings are located in the Technical Campus Area. The Central Helium Liquefier, Building 851, houses compressor equipment that produces the liquid helium necessary for Tevatron magnet operation and is the largest facility of its kind in the world. The Feynman Computing Center, Building 003, contains all of the computing equipment and personnel required to support both the mission oriented computing requirements as well as the administrative requirements of the Computing Division

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Support Area

There are currently 15 buildings in the Support Area which provide general support services to the Laboratory. Buildings 938 and 940 serve as the main· ·warehouses and also are used as the central shipping and receiving point for the site. Building 941 contains the controls for the truck scale weigh station also used in the receiving operations for the laboratory. The Fermilab Fire Department occupies two buildings in the area (932 and 934). Building 922 houses Operations and Maintenance which provides the in-house maintenance capabilities for the overall site. Building 930 contains a vehicle maintenance area, a carpenter and paint shop, and the central dispatcher for Laboratory vehicles.

The Roads and Grounds Group occupies three buildings in this area. Buildings 921 and 923 are used for equipment storage, and Building 925 is used for the storage of road salt used during the winter months. Buildings 924, 928 and 992 are used for general storage, and Building 936 is used specifically for hazardous material storage prior to use.

The Facilities Management Building 926, provides additional space for the Operations and Maintenance Group including space for secured maintenance · stores and other maintenance support functions. Calibration of instruments and measuring equipment used by the ES&H Section is conducted in Building 931, the Radiation Physics Calibration Facility (RPCF)

DEVELOPMENT AREAS

Village Technical Area

(See Table 2-9, and Figure 2-9 Village Technical Area)
Forty-seven (47) individual buildings and a portion of Building 141 comprise the Village Technical Area. The majority of these buildings were residences from the former Village of Weston that existed when the land was originally acquired by the Atomic Energy Commission. Most of these former residences are currently used as light laboratory areas and related office space. Buildings 180 and 186 are wood framed.pole buildings that are utilized as light laboratory space. There are six steel-framed buildings in the Village Technical Area. Of these six, Buildings 179 and 182 are used as machine shops while Buildings 181, 183, 184, and 185provide space for light laboratory activities

DEVELOPMENT AREAS

Village residential Area

Seventy-four (74) individual buildings, as well as a portion of Building 141, comprise the Village Residential Area. All but one were buildings that existed when the land was originally acquired by the Atomic Energy Commission. These buildings were either residences from the former Village of Weston or farm houses that were relocated to this area from other portions of the site. Sixty-three (63) of the buildings are used for on-site housing and related ancillary storage. Building 139 is a concrete structure with an earth berm that serves as a shelter area for Village employees and residents. Approximately 50% of Building 141 it also used for housing purposes. Nine buildings ate utilized for various recreational and institutional functions provided for employees and on-site residents. One of these buildings (164) is a steel-framed gymnasium. Building 56 houses utility equipment for the village water system.

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East Area

The East Area is primarily open land serving as a buffer between the eastern site boundary and the areas of conventional and experimental facilities. There are several areas that have been maintained as cultivated tracts that are leased on a contract basis for the planting and harvesting of various types of farm crops. The open land also serves as a valuable watershed for three man-made ponds located in the southeast corner of the site which contribute to the overall site water collection system.

There are five entrances to the site along the east and south boundaries of the East Area. The East Entrance (Batavia Road) provides daily access during working hours and guard-monitored restricted access at night The Eola Road Entrance provides limited daytime access and is controlled by a locked gate during off hours. The Wilson Street Entrance has been barricaded to prevent access at any time. The Town Road and Kautz Road entrances are controlled by normally locked gates which can be opened for limited access on a monitored basis.

There are 22 individual buildings in: the East Area. Most of these are the farm houses and out buildings that existed when the land was originally acquired by the Atomic Energy Commission. Building 948 provides a central office area for Fermilab Security. Building 856 is the guardhouse at the Batavia Road entrance to the laboratory. Building 949 is a barn used for the buffalo herd maintained on site. Building 964 is used by the janitorial service contractor for administration activities. Buildings 970, 972, and 974 comprise a hazardous waste storage area. Building 976 is utilized for time and material staging. Building 986, a residence, is part of the available on-site housing. The remaining buildings in this area are used for various kinds of storage.

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West Area

(See Table 2-11, and Figure 1-9 Outlying Facilities)
The West Area serves as an open space buffer between the western site boundary and the areas of conventional and experimental facilities. There are both woodlands and native grasses within this area which are being preserved in their natural state. In addition, certain areas have been maintained as cultivated tracts that are leased on a contract basis for the planting and harvesting of various types of farm crops.

There are two entrances to the site along the west boundary of the West Area. The Main Entrance (Pine Street) and the West Entrance (Wilson Street) provide daily access during working hours. The Main Entrance provides guard- monitored restricted access at night. The West Entrance is controlled by a locked gate during off hours.

"Building 852, the Pine Street Guardhouse is a permanent facility located at the Main Entrance. The open land is in itself useful to the Laboratory serving as a watershed which contributes to a site-wide network of ditches and ponds. This system collects and stores surface runoff to provide the cooling water required for magnets and other experimental apparatus.

The director's residence is a set of four buildings that include the on-site accommodations for the Laboratory Director. This area was one of the many original farm sites (Site 29) which continue to be utilized by the Laboratory. One residence (914), one garage (916), and two storage buildings (918 and 920) are contained in this area

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Prairie Reconstruction Area

The Prairie Reconstruction Area is that part of the site that is bounded on all sides by the Main Accelerator Enclosure shielding berm. The area consists primarily of tracts devoted specifically to the restoration of the original Illinois prairie. There are also woodland tracts and marsh areas being preserved in their natural state. In addition, two natural ponds are maintained as part of the site wide Water collection system to supply cooling water for magnets and other experimental apparatus. There are no significant structures located within the Prairie Reconstruction Area.

UTILITY SYSTEMS

Site Utility Systems

(See Figure 1-11 and Table 1-1 Fermilab Wells 1992)
Primary distribution systems for utilities on the Fermilab site include Domestic Water, Industrial Cold Water, Sanitary Sewei:, Natural Gas, Electrical Power, and Telecommunications. There is only one centralized utility plant, Building 214, on the Fermilab site. It supplies both hot and chilled water to the Wilson Hall and the buildings in the Footprint Area for heating and cooling needs. Also located at this central plant is the main water source for the Fermilab site; Well No. 1, which is the main site public water supply. Water is pumped from Well No.1 to the Central Utility Building for chlorination and then to the site distribution system. A description of the site utility systems and site plans are contained in the following sections.

Utility systems

Domestic Water Systems

There are three public 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 onsite. The primary source for this system is Well No.1 which is located near the Central Utility Building (214). Water is pumped from the well into a 50,000 gallon reservoir within the plant. There it is chlorinated and then pumped through the site-wide distribution systein. The secondary source for this system is Well No.3 which is located north of Road Band east of Receiving Road. When Well No.1 is not in use, water is pumped from Well No. 3 into another 50,000 gallon reservoir at the well site where it is chlorinated and then fed into the Main Site distribution system.

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 is a separate distribution system, independent of the main site distribution which, in addition to drinking water, provides the source of water for the fire protection systems located within the Village Areas.

The third public water supply at Fermilab is the water supply located at DO. This system supplies water to the Colliding Beams Experimental Facility at DO. The water is pumped from nearby Well W-5 and is chlorinated at DO prior to. distribution.
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

Industrial Cooling Water Systems

(See Figure 2-12 Industrial Cooling Water)
The Industrial Cooling Water system at Fernilab has a dual purpose. It is used to supply water to the various 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 which 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 whole of the 6,800 acre Fermilab site provides runoff to this network of ditches and lakes and thus even open areas of

UTILITY SYSTEMS

the site contribute to the experimental effort of the Laboratory. There is a second source that is used
: to supply water to the main reservoir. A contract with the State of illinois allows Fermilab, when water levels are sufficient, to pump water from the nearby Fox River to supplement and maintain water levels at Casey's Pond.

The present total capacity of the on-site ICW supply system is 185.7M gallons based on existing lake and ditch sizes and average rainfall. Building 855, the pumping station at the main reservoir, contains 3-5,000 gpm variable speed primary pumps and 4-1,000 gpm single-speed secondary pumps which supply water to the site-wide distribution system. The average pumping output of the Casey's Pond Pumping Station is primarily dependent on 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 as low as 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 overall system capacity

Sanitary Sewer System

There are two (2) underground sewage collection systems at the Laboratory. One serves the main site, the other serves the Village. 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 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. The collection system which serves the main site facilities is in generally good working condition. There has been an increase in the infiltration rate of the Village system in recent years due, primarily, to the age of the system. A portion of this system has been repaired. Investigation continues to identify and remedy the remainder of this problem

Natural Gas Distribution

(See Figure 2-14 Natural Gas)
Gas is delivered to Ferrnilab by the Northern illinois Gas Company from two separate source points. The primary gas supply is an 8-inch line which is 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, 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 technical support area is one of a few which is not completely served by natural gas. Several studies have been conducted, and it is anticipated that this area will be converted in total in the near future. The

TRANSPORTATION

CIRCULATION

The existing roadway configuration on the Fermilab site has proven to ·be adequate for the movement of materials and personnel on a daily basis. All facilities on the site are accessible by motor vehicle with the greatest majority of the roadways having a paved surface. The motor vehicle is the most common method utilized for on-site travel. Both private and government-owned vehicles are used by employees for travel between facilities in the course of their daily activities. During normal employee hours, there. is also a taxi service which utilizes government-owned vehicles to transport employees on their work- related trips. In addition to the roadways, there is a paved bicycle path which extends from the East Entrance at Batavia Road to the West Entrance at Pine Street. This path is used primarily for recreational purposes including cycling, jogging, and walking.

PUBLIC TRANSPORTATION

Fermi National Accelerator Laboratory (Fermilab) is located on a 6,800 acre site about thirty-five miles west of Chicago. Fermilab is just north of the the East- West Tollway (I-88) and about thirty miles southwest of O'Hare International Airport. About 5,500 acres are in DuPage County; 1,300 acres are in Kane County. The towns of Aurora, Batavia, Geneva, Naperville, North Aurora, St. Charles, Warrenville, West Chicago, and Wheaton are all within a twenty minute drive of Fermilab.

TRANSPORTATION

Virtually all movement of persons, goods, and materials into and out of the Fermilab site is by motor vehicle. Trucks used to deliver material to the site generally enter at one of the three primary entrance and proceed along Roads A, B, and D to the Main Receiving Area at Warehouse #2 (Building 940). The Burlington Northern Railroad does maintain a right-of-way through the extreme northwest portion of the Fermilab site adjacent to the Railhead Storage Area. Occasionally, this rail access is utilized for the delivery of large items when rail delivery proves to be more economical than over-the-road transit. In terms of personnel transportation, most employees elect to travel to and from work by personal vehicle. There are a few organized car pools; however, the number of employees which participate is very small.

PARKING

Parking lots exist in reasonable proximity to virtually all facilities located on the site. The layout and size of parking lots varies with respect to the facility use and employee requirements. The greatest concentration of parking is located in the Technical Support Area and the Wilson Hall/ Footprint·Area. In both of these areas, there are limited duration parking spaces designated for visitors and normal short-term employee parking, There are also spaces designated for particular government vehicle assigned to specific groups located within the adjacent buildings. There is currently no assigned employee parking. At the present time, parking areas are adequate.for the facilities they support with the exception of the Wilson Hall/Footprint Area. Recent

SAFETY AND SECURITY

SECURITY

The Security Department is responsible for the protection of Fermilab, its·employees, subcontractors, visitors and guests, and for compliance with applicable DOE orders. Fulfilling these responsibilities allows high-energy physics research to take place unimpeded. With DOE orders, the Security Department operates in the physical security arena only. There is no classified activity of any type at Fermilab nor is any classified material stored. No SNM (special nuclear material) is stored or used at Fermilab; however, a minor amount of Category IV nuclear material is on hand for instrument calibration purposes only. In addition to providing for the physical security of government property, equipment, and other assets, the Security Department also conducts traffic safety operations. The site consists of about 6,800 acres of land containing approximately 36 miles of roadways on which traffic safety rules are enforced.

Fermilab facilities are a combination of research laboratories, office complexes, support facilities, and housing units in a campus-like atmosphere. Physical facilities range from those "open to the public", generally from 6:00 a.m. to 8:00 p.m., to areas categorized and designated as "Property Protection Areas". The site perimeter is unfenced but does have road gates and control points staffed for off- hour access control. Buildings and other areas of security interest are protectedby locked doors and/or fences

PHYSICAL SECURITY

.The security protective force consists of a Chief and Secretary, four (4) Security Supervisors, and about 37-40 subcontracted security guards. None are DOE Security Inspectors and none are armed. The force is structured into three shifts each with its own Shift Lieutenant. The four Security Supervisors (rank of Captain) provide supervisory oversight and piimary interface with other Lab elements.

The force operates around the clock conducting mobile vehicular patrols, walking rounds, and fixed post operations. Security Guards identify security hazards and deal with them according to established policies and procedures. They complete preliminary investigations including traffic accidents and L088 prevention activities. Security officers enforce traffic safety rules by patrol,. traffic
·and parking citations, and verbal warnings. They also perform special duties for VIP visits, large public activities hosted on the Lab, and other special events. Besides recording all actions on appropriate written reports and logs, the Security Department maintains four types of related computer databases.

Certain areas, designated in response to DOE order requirements or because of vulnerability risk assessment, are also protected by physical security a]arm systems. These alarms annunciate in the Fermilab Communications Center which is manned 24 hours per day. The Communications Center is not part of the Security Department but dispatches Security resources to investigate and handle all alarm annunciations

TRAFFIC SAFETY

Fermilab allows use of its roads by the public during the day. Traffic controls and road designs comply with the "Illinois Manual on Uniform Traffic Control Devices" so there is consistency as individuals travel from off site to on site and· off site again. Issues which arise regarding controls and designs are reviewed and acted upon by Fermilab management.

Site Security monitors traffic, issues/tracks citations, and provides personnel to direct traffic in special situations (such as emergencies or large gatherings). Division/Section heads are periodically provided with a report of traffic tickets issued to personnel with their organizations. Repeat offenders are disciplined according to a point. system similar to that used by states. Site Security is administered by the Emergency Services Department in the Business Services Section

Emergency Response

The Communications Center in Wilson Hall is normally notified of emergencies via telephone or computer. On-site personnel are instructed to report emergencies using the "3131" emergency phone number. Automatic fire protection systems are also monitored by computer and provide an alarm in the Center if

SAFETY AND SECURITY

there is a problem. The operator will issue a "code" over the Lab-wide emergency paging system and notify appropriate personnel for response.

Most emergency calls require an action from the Fire Department and/or Site. Security. The problem needing a response is typically a fire alarm or personal injury. A fire protection technician, electrician, mechanic, ES&H expert, or local expert may be summoned for advice to inactivate/correct a malfunctioning piece of equipment or to initiate an investigation. Minor injury cases are referred to the Medical Department or may be handled by the Fire Department on the scene. Personnel with major injuries are transported to an area hospital.

Each division/section prepares plans to respond to credible major emergencies. The most likely major emergencies at Fermilab are a fire or tornado. Some areas also have a potential to expose personnel to a hazardous atmosphere (primarily oxygen deficiency from spills of inert liquefied gases). Alarms are located in structures to inform people of major emergencies. Outside sirens are also strategically located throughout the Fermilab site. The alarms/sirens need only convey two different instructions, either to evacuate the structure or to take shelter, and this is accomplished by modulating the sound.
Less likely emergencies would involve a large radiation exposure/contamination

of an employee/experimenter or spill of a toxic chemical. Fermilab has facilities in the Village area to assess accidental radiation exposures and decontaminate personnel. In addition, the Fermilab Fire Department is trained and equipped to respond to foreseeable chemical spills.

The Emergency Preparedness Planning Office is part of the Director's Office and has responsibility for developing and maintaining the Laboratory's emergency plan.

Fire Protection

The primary means used by Fermilab to maintain an "improved risk" status are automatic fire detection and suppression as well as fire resistant construction. Most fire detection apparatus are connected to a computer monitoring system and structures are generally provided with water sprinkler suppression. Halon has been used in special applications but is being employed less often due to concerns about the ozone layer.

Over the past several years, the fire protection of experimental enclosures has been undergoing a· program of improvement including installation of high sensitivity fire detection, suppression systems to protect the apparatus as well as the structures, and smoke/heat venting. In addition, experimental apparatus containing large amounts of flammable gases are subject to formal review and mandatory corrective measures.

As noted above, Fermilab maintains an ability to rapidly respond to fires with its own Fire Department. In addition, there are mutual aid agreements with the fire departments in the surrounding communities.

The Fermilab fire protection program will be outlined in the Fermilab Fire Protection Manual.

ENVIRONMENTAL/ SUSTAINABILITY

One mechanism Fermilab uses to assure environmental quality is through appropriate monitoring. All monitoring results continue to indicate that off-site exposures when measurable, are many times below applicable guidelines.

The emphasis in radiological monitoring is placed on exposure pathways appropriate to high-energy physics laboratories. External exposures may result· from direct penetrating radiation scattered from the beam (primarily muons) or short-lived air activation products (C-11, N-13, and A-41). Internal exposures may result from activation products leached into water (H-3 and Na-22), primarily potential drinking water.

Penetrating radiation measurements are primarily conducted using a Mobile Environmental Radiation Laboratory (MERL), a vehicle with detection equipment as well as a site-wide network of 120 fixed detectors with continuous .data recording. Airborne releases are continuously recorded using stack monitors at strategic locations. Water flow rates are recorded and samples collected monthly. Additional monitoring for radiomiclides has been conducted on sediments and vegetation to investigate other possible exposure pathways.

Non-radiological environmental monitoring includes analysis of drinking water quality, and sampling for pesticides, PCB's, and heavy metals. Fermilab operates two on-site public water supplies and monitors drinking water quality to assure compliance with Illinois Environmental Protection Agency (IEPA) standards. Pesticides are used to control weeds and insects. Although the choice of pesticides is limited to less hazardous types and quantities restricted, monitoring is conducted to assure that concentrations are not building up. In the past, PCB's were used as a dielectric in transformers and capacitors because of their fire- resistive characteristics. Although the majority of. on-site PCB's have been disposed off-site, monitoring is conducted at previous use sites to identify spills on the ground and to assure compliance with applicable standards. Heavy metals include chromium and lead. Zinc Chromate was used for a short time to clean

cooling towers at the Central Utilities. Building and lead is used as a radiation

shielding material. Monitoring is conducted as needed for these metals to assure compliance with applicable standards.
Radioactive/Hazardous Wastes: Fermilab generates both radioactive and chemically hazardous wastes. Accelerating and transport equipment, as well as anything nearby, may become radioactivated from interaction.with high intensity particle beams. Typical radionuclides produced are Na-22, Mn-54, and Co-60. Radioactive equipment which is no longer useful is stored and, if necessary, repackaged at Site 67 (994). Much of this material is incorporated into cement "shielding blocks". A fraction of this equipment cannot be used for this purpose and is disposed of off-site as radioactive waste. All of Fermilab's radioactive waste is classified as low level.

Chemical wastes are typical of those found in a medium-sized industry and include ethylene glycol, oils, solvents, corrosives, coatings, PCB's, asbestos, and lead. These are stored and, if necessary, repackaged at Site.SS (970,972,974), until they are shipped off site for disposal. Chemical wastes are handled in accordance with the Resource Conservation

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ENVIRONMENTAL/ SUSTAINABILITY

and Recovery Act (RCRA), the Toxic Substance Control Act (TSCA), the Superfund Amendments and Reauthorization Act ·(SARA), and the special waste regulations of the State of illinois.

No radioactive or hazardous wastes are disposed of on the Fermilab site. In addition, all such wastes leaving the site for disposal are packaged in accordance with Department of Transportation (DOT) regulations.

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Regional and Local Context
Site History/ Background
Natural Environment
Land Use Management
Technical Areas
Utility Systems
Transportation
Security and Safety
Environment Sustainability
Cultural Resources

CULTURAL RESOURCES

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> “My fantasy of a utopian laboratory clearly required a setting of environmental beauty, of architectural grandeur, of cultural splendor...”

Section 3

DEVELOPMENT PLAN

DELIVERING SCIENCE THIS DECADE

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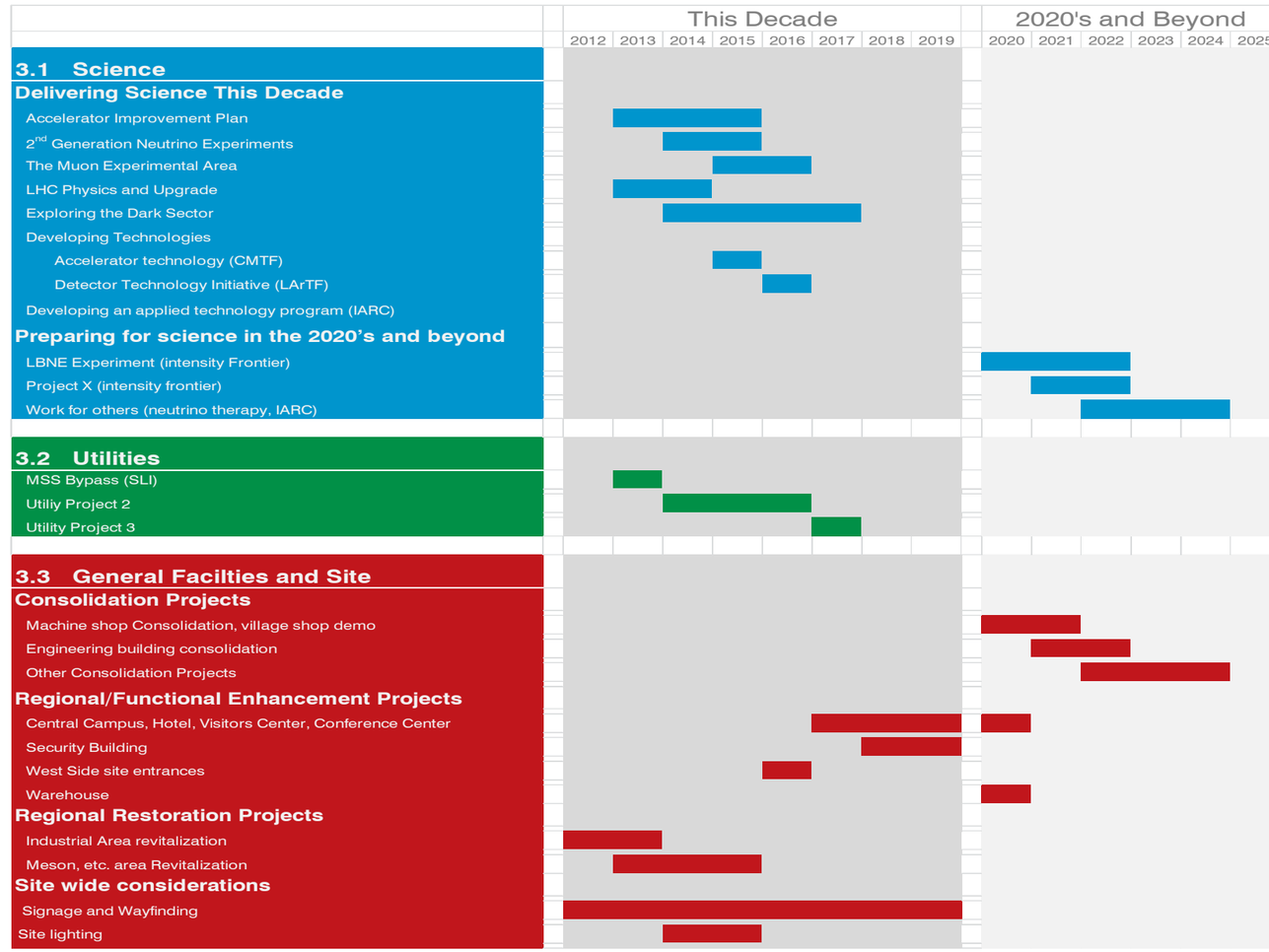

MUON CAMPUS

Overview

High-intensity sources of muons enable ultra-precise measurements of their fundamental physical parameters, as well as searches for new physics phenomena in rare processes involving muons. Such measurements could yield significant discoveries, such as the unexpected violation of lepton-flavor symmetries or subtle new physics entering at the quantum-loop level. Starting in 2016, Fermilab's Muon g-2 experiment which will reuse the Brookhaven muon storage ring with the former Fermilab antiproton source will study the anomalous magnetic moment of the muon, where possible evidence for new physics has already been detected. Muon g-2 will also search for an electric dipole moment for the muon, which if detected would imply a new source of CP violation. Rare decays of muons, if observed, could be harbingers of new physics phenomena. Starting late this decade the Mu2e experiment will search for one such rare-

> Rare decays of muons, if observed, could be harbingers of new physics phenomena

MUON CAMPUS / MC-1

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MUON CAMPUS / MC-1

THE G-2 EXPERIMENT

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MUON CAMPUS / MC-2

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THE EXPERIMENT

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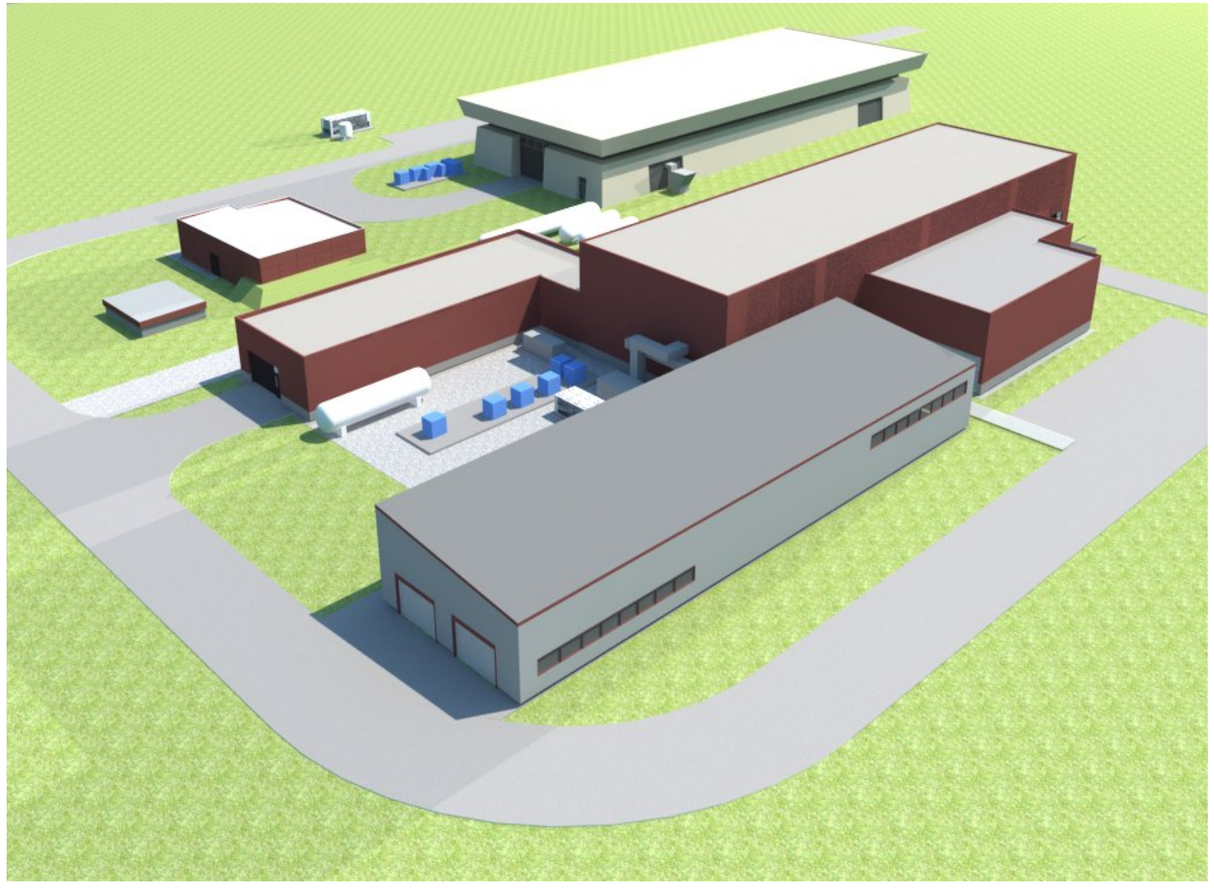

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ILLINOIS ACCELERATOR RESEARCH CENTER

Developing an Applied Technology Program

Powerful innovative accelerator and detector technologies created for basic science and developed by industry have produced particle accelerators and detectors addressing key economic and societal issues. However, there exist gaps in translating breakthroughs in science and technology into applications that benefit society. Fermilab is establishing the Technology Applications Program to leverage laboratory resources and capabilities toward the application of high-energy physics accelerator and detector technology to problems of national importance in the fields of Energy and the Environment, Medicine, National Security and Industry. The success of this program will require developing partnerships with Industry. Fermilab's strategy to improve coordination between basic and applied research hinges on leveraging the investment of the State of Illinois in the Illinois Accelerator Research Center (IARC) and current collaborative activities between Fermilab and industry in accelerator technology development and three-dimensional vertical integrated silicon and silicon-based multi-pixel detector technology. IARC consists of an office and education building with attached industrial space outfitted with the necessary infrastructure for the development and testing of accelerator technology. State investment in IARC was motivated by the goal of growing accelerator-based industry in the State by enhancing current collaborations and technology transfer between Fermilab and industry. We anticipate partnering with both federal and private entities to develop and apply technology toward national needs in Energy and Environment, Medicine, National Security and Industry. Through IARC, Fermilab will provide an attractive facility to enable development and demonstration of concepts and products by industry. To that end, Fermilab will engage industrial

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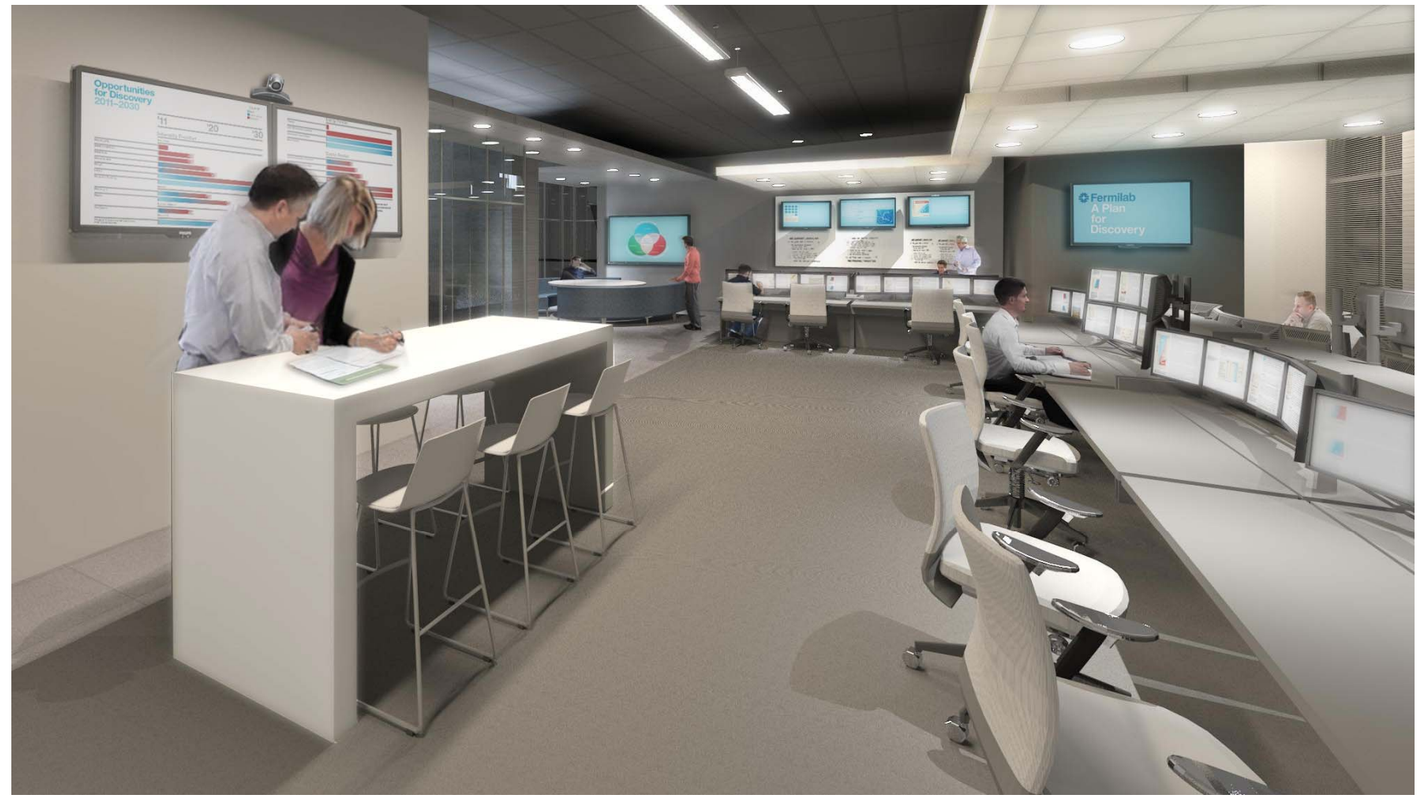

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LArTF

Liquid argon time projection chamber (LArTPC) technology has emerged to provide ultimate detectors for neutrinos at multi-kiloton scale and dark matter searches. This technology allows extremely high quality particle tracking and event reconstruction. The ionization charge from the passage of particles through argon is drifted with an electric field and collected on readout wire planes; a 3-dimensional track can be reconstructed using charge arrival time information. Furthermore scintillation light signals in argon detected by photomultiplier tubes can allow fast timing of signals and enhance event localization. Very high purity cryogenic argon is required and this has been demonstrated by Fermilab's R&D program. Track granularity is determined by wire spacing, and in principle very fine-grained tracking can be achieved. Particle identification is possible by measuring ionization energy loss along a track. Because of the excellent, full-particle tracking capability of liquid argon, very high-efficiency particle reconstruction allows a smaller LAr detector to match the efficiency of conventional technology such as a water Cherenkov detector of a given mass, with an approximate ratio of 1:6. The current largest liquid argon detector instance is ICARUS in Europe. In the U.S., a program of development towards large liquid argon detectors began with ArgoNeuT at Fermilab and continues with MicroBooNE, the upcoming short baseline neutrino experiment (operations will begin in 2014). The LAr technique is as yet to be proven at multi-kiloton scale, but R&D has so far yielded promising results.

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Science for the 2020's and beyond

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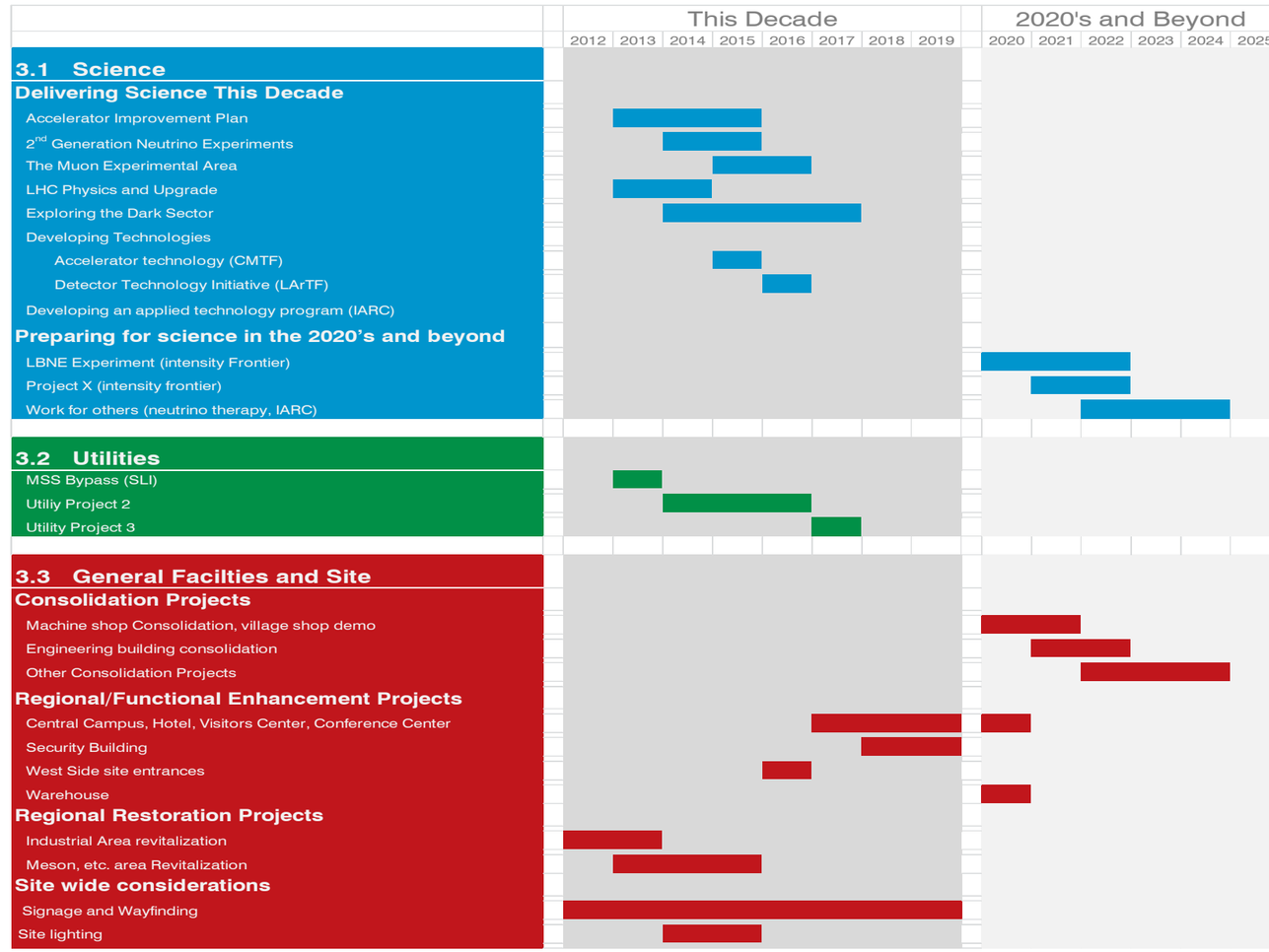

LBNE

LBNE experiment

The Long-Baseline Neutrino Experiment, which could be operating in the 2020s, will represent the next giant step in the quest to understand neutrinos and the origins of a matter-dominated universe. LBNE's critical scientific mission is to determine if leptons experience CP violation. As its main goal, LBNE will search for a matter-antimatter (or CP-violating) asymmetry in the oscillation of muon neutrinos and antineutrinos to electron neutrinos and antineutrinos. LBNE will be the first experiment capable of discovering CP violation in the neutrino sector. Important aspects of LBNE will be its longer baseline and its versatile and massive far detector. The project team and the scientific collaboration have made the technology choices for the beamline and the far detector and refined the cost estimates. The far detector will be a liquid-argon time-projection chamber of several tens of kilotons. This detector allows for a rich physics program beyond neutrino oscillation studies. This includes a high-sensitivity search for proton decay, which probes the grand unification scale of order 1016 GeV, and high-sensitivity studies of neutrinos coming from supernovae within our galaxy. Although the physics case has strongly been endorsed by the scientific community and the National Academy of Sciences, Office of Science Director concluded in late March that the peak cost of the project cannot be accommodated in the current budget climate and asked Fermilab to lead the development of an affordable and phased approach or alternative configurations to LBNE. A Steering Committee has been formed by Fermilab to study phased approaches and alternative experimental configurations. The Committee will deliver its draft report by June 1 and its final report by July 1.

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PROJECT X

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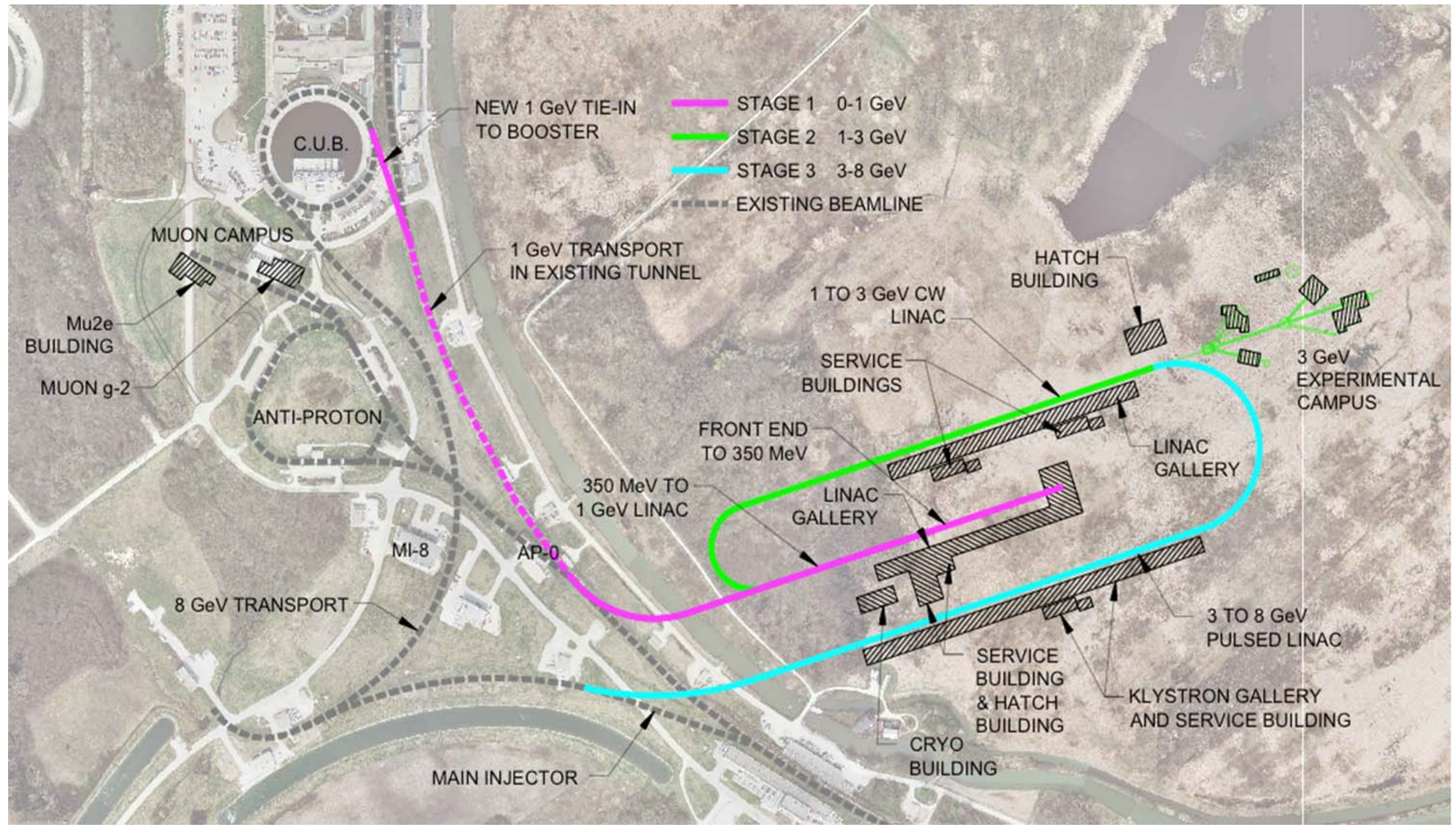
For breakthrough to a deeper understanding of nature and the origins of matter, either discovering new phenomena or providing the critical clues that explain new physics discovered in this decade, it will be essential to build a next generation accelerator facility. Fermilab is pursuing the design and construction of such facility, *Project X*, in collaboration with national and international partners. *Project X* will be the world's most intense and flexible proton accelerator. As the key to Fermilab's long-term world leadership at the Intensity Frontier, it will drive a long baseline neutrino experiment with ten times the flux of the present Fermilab beam, short baseline neutrino experiments with ten times current fluxes, and kaon, muon and Electric Dipole Moment (EDM) experiments with fluxes that are two orders of magnitude greater than the current capabilities. During the *Project X* era the beam intensity up to 3 GeV would be a factor of a hundred greater than this decade's complex. *Project X* is a high intensity continuous wave superconducting linac and would substantially re-use existing facilities such as the Main Injector and Recycler Ring, infrastructure that would be very costly to reproduce elsewhere. The utilization of superconducting radio frequency technology for *Project X* has aligned the development effort with that of the ILC, to the benefit of both. *Project X* is also being designed to serve as a platform for the high intensity proton source required for the front end of a neutrino factory or a muon collider, thus allowing for the very long range development of the Fermilab complex.

The laboratory developed 3-staging opportunities for *Project X* in a manner that integrates with the other activities contained within the laboratory's Intensity Frontier plan. Each stage provides compelling physics opportunities and at the completion of the final state the full vision of a world leading intensity frontier program at Fermilab and in the U.S. is



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PROJECT X

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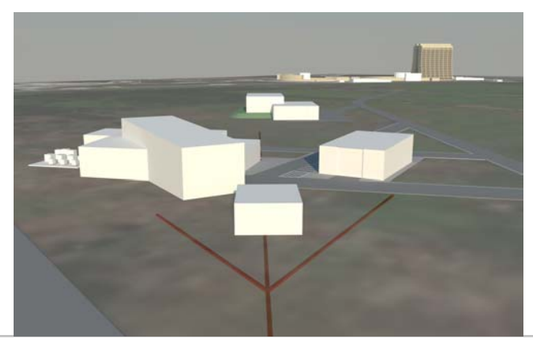

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UTILITY PROJECTS

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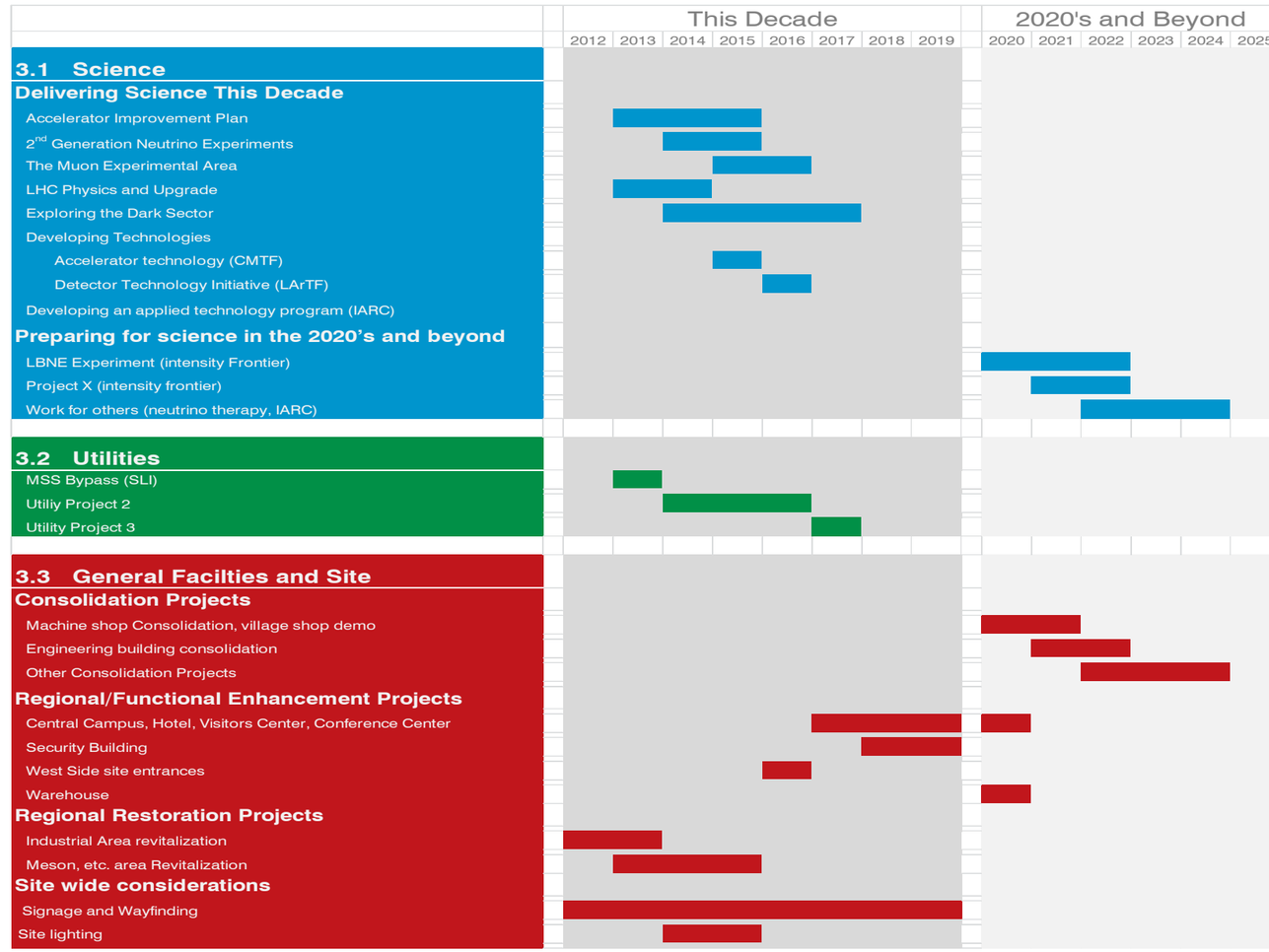

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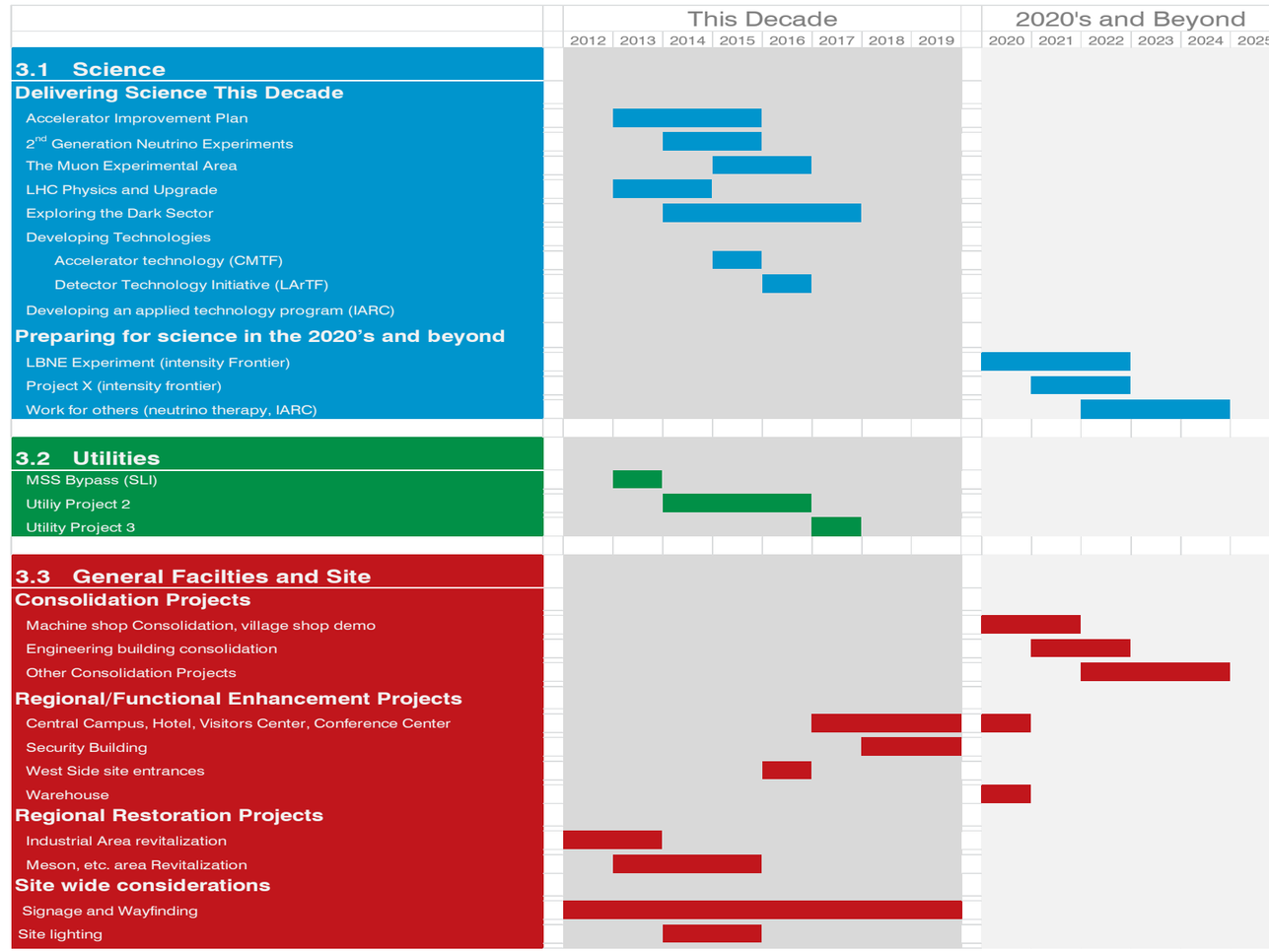

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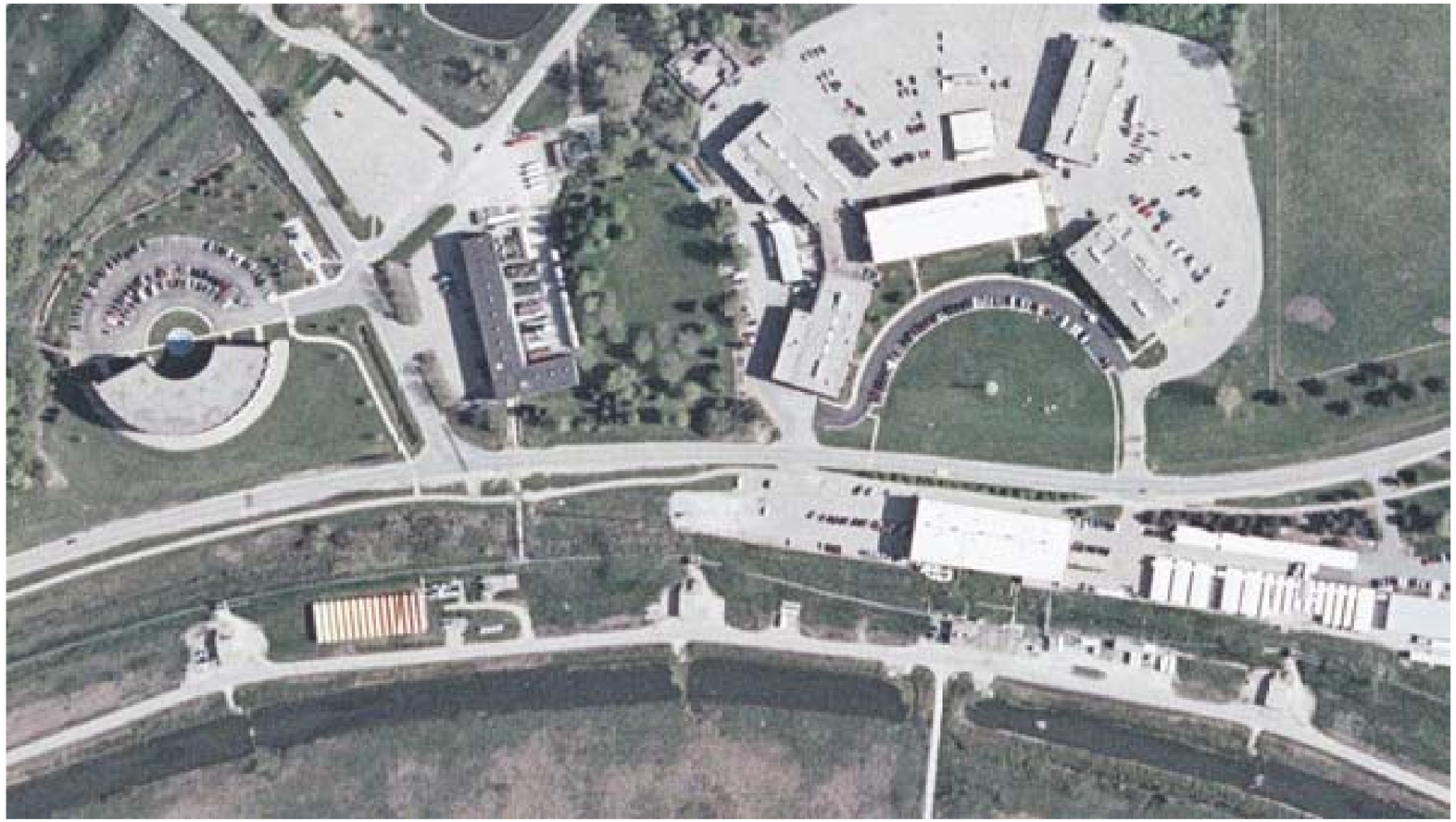

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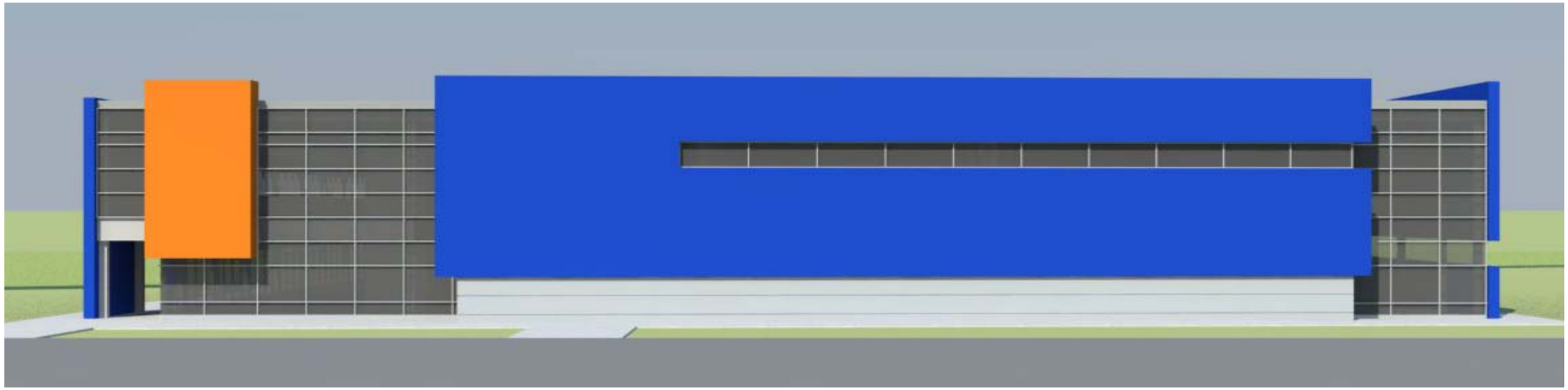

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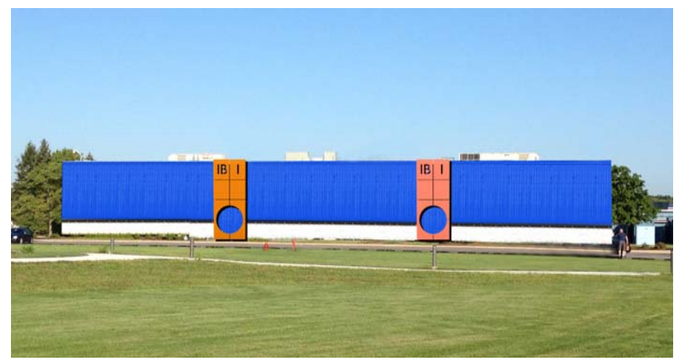

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MESON AREA REVITAIZATION

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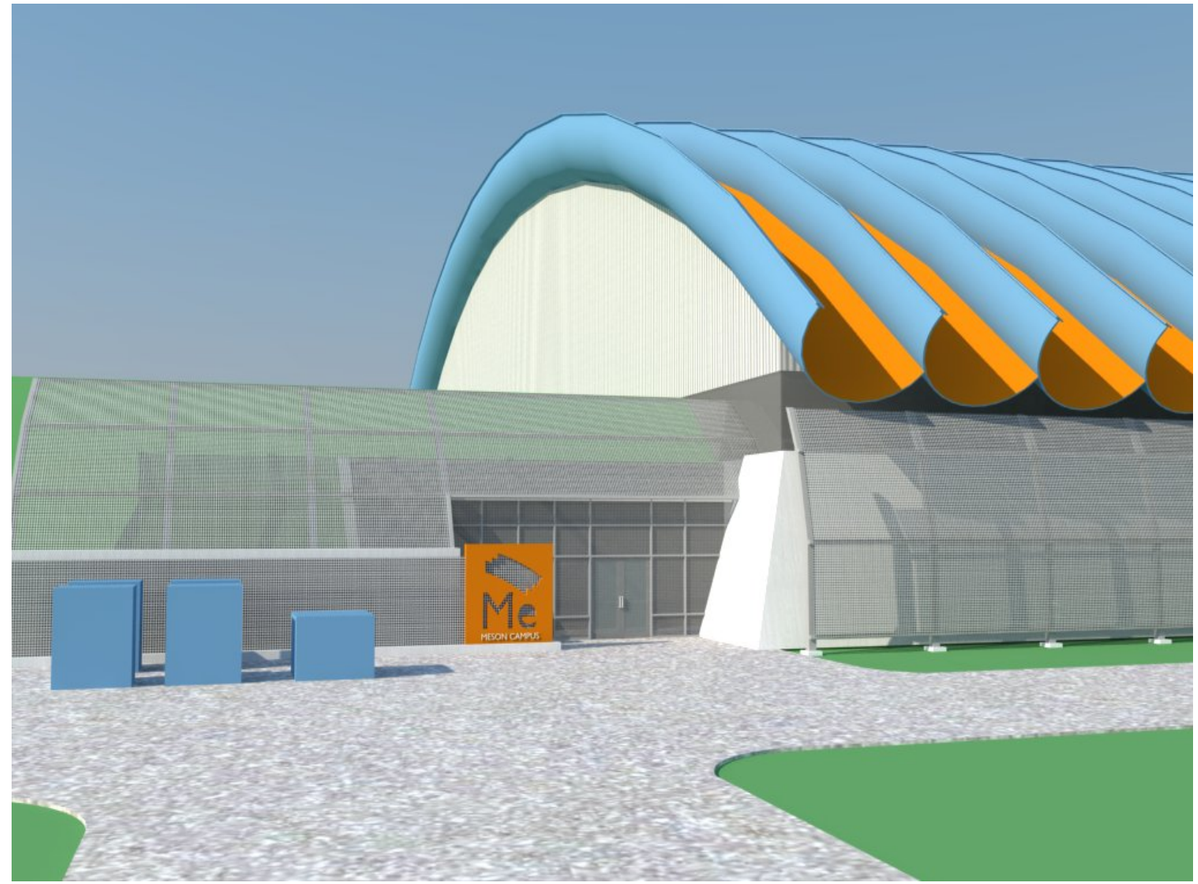

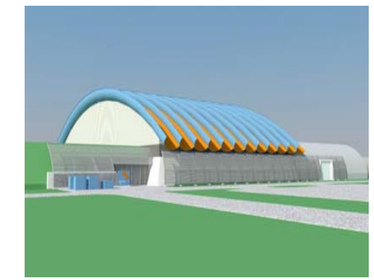

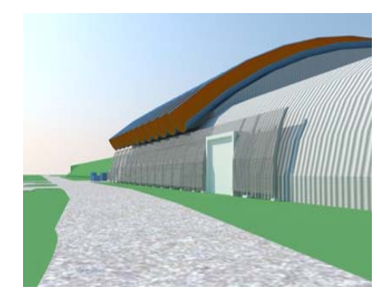

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SITE 38 SUSTAINABILITY UPGRADE

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WILSON HALL SPACE UTILIZATION

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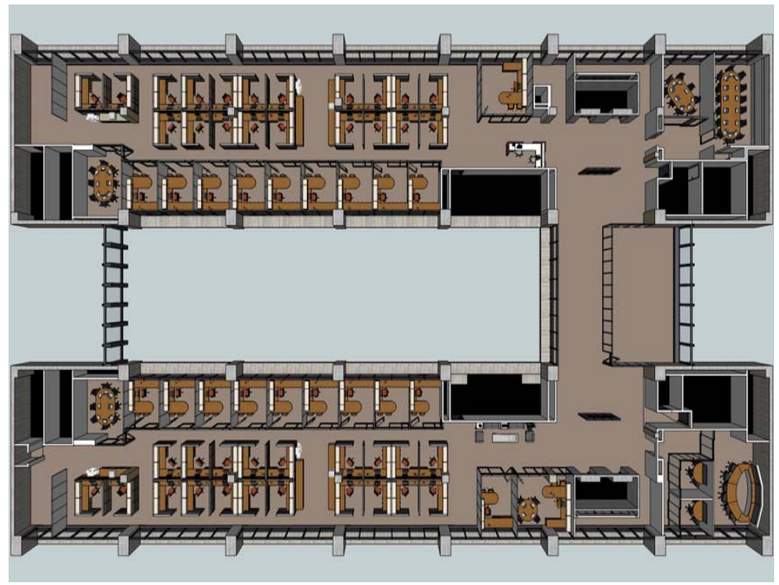

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GRID COMPUTING

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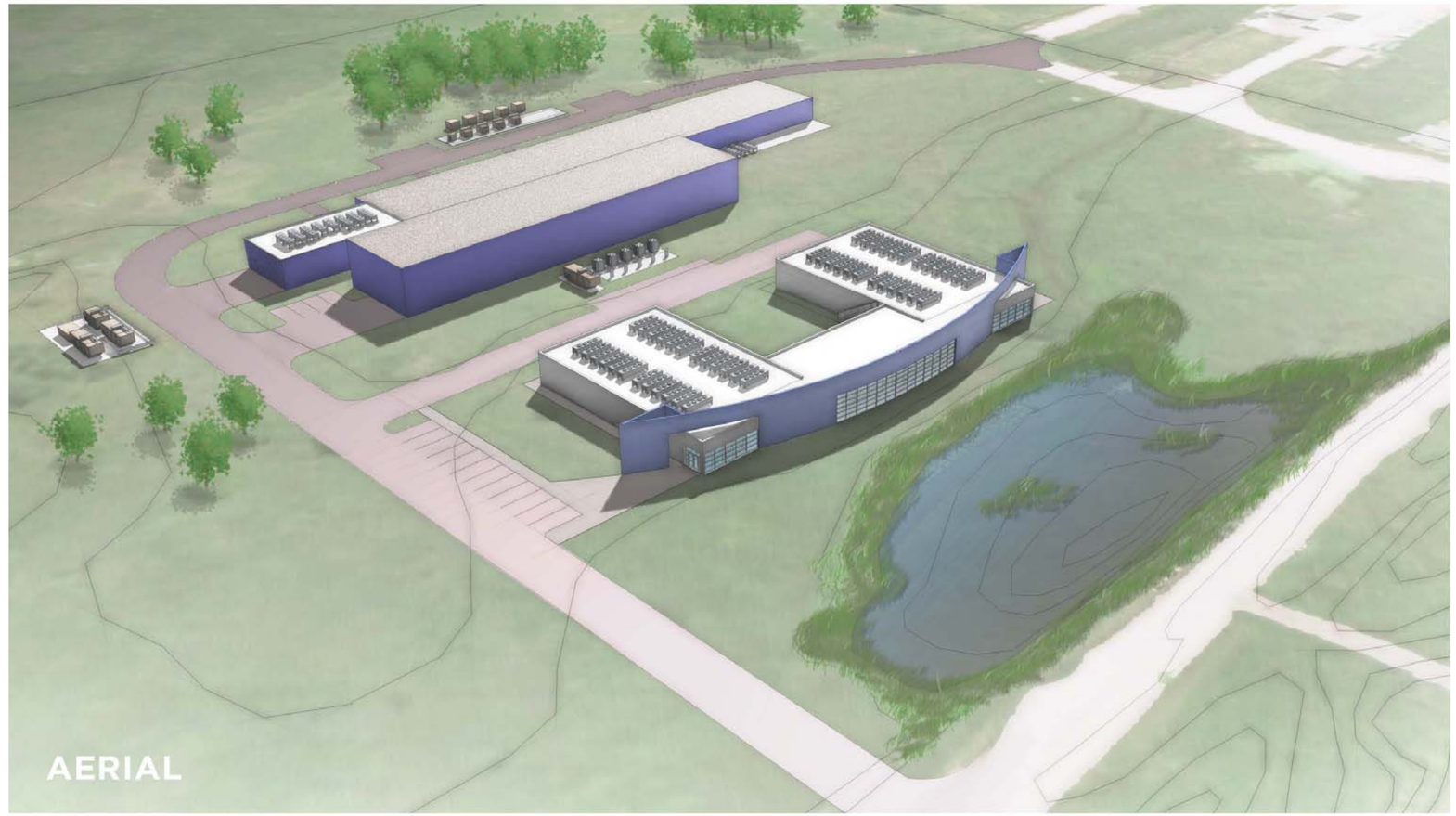

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VISITORS CENTER

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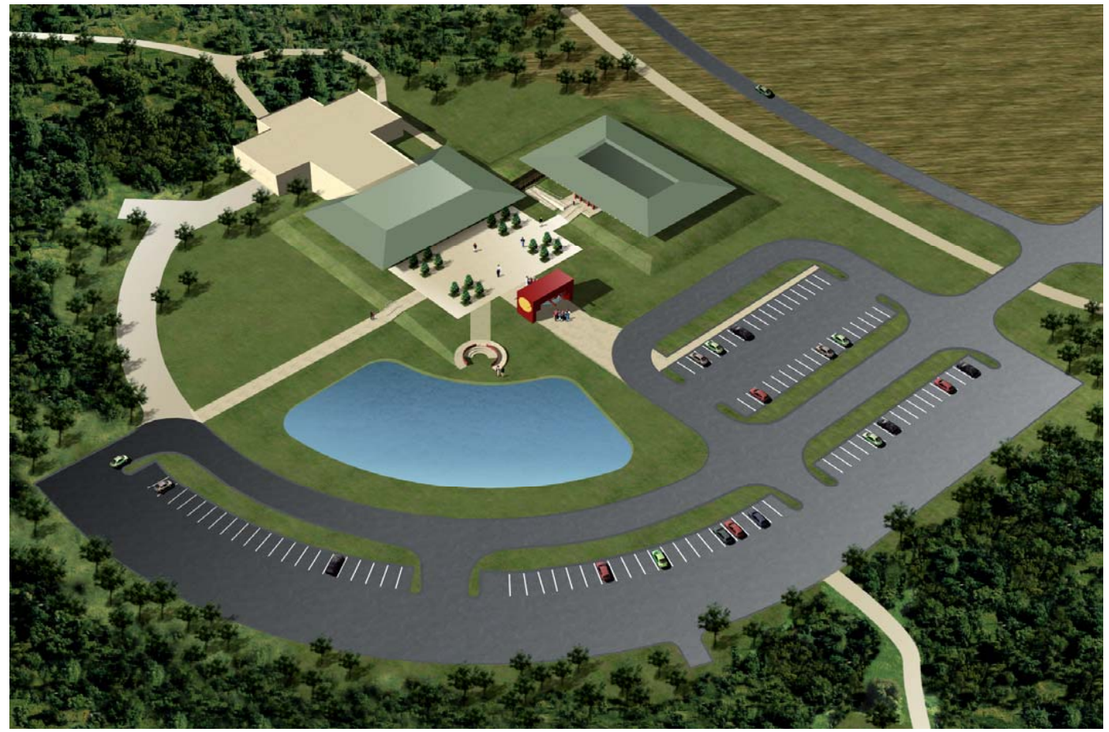

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CENTRAL REGION LONG RANGE PLAN

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