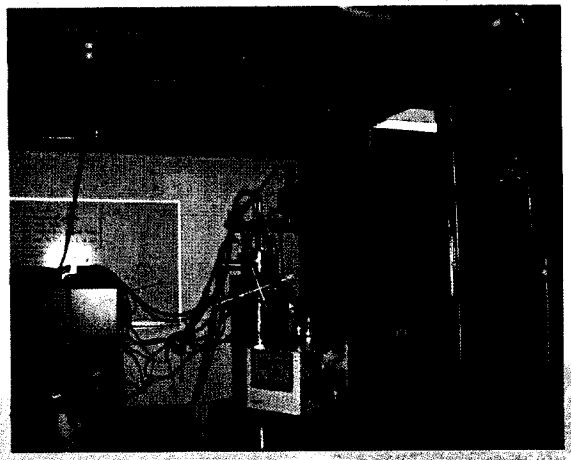
LA-UR-03-8251

Physics Facility Strategic Plan

"Too many of our world-class scientists work in substandard labs; it is critical to the Laboratory's reputation of scientific leadership to fix this problem."

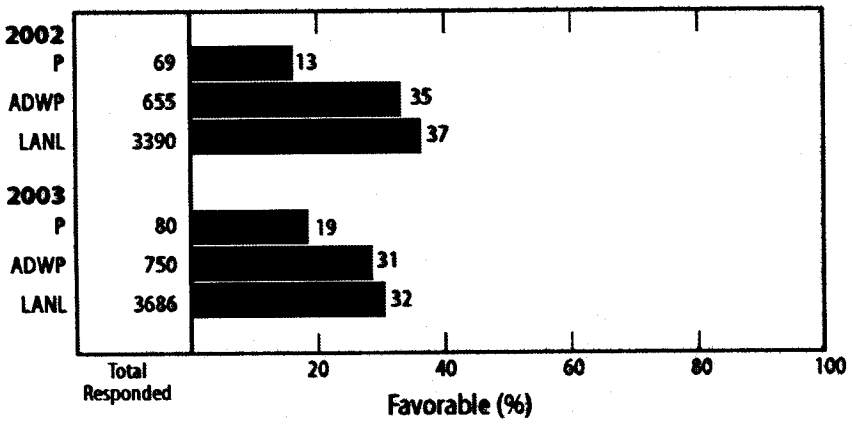
— Susan Seestrom, Physics Division Leader



Checkpoint Survey

Productivity

"Inadequate Laboratory infrastructure and facilities do not hinder my productivity."



November 5, 2003

Unless otherwise noted in the text, facility spatial and staffing data are effective August 31, 2003.

1943 • 2003

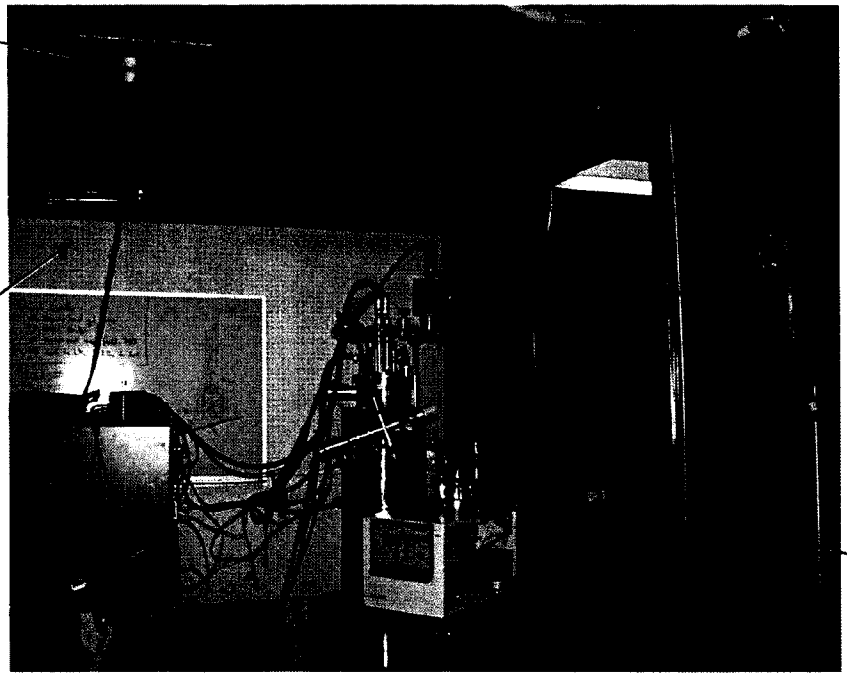
Los Alamos

Ideas That Change the World

NNSA

About the cover:
Dr. Vincent Yuan, a world scientific leader in neutron resonance spectroscopy, works in a cold, dank, noisy basement lab in building MPF-1 at the LANSCE accelerator facility. The photograph below illustrates the many environment obstacles he faces performing his research.

The chart, excerpted from annual Laboratory checkpoint surveys, shows that P Division scientists have a dismally low opinion of their laboratory spaces — nearly half again as low as the already low opinion that employees throughout the Laboratory hold about their spaces.



This photograph was artificially lightened to allow detail to be seen.

Produced by the Physics Division Office
Physics Division Facility Strategic Plan Committee:
Pamela R. French (chair), Steven J. Greene, M. Anne Donohoe, Stephen M. Glick, Sarah M. Salazar,
Todd Heinrichs (editor), and AnnMarie Cutler (cover design and illustration)

"In the areas where we work, in TA-53, the buildings are sound, but most space must be reconfigured and refurbished for new activities. The time delay and lack of funds for fairly simple operations that would make space usable is appalling. In fact the Lab does much to support new hires and postdocs; unfortunately the space available for supported research is of unacceptably poor quality and the delay imposed (years) and the time required for refurbishment is crippling for early career researchers. Adequate space is the single component missing from the 'success' equation. There must be a way to get KSL and their endless red tape and delays out of the loop."

-Stephen K. Lamoreaux, P-23: Neutron Science and Technology

"The quality of much experimental space is markedly substandard. We will not be able to recruit and retain the best scientists if we can't offer better facilities. Typically, academic research institutions offer full refurbishing of space to accommodate experimental needs of the incoming researcher. Also, bringing a potential recruit in an 'unappealing' environment and trying to convince them that the best work in the world is being done here can be a tough sell."

-Fiorenzo Omenetto, P-23: Neutron Science and Technology

"The main problem is that available light-lab space is very limited, so that we are forced to share only about 40 sq ft among multiple projects and many workers from multiple teams and groups. This is a prescription both for lack of productivity and for excessive cross-project hazards in the long term. Having worked at the Laboratory for five years, I have no access to light lab space that I would describe as usable for a new project or concept development."

-Alexander (Andy) Saunders, P-25: Subatomic Physics

"There are two quite different and compelling reasons to improve lab space. The first, and most obvious, is that it is impractical to perform complicated experiments in small spaces with substandard facilities. The second is less tangible but perhaps more important to those of us who battle the experiments and fight to keep them funded—it represents a commitment of the organization to the people doing the science and a clear acknowledgment to them that their work is important."

-Dana Berkeland, P-21: Biological and Quantum Physics."

"Too many of our world class scientists work in substandard labs; it is critical to the Laboratory's reputation of scientific leadership to fix this problem."

Letter from the Physics Division Leader

Physics Division uses its unique capabilities in basic and applied science to provide solutions to complex problems of local, national, and global interest in the areas of fundamental experimental science and national security. Our proud history and current mission require that we manage our facilities wisely while also looking toward additional mission challenges in the future. Being good stewards of our facilities helps assure our ability to accomplish our vital mission. The facilities that we use at the Laboratory are a critical element in maintaining our world-class scientific and experimental diagnostic leadership. Physics Division is very proud of its scientific accomplishments and looks forward to fulfilling future mission needs that require appropriate facilities now and in the future.

I support this plan as a tool to improve our current and future working and experimental environment so that we may continue to contribute to the Laboratory's excellence in science and national security over the next ten years and beyond. This Facility Strategic Plan will guide us in fulfilling our mission responsibilities and will provide the framework for sound development decisions as we meet our current and future requirements. This plan will guide our long-range planning and decision-making processes; it will guide our priorities to improve the quality of our work and lab spaces to help Physics Division attract and retain the best scientists in the world. This plan will also consolidate many Division functions to improve operational efficiency.

I encourage all those that are involved in decision making about our future workspace to take steps to improve the poor-quality space that our experimental scientists and technicians currently occupy. Laboratory management, administration, and computing space is well along the path of huge improvements, while light laboratory space continues to deteriorate. We will not be able to recruit and retain the best and brightest scientists without commitment and resolve to improve working conditions.

Susan J. Seestrom

Susan J Seestrom

Physics Division Leader

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List of Acronyms and Abbreviations

ADA Americans with Disabilities Act

ADSR Associate Director for Strategic Research

ADWP Associate Director for Weapons Physics

AS administrative support (Laboratory job series)

CAS condition assessment survey

CTX compact torus experiment

D&D decommissioning and demolition

DARHT Dual-Axis Radiographic Hydrodynamic Test (Facility)

FMRI functional magnetic resonance imaging

FMU facility management unit

FRX-L Field-Reversed Configuration Experiment-Linear

FSP facility strategic plan

FTE full-time employee

FWO-SSCM Facilities and Waste Operations Division Support Services Contract Management

FY fiscal year

GPP general plant project

HVAC heating, ventilation, and air conditioning

KSL KBR, Shaw, and LATA (Laboratory subcontractors)

LANSCE Los Alamos Neutron Science Center

LDRD Laboratory-Directed Research and Development

LIR Laboratory Implementation Requirement

M million(s)

MPF Meson Physics Facility (LANSCE bldg designation)

n/a not applicable

NIS Nonproliferation and International Security (Division)

NISC Nonproliferation and International Security Center

NTS Nevada Test Site

OS office support (Laboratory job series)

P Physics (Division)

P-21 Biological and Quantum Physics Group

P-22 Hydrodynamics and X-Ray Physics Group

P-23 Neutron Science and Technology Group

P-24 Plasma Physics Group

P-25 Subatomic Physics Group

P-DO Physics Division Office

PHENIX Pioneering High-Energy Nuclear Interaction Experiment

pRad proton radiography

RHIC Relativistic Heavy-Ion Collider

SM South Mesa

SNO Sudbury Neutrino Observatory

SSM specialist staff member (Laboratory job series)

TA technical area

TEC technician (Laboratory job series)

TSL Ten-Site Laboratory (TA-35 bldg designation)

TSM technical staff member (Laboratory job series)

TYCSP Ten-Year Comprehensive Site Plan

UC University of California

UCN ultracold neutron

EXECUTIVE SUMMARY

The Physics (P) Division Facility Strategic Plan (FSP) envisions a future where the employees of Physics Division and their laboratories are concentrated at (or near) Technical Area (TA) 3. Consolidation will improve interactions between scientists from P Division's groups and scientists from collaborating divisions by allowing more frequent and more intense collaboration. This increased synergy will enhance our ability to bring our world-class basic- and applied-research programs to fruition. The facilities proposed in this FSP are replacements for and upgrades to a 50-year-old infrastructure that now inhibits our progress in meeting the needs of the Laboratory's national-security mission and is becoming increasingly costly to maintain.

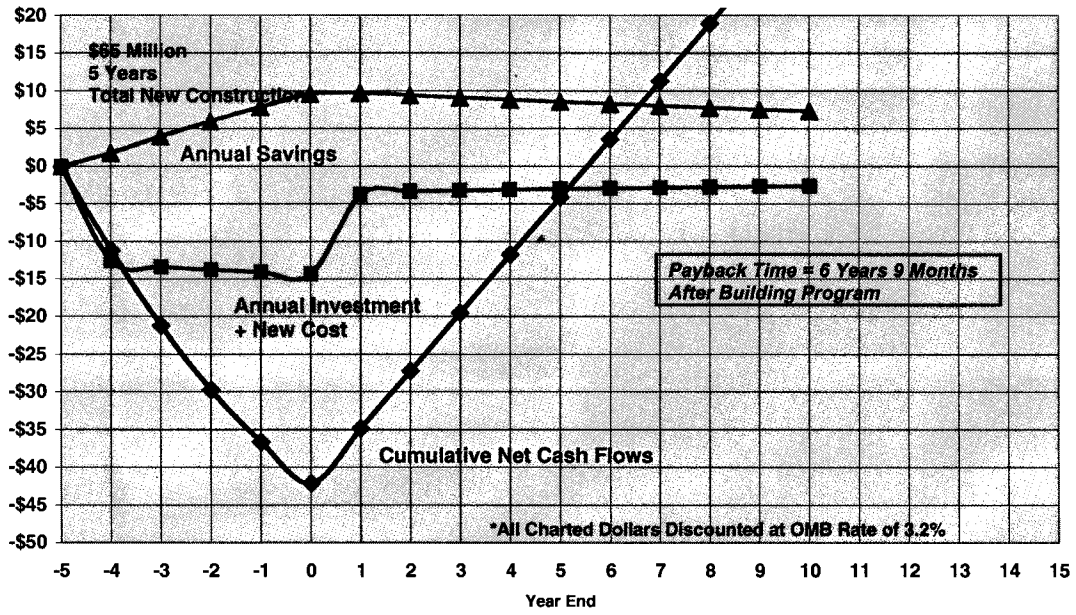
Our FSP offers alternatives to remedy the dual problems of dispersion of P Division personnel across three primary TAs (TA-3, -35, and -53)—and the resulting dilution of our research time and effort. It also addresses the increasing difficulties we face in occupying aging, deteriorating space and facilities. Much of our space has been pressed into service for functions for which it was not designed, and some has been occupied for decades despite its original "temporary" nature. This has had a negative effect on our efforts to recruit and retain the best scientists. The impact on P Division employees was exemplified in the 2002 checkpoint survey conducted by the Laboratory. Division responses to the productivity item "*Inadequate Laboratory infrastructure and facilities do not hinder my productivity*" received a 13% favorable score; ADWP and the Laboratory-wide scores were much more positive: 35% and 37%, respectively. In other words, 87% of the respondents believe that P Division's facilities and infrastructure ***do*** hinder productivity.

The P Division FSP envisions several alternatives—all of which would provide our staff with world-class space and facilities that will facilitate their research in a safe, secure, and productive environment proximate to each other and their other major scientific collaborators. Our FSP's major focus is the construction of new state-of-the-art physics facilities to co-locate physics research groups. This will enhance synergy between basic and applied physics through additional scientific interactions and collaborations; attract and retain top personnel; leverage cost savings through economies-of-scale and reduced maintenance costs; and position us to better support future Laboratory missions and growth activities.

The plan reviews Division and Laboratory goals, missions, and objectives (Section 1.0). Next, the plan details and summarizes the current deteriorating conditions of both the 50-year-old South Mesa (SM) 40 edifice, which has historically served as the P Division central structure, as well as the other facilities throughout the Laboratory, which our various groups occupy. A summary which applies the Division and Laboratory goals, missions, and objectives to the Division's current and projected space and operational issues, needs, strengths, and weaknesses is included (Section 2.0). P Division's Facility Plan and Vision is identified, which provides alternative solutions (Section 3.0). Finally, the Division's preferred solution is supported by a cost-savings analysis (Section 4.0).

With the assistance of the Decision Applications Division, we completed a cost-savings and financial analysis for the P Division FSP. The analysis, using information from the Sections 2 and 3 of this report, resulted in a payback time estimate after building completion of 6 years and 9 months. After construction completion, it is estimated that an average net savings of approxi-

mately $11.8 M per year (undiscounted) may be realized for several years if the preferred scenario of this plan is completed as written.



This document also calls attention to the significant roles and accomplishments P Division has made to the overall Laboratory mission since 1943 (*e.g.*, spawning six new divisions with major facilities and programs, fundamental research and discoveries leading to two Nobel prizes, etc.), as well as the impact it has today on the Laboratory's national-security and weapons missions. The argument for functional and efficient new facilities to further these precedents is obvious: current structures are outdated, unsafe, inefficient, extremely costly to maintain or modify, and far from optimal for scientific research and collaboration.

Developed in accordance with P Division's earlier submission to the FY03 (fiscal year) Ten Year Comprehensive Site Plan (TYCSP), this document follows all applicable Laboratory policies and procedures and remains consistent with the Laboratory's strategic mission and vision. The stated development strategy and construction scenario also fits well within the overall TA-3 Revitalization and Master Plan.

In short, P Division believes that drawing the staff and the majority of its laboratories together at TA-3 will increase our scientific productivity and improve our cost effectiveness for the Laboratory.

1.0 INTRODUCTION

This Facility Strategic Plan (FSP) for Physics (P) Division is intended to serve as a facilities roadmap that guides us in making essential facility-improvement decisions necessary to fulfill existing and future missions, as they are discussed in our Division Supporting Plan. We have also developed our plan within the context of the Laboratory's Ten Year Comprehensive Site Plan (TYCSP).

Physics Division was established in April 1943. It continues to serve, as it did during World War II, as an engine of new ideas for the national-security mission of the Laboratory and as a national resource for world-class basic research. It is at the interface of scientific disciplines and of basic and applied experimental research that new ideas emerge. Proximity to colleagues in other disciplines and within our own Division is key to enabling the development of those new ideas. Testing those ideas in experiments often requires state-of-the-art facilities. Facilities are a critical resource for all experimental science divisions, and P Division depends heavily on them to fulfill its mission.

Laboratory scientific facilities have been in decline for many years, and we will illustrate in this FSP that there are many substantive reasons why improving P Division facilities is crucial to continued success. We conduct precision experiments in 20- to 50-year-old buildings with inadequate infrastructure; we set up experiments in spaces never intended to serve as laboratories; staffing growth in the division over the last five years has surpassed the availability of adequate laboratory and office space. We are located in 3 primary technical areas (TA-3, -35, and -53) and the amount of time spent driving and parking to collaborate within the division and with other divisions is a substantial drain on productive time. These inhospitable environments are demoralizing scientists, which in turn affects productivity. These circumstances can and do result in compromises to safety and security and in an inability to attract and retain the best scientists in the world. We are finding it exorbitantly expensive to improve and even maintain old buildings that have been neglected for decades.

1.1 Goals

The goal of this plan is to enhance recruiting, retention, productivity, and scientific excellence; to enhance safety and security; to reduce the maintenance costs of facilities; and to reduce the overall Division square footage. Specifically, the benefits accrued from implementing this plan will

- provide scientists with state-of-the-art facilities to better perform world-class science;
- improve our ability to attract and retain the best scientists in the world with our first-rate laboratories;
- enhance synergy among scientists and minimize nonproductive travel/parking time by locating most employees in the TA-3 area;
- improve safety, security and productivity by designing space for the required functions with the right balance of lab and office, and classified and unclassified;
- reduce annual operating costs significantly by returning large amounts of space to the institution to be either destroyed or put into effective use for other needs; and

- reduce maintenance costs through the use of new facilities over the old.

Implementation of this plan will result in

- the demolition of several small general utility buildings east of South Mesa (SM) 40 and north of SM-502,
- the return of 50,000 sq ft of space (including the Atlas high bay) to the institution,
- a reduction in management and administration of 5% ($200 K),
- a reduction in Information Systems Support of 5% ($40 K),
- a reduction of maintenance and improvement work orders of 40% ($280 K),
- a reduction in property and financial support of 10% ($80 K), and
- a reduction in staff time spent driving and parking ($600 K annually).

The FSP achieves institutional goals of

- reducing the Division's footprint while planning for 10% growth in personnel (by 17%: 39,000 sq ft),
- reducing maintenance costs (by 30%: from $7 M to $4.9 M),
- improving the desirability and functionality of laboratory space,
- reducing P Division costs (by $600 K in the first year after the completion of construction), and
- increasing P Division productivity by co-locating personnel near major collaborators at TA-3 (at an annual cost savings of $600 K).

1.2 Mission Drivers

Physics Division plays a key role in the national-security mission of the Laboratory. The Division is successful in contributing to this mission because of its outstanding basic and applied research. Not only does it serve as an engine of new ideas for the Laboratory's mission, it also provides an institutional pipeline of strong scientific leaders and nurtures a disciplined culture of scientific inquiry and peer review necessary for the Laboratory to thrive. The fundamental basic-science research attracts the best and brightest to Los Alamos who then often become interested in the Grand Challenges of national security contributing both to the basic and applied missions. In order to attract the best, we need to offer state-of-the-art facilities that the Division currently cannot provide in many instances. In addition, attracting the best is more crucial now than ever as we anticipate a retirement rate of about 10% per year for the next several years in the scientist population of P Division.

1.3 Physics Division Mission

Our mission is to further understanding of the physical world, generate new or improved technology in experimental physics, and establish a physics foundation for current and future Laboratory programs. To support this mission, we conduct research in

- high energy-density physics;
- plasma physics;
- nuclear and particle physics;

- biophysics; and
- quantum information, science, and technology.

For 60 years, this Division has developed important new ideas from weapons diagnostics to nuclear and accelerator physics and enhanced radiography. These ideas have spawned six new divisions and have been critical, most recently, to grounding computer simulations and models in experimental data and in developing predictive capabilities for the Nuclear Weapons program. P Division continually develops ideas and concepts to address real-world problems. These contribute to areas such as stockpile surveillance and assessment, biological processes related to the human nervous system, chemical threat detection and mitigation, and information protection and compromise. P Division is a world leader in several key research areas important to national security, as evidenced by recent Division Review Committee reports and grades of excellent to outstanding in fields such as nuclear physics; quantum information, science, and technology; plasma physics; biophysics; and hydrodynamics.

We anticipate several facility needs that will surface with evolving mission needs and progress on current experimental approaches. Two of the biggest needs are

- improvements to the Trident facility needed to conduct experiments with nuclear materials and
- improvements at the Los Alamos Neutron Science Center (LANSCE) to enable user facilities for proton radiography (pRad) and for ultracold neutron (UCN) research.

With current progress in the area of brain mapping/neural computation, a small-mammal (rodent) research facility will be required to continue that breakthrough work. Experimental physics frequently requires the use of large (multi-ton) magnets and specialized machines that have specific facility requirements (such as Atlas) for installation and operation. Often we build large detectors for new facilities located elsewhere, for example, the muon detector built for the Relativistic Heavy-Ion Collider (RHIC) at Brookhaven National Laboratory; the construction of these large detectors require the availability of specialized space for device fabrication and assembly. And should the United States choose to recommence underground nuclear testing, P Division would play the key diagnostics and experimental roles that it played in the past. Several facilities would require upgrades before resuming a testing program.

Another important element of the P Division mission is to contribute to the Laboratory's pipeline of scientific leaders. Physics Division leaders have often served at the directorate level of the Laboratory, and one has recently served as Laboratory Director. In the last 18 months, four Physics Division managers have been selected for higher-level leadership positions in the directorate office and in other divisions. We endeavor to recruit the very best in the world in our scientific staff, the most competent staff in our technician and professional ranks, and develop them to serve the Division and Laboratory in scientific and administrative leadership roles.

Physics Division follows a set of guiding principles that we believe nurtures our staff and furthers their ability to contribute to our mission. Below is the summary version of those guiding principles.

- Our business is science and its application.

- Know what we are working on and why it is important.
- Respect others.
- Be creative—it is the Physics way.
- Recognize and reward distinguished contributions.
- Never stop learning.
- Hire and retain the best people.
- Know and walk your spaces.
- Seek peer review consistently.
- Maintain open doors and open communication.

We believe that through the implementation of our guiding principles, our focus on scientific inquiry, peer review, and intellectual freedom, we create a culture that develops staff to their capacity, prepares them for leadership positions throughout the Lab, and contributes positively to a healthy Laboratory culture.

1.4 Current Resources and Challenges

Forefront experimental research requires access to safe, secure, high-quality laboratories, equipment, and specialized facilities. P Division staff travel all over the world to conduct experiments both for basic and applied programs, and so they are familiar with state-of-the-art laboratory facilities. Based on our own assessment using criteria we thought most relevant,

- about 26% of our lab space is in poor condition and barely meets researchers' needs,
- another 24% is just fair, and
- about 30% of our staff share small offices, which inhibits productivity;

20% of our space at TA-53 is unacceptable by even the most generous standards (plywood- and pegboard-walled cubicles with no ventilation system) and about 9,000 sq ft of space is needed now to meet office and lab needs.†

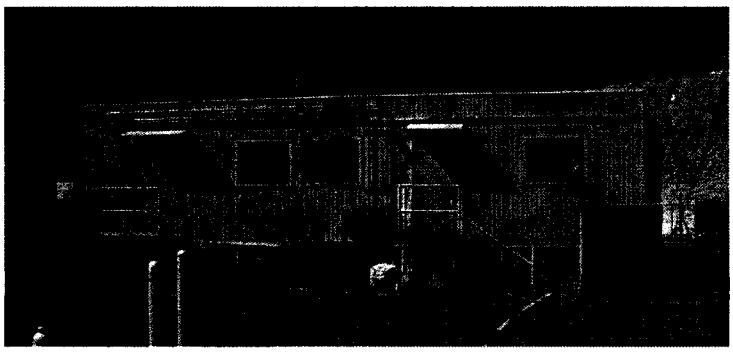


Figure 1.4-1. A photo of the exterior of MPF-575 at LANSCE. This is the space allotted to Tom Bowles to house international visitors who come here to participate in our world-leading UCN research.

† Data collected to support the claims made here can be found in Section 2.0 of this FSP.

Most of our work is carried out in three technical areas, TA-3, -35, and -53, and each presents a different set of challenges. In all locations we need better quality and more light lab and office space to enable forefront research. Many scientists work in cramped and unacceptably adverse conditions. Excessive hours are spent driving and parking to talk with collaborators (*e.g.*, a recent survey of Division technical staff indicated that more than three man-weeks, or about 3% of their time, were consumed ***every week*** by driving and parking, mostly between TA-3 and the other TAs). In fiscal year (FY) 2003, the Division spent $7 M on space, much of which is in poor condition and inadequate for its purpose (at least 25% of labs and 18% of offices). We are hard pressed, often failing, to provide the quality of space and facilities necessary to support excellent experimental physics research.

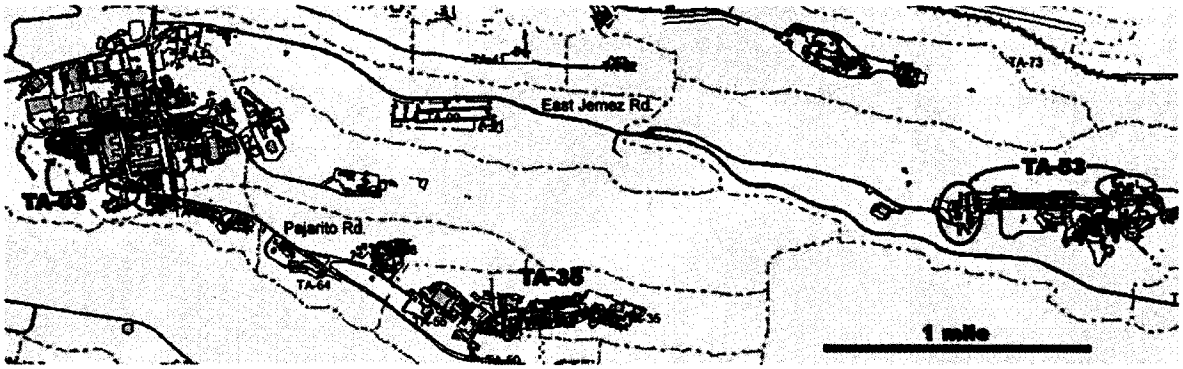


Figure 1.4-2. This map that spans several Laboratory technical areas illustrates the distance that separates P Division scientists. The buildings in which we occupy space are shown in red.

P Division recently remodeled lab and office space for the Quantum Institute, in SM-40, the Physics Building, which is over 50 years old. We incurred costs double the engineering and crafts estimates because infrastructure problems arose that could not be known at the time of design (*e.g.*, asbestos, undetected leaking pipes, electrical conduits crammed beyond capacity, etc.). In this plan, we will present data that demonstrate that building new labs and offices from scratch will be much more cost effective than attempting additional remodels in old buildings.

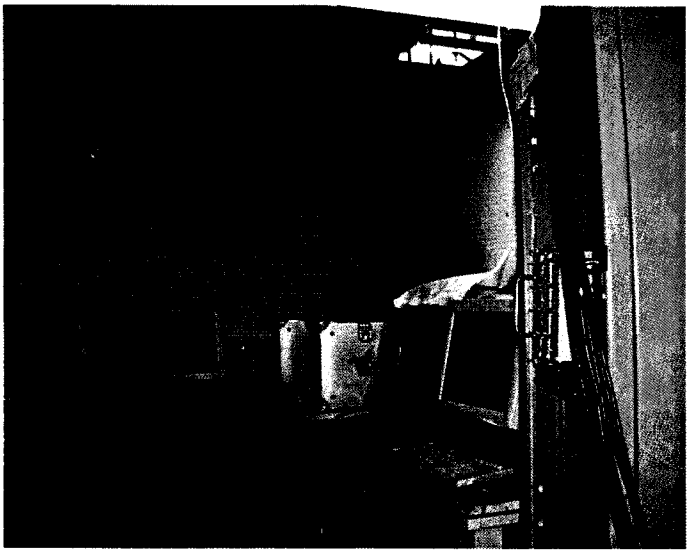


Figure 1.4-3. Another photo of Dr. Vincent Yuan's lab space in the basement of MPF-1 (through the doorway in the cover photo). Note the pegboard walls and lack of ceiling.

Physics Division has long been a valued contributor to the nation's security; but the current conditions of our labs and offices jeopardize that value and contribution. For P Division to remain competitive in world-class science and national-security missions, we must have high-quality space in which to work.

1.5 Strategy

Our long-term strategy is to co-locate as much of the P Division staff and operations as possible at TA-3 to gain synergies among the physics groups and to be near the majority of our collaborators (see Tables 2.5-1 and 2.5-2 on page 34 for more details). Physics Division does not own any real estate; therefore, we have no available land to site possible new buildings. Our planning scenarios involve multiple organizations and carefully sequenced events to meet the Laboratory's objectives as stated in the TYCSP. The goal of this plan is to

- enhance recruiting, retention, productivity, and scientific excellence;
- enhance safety and security;
- reduce facilities maintenance costs; and
- reduce the overall Division square footage.

2.0 PHYSICS DIVISION FACILITIES TODAY

2.1 Background

Physics Division currently has 392 people working in Los Alamos as employees and students (350), contractors (28), and deployed personnel from other Laboratory organizations (14).† They are located in 35 buildings at four TAs (TA-3, -35, -53, and -57). Projected growth is approximately 10% over the next five years. This means P Division will require both office and appropriate lab space for an additional 39 people. Significant facilities problems currently exist in all P Division locations.

2.1.1 TA-3

- Overcrowding in TA-3's SM-40 and SM-215 facilities.
- Insufficient unclassified space for students.
- Many labs in poor condition.

Figure 2.1-1. The labs for a retinal-study experiment in the basement of SM-40 (room E28). The graduate student in the right-hand photo barely has room to push his chair back from his workstation to stand up.

2.1.2 TA-35

- Time lost commuting back and forth between TA-35 and TA-3. This is particularly true of some P-22 personnel who must shuttle back and forth between TA-3 and TA-35 on a daily basis because the group has no unclassified space at TA-3.

Figure 2.1-2. In the lab where our staff is constructing the fast-pulse focusing coil for the Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility second axis (in TSL-125, room A100C at TA-35), technicians have narrow aisles and no open space to accomplish their tasks efficiently.

† These figures were drawn from the relevant Laboratory databases on March 31, 2003.

2.1.3 TA-53

- Severe overcrowding in TA-53's MPF-1 facilities.
- Labs and offices being sited in inappropriate spaces (*e.g.*, in basements with plywood-walled bullpen arrangements).
- Time lost commuting back and forth between TA-53 and TA-3.
- Insufficient classified office space and lack of classified data-acquisition facilities for pRad.
- Lack of essential shower facilities for cleanup/decontamination after working in explosives containment vessels.

Figure 2.1-3. Four photos of "lab" space in the basement of MPF-1 at LANSCE. The top-left photo is of a pegboard- and plywood-walled cubicle being used as a lab with an open overhead of the building utility systems. The top-right and bottom-left photos are of other ramshackle work-spaces that have been established in the MPF-1 basement. Shown on the bottom right is a typical doorway to these labs. These "doors" basically amount to the plywood cutouts of the door opening being hinged and used as the door. These pictures cannot convey the ambient noise level in this basement. All of these spaces are near the utilities plant spaces of MPF-1. A constant pervasive background noise of hissing, whirring, and clicking makes work and conversation in this environment difficult.

2.1.4 TA-57

- Minimal infrastructure and safety systems.

2.1.5 General Facility Issues

1. Geographic dispersal inhibits essential collaboration within the Division and with other divisions.
2. Many of our facilities are old and in poor condition. Old and poor-quality space is very expensive to improve and maintain.
3. Modern research practices necessitate more modern facilities; the cost to remodel labs and offices in old buildings is extremely expensive.
4. Security and safety criteria require better protection of materials and people, better achieved through good building design.

Overcrowding has resulted in personnel doubling up in cramped offices and getting by with laboratory space that is inadequate for current needs. Researchers attempt to overcome the geographic divide by spending significant commuting and parking time, resulting in a loss of productivity. A recent survey of 50 P Division technical staff personnel was analyzed to reveal 3 man-weeks were lost to commuting around the Laboratory by this group, ***every week***. Therefore, it is potentially true that for our 200-member research staff this figure could come to 600 man-weeks (of 10,000) annually or 6% of the staff's time. Furthermore, the need to maintain operations in multiple facilities results in increased cost because of redundancies in equipment and operating systems, such as waste removal, conference rooms, computer-server rooms, high-bay space, storage space (both common storage and large-item storage), and common space, which must be duplicated at each separate site.

Table 2.1-1
Laboratory Facility Condition Assessment Criteria

Building condition is considered...	if deferred maintenance is required at a cost of...	to...
excellent	less than 2%	2% of replacement plant value.
good	from 2%	less than 5% of replacement plant value.
adequate	from 5%	less than 10% of replacement plant value.
fair	from 10%	less than 25% of replacement plant value.
poor	from 25%	less than 60% of replacement plant value.
fail	if replacement is required because major deferred maintenance cost is greater than 60% of replacement plant value.	

The Laboratory's Condition Assessment System (CAS) assesses most of the buildings we occupy to be in "adequate" condition, but they do not serve P Division mission requirements effectively. This is primarily attributed to the age of the buildings—many are over 30 years old. Many buildings do not meet modern code and functional requirements. On average, the Divi-

sion pays $38.04 per sq ft annually for the space it occupies. If we look solely at the space we occupy at LANSCE, the annual amount is $64.60 per square foot.

The recently renovated labs in SM-40 for our new Quantum Institute cost $560 per sq ft. As a comparison, nearly $55M was spent for the 164,000-sq-ft Nonproliferation and International Security Center (NISC) for an average cost of about $335 per sq ft. This is an appropriate comparison as the NISC features offices, light labs with special capabilities, and classified space.

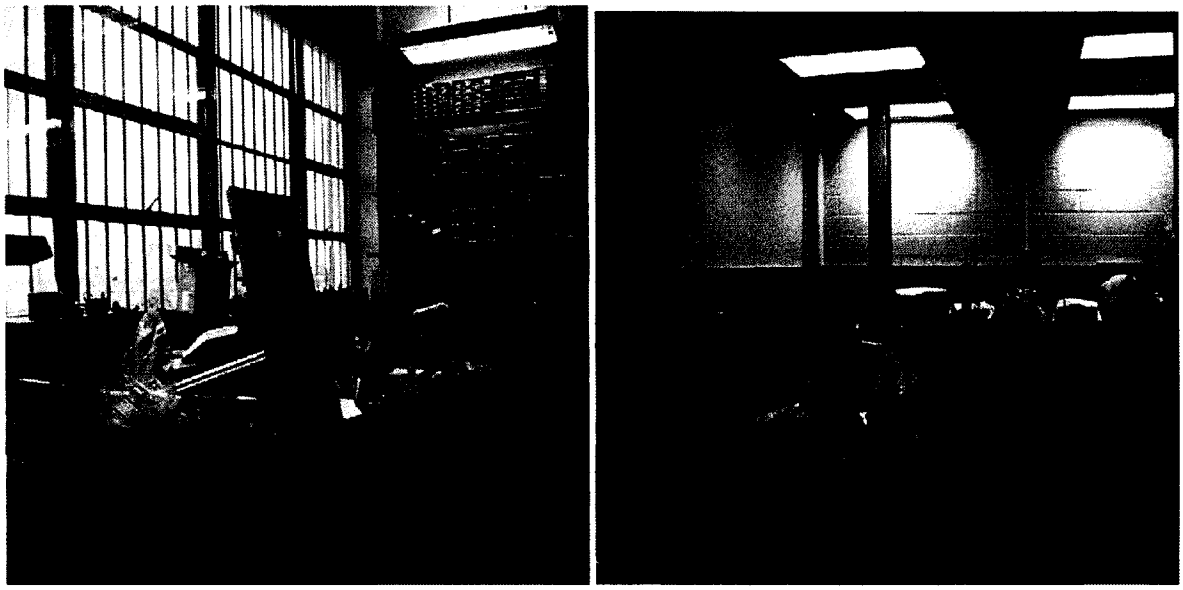


Figure 2.1-4. Before (left) and after (right) photos of a recently renovated Quantum Institute lab space in SM-40 (E137). Note the extensive remodeling needed to upgrade this laboratory including HVAC, electrical power, and new flooring.

Table 2.1-2
P Division Facility Use/Mission Suitability Assessment Criteria

Criteria	Parameters	Weighting
1. Infrastructure	Capacity of utility services is sufficient to meet demands of current use, up-to-date with code requirements, absence of asbestos and other toxic materials.	1
2. Working Environment	Adequate space per worker; proper control of temperature, ventilation, illumination, ambient noise, and rodents/wildlife.	1
3. Safety Systems	Proper fire protection, proper door interlocks, meets Americans with Disabilities Act (ADA) needs, and no radiological or hazardous materials requiring cleanup are present (*e.g.*, beryllium).	1
4. Security Systems	Adequate secure keyboard, vault, and monitor systems to meet classified computing requirements, sufficient distance between classified and unclassified offices.	1
5. Adjacencies	Sufficient proximity exists between collaborating groups within P Division (5a) and with our collaborating divisions (5b).	2
6. Maintenance Costs	Progress toward executing backlogged improvements, costs far less than new construction.	2

Table 2.1-2
P Division Facility Use/Mission Suitability Assessment Criteria

Criteria	Parameters	Weighting
7. Improvements	Cost to improve space is less than the cost of new construction.	2
8. Function	Space is designed for current use.	2

We will assess the condition of each major facility in which we occupy space against the Division's mission-specific suitability criteria in Table 2.1-2 and assign an overall grade from the choices below.

- **Good**: The facility's condition in this area meets our mission-specific requirements ***well*** and ***will probably*** continue to do so well into the next decade. The grade will stand on its own with no further explanation.
- **Fair:** The facility's condition in this area ***does not adequately*** meet our mission-specific requirements. Some deficiencies exist; these deficiencies will be described.
- **Poor:** The facility's condition in this area ***inhibits our ability to complete*** mission-specific requirements. The assessment will contain a description of the major deficiencies.

The criteria of Table 2.1-2 will be applied to each of our major buildings or operational sites. The grades assigned each criterion are: poor = 0, fair = 1, good = 2. Each criterion will be weighted. A weighting of 1 indicates the criterion, while important, is not presenting a systemic problem for us. Criteria where we believe systemic problems affect our mission are weighted as 2. A weighted score for each building or site is the sum of weighted scores (score multiplied by the weighting factor) and represents a judgment as to how each place meets our current needs and is an indication of where problems will lie for the future. A grade of "good" for all criteria would generate a maximum score of 24.

2.2 Physics Division Facilities Assessment[†]

2.2.1 TA-3 Facilities

[†] Contact the Physics Division Office to receive detailed data that supports this section.

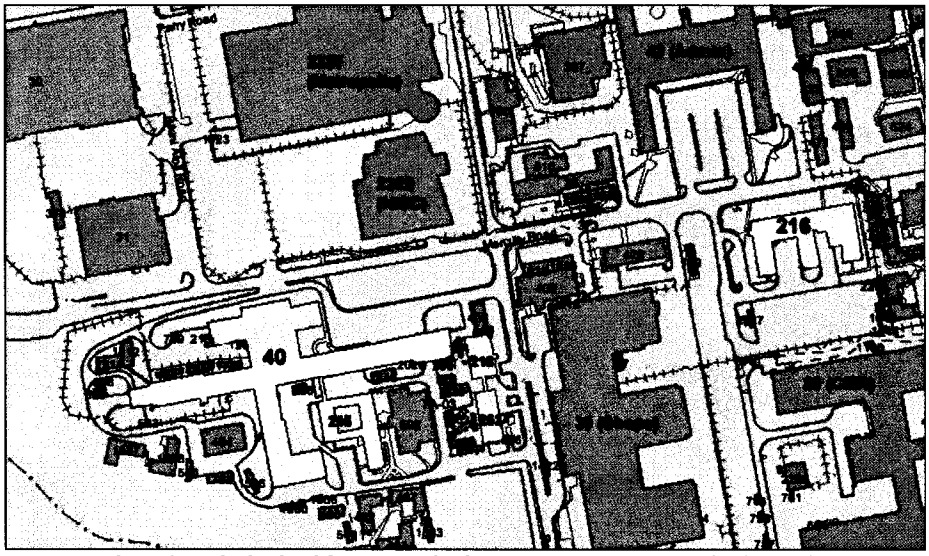


Figure 2.2-1. A map of TA-3 with the buildings in which we occupy space marked in yellow.

General: The TA-3 facilities are P Division's oldest set of facilities and the ones in the worst condition. The generally poor condition of the space we occupy in buildings such as SM-40 requires that we undertake extensive renovation efforts in order to make the space functional for new experimental efforts. For example, as we discuss in Section 2.1.5, we recently renovated several laboratory spaces for the new Quantum Institute at a cost of $560 per sq ft.

The quality of the space that we occupy in SM-40 is illustrated by another example as well. P-21 recently tried to convert an old photo lab in the basement of SM-40 into a research lab for animal experimentation. Our space conditions are such that this was the only location feasible for the proposed laboratory. However the institutional Animal Use and Care Committee deemed the space unfit for the habitation of live animals (in this case frogs). The Animal Care Standards required us to renovate the space for this new use—despite the fact that our people had been using this space as a laboratory for some time.

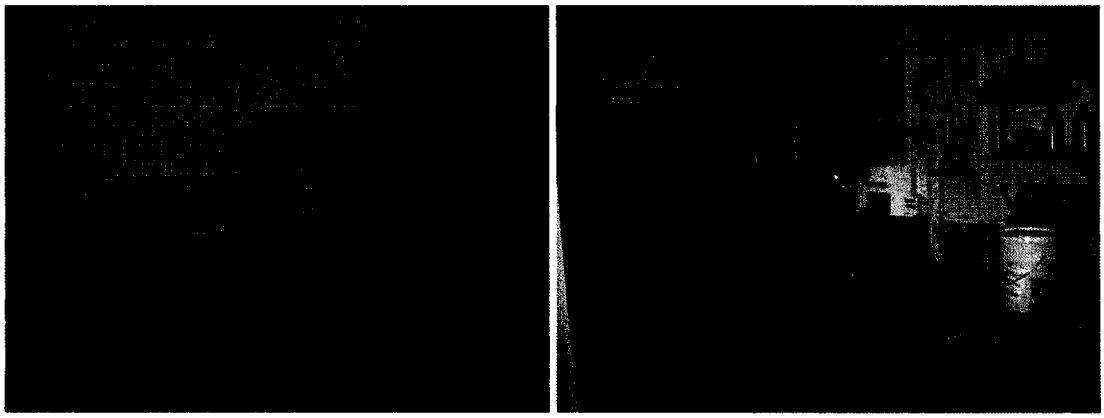


Figure 2.2-2. This is the "frog lab" (room E29A in the basement of SM-40) mentioned at the beginning of Section 2.2.1. Even after the renovations deemed necessary by the Laboratory's Animal Use and Care Committee, it is a cramped crowded space.

2.2.1.1 SM-40 (Physics Building)

The Physics Building is a 152,812-gross-sq-ft building built in 1953. P Division occupies 24,704 billable sq ft in the SM-40 building. Building tenancy and use are as follows:

TA-03-SM-40 (152,812 gross sq ft†)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	50 (132 sq ft/FTE)	6,598 (29)	12,294 (12)	2,120	1,767	1,925	24,704
EES Division	23 (139.1 sq ft/FTE)	3,200 (13)	3,018 (6)	1,416	334	200	8,168
HSR Division	n/a*	-	1,461 (5)	18	-	-	1,479
MST Division	55 (109.1 sq ft/FTE)	6,001 (31)	9,005 (28)	601	516	1,152	17,275
NIS Division	88 (138.0 sq ft/FTE)	12,140 (65)	12,936 (23)	5,688	1,909	7,564	40,237

† The difference between this figure and a sum of the billable space 'Total' column is the nonbillable space of the building [*i.e.*, hallways, stairwells, restrooms, equipment/mechanical rooms, and operating systems (*e.g.*, waste removal), etc.]

* n/a = "not applicable" because this Division has no staff with assigned offices in this building.

Assessment: The facility was originally designed to house cyclotrons. Since the 1960s, the building has been subject to several modifications both major and minor, some documented and some not. As a result, the electrical system has evolved over time such that its configuration is not fully known. SM-40 is not scheduled for replacement during the current TA-3 revitalization and the facility management unit (FMU) staff is not aware of any future replacement plans although the building is slated for some level of remodel in the "out years" of the revitalization effort.

Phase II (of IV) of an electrical-upgrade project is scheduled to begin in FY03 to improve the electrical at a cost of $2.5M. SM-40 also houses an old printed circuit board shop in the north wing, which contains equipment and surfaces that are contaminated with cyanide, mercury, lead, and other heavy metals left behind when the Mechanical Fabrication Division was disbanded in 1991. The space is presently in Phase II (of IV) of a decontamination project. In the past two years, ~$300,000 has been spent on heating, ventilation, and air conditioning (HVAC), window AC, and lab chillers in an effort to maintain the habitability of some of the SM-40 spaces occupied by P Division. Despite these efforts, many offices experience temperature fluctuations from 50°F in winter to temperatures over 100°F in the summer. The basement suffers from a lack of sufficient headroom; it was intended as storage space—never to be used as office or laboratory space. The clean room in the east high bay registers temperatures greater than 98°F—intermittently interfering with (and halting) operations. SM-40 contains a great deal of asbestos—which has been mitigated in place (*i.e.*, sealed in/encased). While this is sufficient for routine operations, whenever we engage in renovations to modernize a laboratory space, asbestos removal greatly increases the costs of the work (*e.g.*, recent upgrades to quantum information science labs cost $560 per sq ft—partially attributable to asbestos removal). Complete asbestos abatement in our SM-40 spaces will cost ~$50,000.

This building has a Deferred Maintenance Cost of $625,681 resulting in a CAS score of 'Excellent.' However, expensive repairs are required to ensure the continued health and safety of

P Division employees. These repairs include electrical upgrades, corridor ceiling repairs, fire-safety issues, roof repairs, HVAC upgrades, and potable water issues—at an estimated cost of ~$3,092,000. In addition, this facility requires the cleanup, disposal, and correction of unsafe conditions—at an estimated cost of ~$1,600,000.

An assessment using the P Division criteria in Table 2.1-2 rates SM-40 for offices as 9 on a scale where all criteria well met equals 24 points. Its rating for light laboratories is 8 out of 24. The major problems for both offices and labs are lack of adjacency for much of P-Division operations, high maintenance costs, and costing much more to upgrade space than to build new. We thus consider this poor space. WEIGHTED SCORE(S): Offices = 9; Labs = 8.

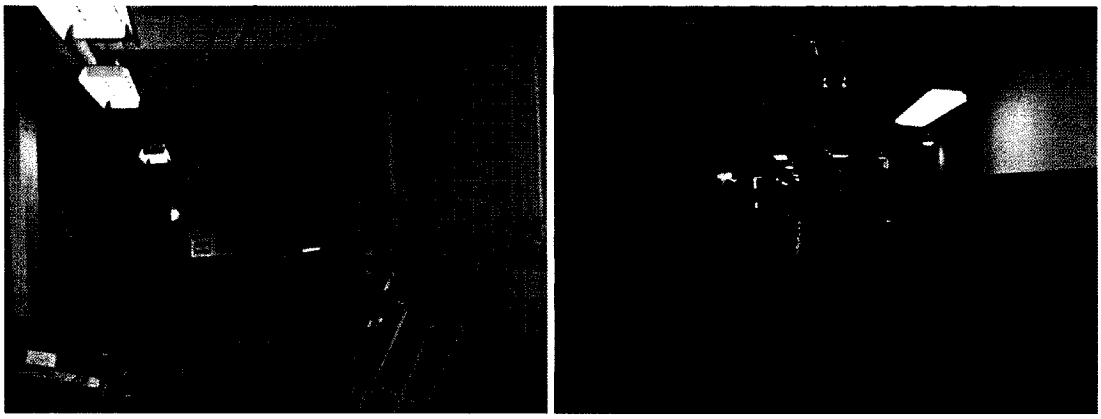


Figure 2.2-3. This "laboratory" space (left) in the basement of SM-40 is so undesirable that no researcher will take it. We use it for storage of old experimental components. On the right is the long dark hallway that researchers must use to enter their SM-40 basement laboratory spaces. Part of the problem is that the oppressiveness of these low, dark confining common spaces contributes to poor morale among the staff who must work in this area.

2.2.1.2 SM-215 (Physics Analytical Center)

The Physics Analytical Center is 26,393 gross sq ft and was constructed in 1968. Physics Division occupies 7,194 billable sq ft in the SM-215 building. Building tenancy and use are as follows:

TA-03-SM-215 (26,393 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	49 (101.6 sq ft/FTE)	4,979 (34)	-	1,490	325	274	7,194
EES Division	25 (191.2 sq ft/FTE)	4,781 (30)	-	466	231	180	5,658
NIS Division	10 (128.2 sq ft/FTE)	1,282 (9)	-	654	536	467	2,939

Assessment: This structure was designed as an office building and is occupied as such today. The offices are all adequately sized and the availability of conference rooms is sufficient. Upgrades to electrical and network services would allow its occupants access to the most modern technology available.

This building has a Deferred Maintenance Cost of $1,325,289 resulting in a CAS score of 'Excellent.' However, repairs are required to ensure the continued health and safety of P Division employees. These repairs are HVAC upgrades—at an estimated cost of $92,000.

For office space, this building rates 20 and is considered good overall. Our only concerns are increasing maintenance costs and that the costs of improvements, per square foot, is rising towards the equivalent replacement cost. WEIGHTED SCORE(S): Offices = 20.

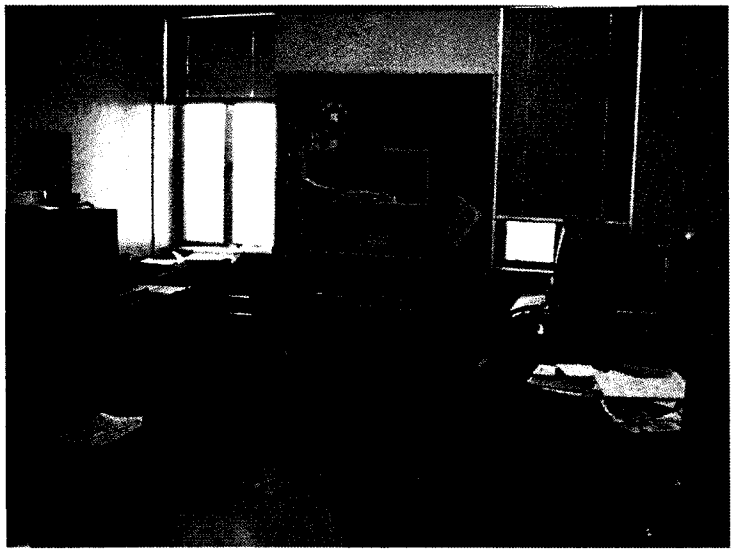


Figure 2.2-4. This 195-sq-ft office in SM-215 (room 113) houses four people (one workstation is off-camera at the left). That is 48-sq-ft per person, including space for the desk and their file cabinet or bookshelves.

2.2.1.3 SM-216 (Weapons Test Support)

The Weapons Test Support facility was constructed in 1968 and is 42,256 gross sq ft, 22,447 of which P Division occupies. Building tenancy and use are as follows:

TA-03-SM-216 (42,256 gross sq ft)							
	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
Tenant		Office	Lab	Storage	Conf.	Other	Total
Physics Division	53 (212.2 sq ft/FTE)	11,246 (68)	6,876 (15)	1,080	352	2,893	22,447
DX Division	34 (113.7 sq ft/FTE)	3,866 (23)	1,012 (5)	683	551	1,223	7,335
FWO	2 (138 sq ft/FTE)	276 (1)	-	-	-	-	276

Assessment: This facility houses both offices and light labs. The offices are large and well utilized. Infrastructure issues include the need for a new roof, heating and ventilation problems, and beryllium contamination. SM-216 is located in a secure area.

This building has a Deferred Maintenance Cost of $272,985 resulting in a CAS score of 'Excellent.' However, expensive repairs are required to ensure the continued health and safety of P Division employees. These repairs include a new roof, HVAC upgrades, and lighting repairs: at an estimated cost of $1,200,000.

The P Division score for this building is 11 for the office space and 12 for the lab space. The building infrastructure is only fair, as is adjacencies because the group is split between TA-3 and TA-35. Additionally, maintenance costs and the cost for improvement are both rated poor. This building is generally poor for our mission under current conditions. WEIGHTED SCORE(S): Offices = 11; Labs = 12.

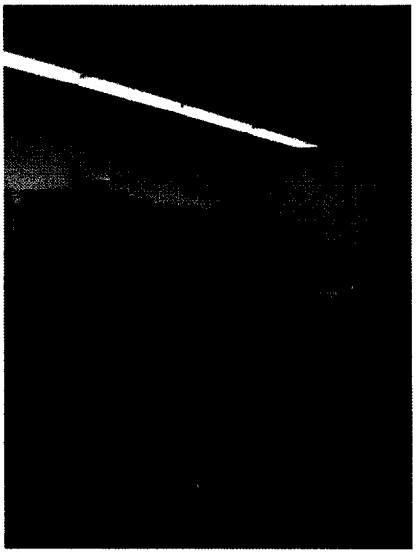


Figure 2.2-5. Lab space in the basement of SM-216 (room 8). The ceiling panels were opened to expose a leak (note the spot on the floor in front of the step-stool). Every time it rains, water comes down from the roof, through the walls, and then out into the ceiling of this lab—all despite numerous attempts to fix it.

Figure 2.2-6. This lab space in the basement of SM-216 (room 10A) is 10 ft by 15 ft with two small entryways (one is visible in the far left). This tiny crammed space is known locally as "The Sisyphus Memorial Laboratory" for reasons that are evident in the photo.

2.2.1.4 SM-218 (Prototype Electron Accelerator Lab)

The Prototype Electron Accelerator Lab facility was constructed in 1967 and is 6,615 gross sq ft. It contains a clean room, a large magnet, and a screen room. Building tenancy and use are as follows:

TA-03-SM-218 (6,845 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	n/a*	-	4,091 (2)	804	-	314	5,209

* n/a = "not applicable" because this Division has no staff with assigned offices in this building.

Assessment: This building has a Deferred Maintenance Cost of $10,907 resulting in a CAS score of 'Excellent.' However, repairs are required to ensure the continued health and safety of P Division employees. These repairs include HVAC upgrades—at an estimated cost of $87,000.

P Division criteria rate this building, and the adjacent SM-253, as 17. They both provide space for a variety of light-lab activities. The overall score of 17 indicates the structures can be considered fair in terms of our mission. The principal issues are that adjacencies are only fair because this separates a major P-25 asset from the majority of the group located at TA-53, the work environment and functionality of the building are only a fair match for the work, and safety and security systems were not designed for current uses and must be significantly changed as programs change. WEIGHTED SCORE(S): Labs = 17.

2.2.1.5 SM-253 (Magnetic Energy and Storage Facility)

The Magnetic Energy and Storage facility was constructed in 1966 and is 6,845 gross sq ft. It contains the SNO (Sudbury Neutrino Observatory) pool, FMU-2 personnel, and KSL Zone Personnel. Building tenancy and use are as follows:

TA-03-SM-253 (6,615 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	n/a*	-	380 (1)	-	-	-	380
FWO Division	4 (54.5 sq ft/FTE)	218 (4)	2,137 (0)	253	-	-	2,608

* n/a = "not applicable" because this Division has no staff with assigned offices in this building.

Assessment: This building has a Deferred Maintenance Cost of $20,124 resulting in a CAS score of 'Excellent.' However, repairs are required to ensure the continued health and safety of P Division employees. These repairs include electrical, roof, and HVAC upgrades—at an estimated cost of $47,500.

P Division criteria rate this building, and the adjacent SM-218, as 17. They both provide space for a variety of light-lab activities. The overall score of 17 indicates the structures can be considered fair in terms of our mission. The principal issues are that adjacencies are only fair because this separates a major P-23 asset from the majority of the group located at TA-53, the work environment and functionality of the building are only a fair match for the work, and safety and

security systems were not originally designed for current uses and must be significantly changed as programs change. WEIGHTED SCORE(S): Labs = 17.

Table 2.2-1
Summary of TA-3 Weighted Suitability Assessment Scores†

Building	Room Type	
	Office	Lab
SM-40	9	8
SM-215	20	n/a*
SM-216	11	12
SM-218	n/a	17
SM-253	n/a	17

† Total possible score is 24.

* n/a = "not applicable" because P Division occupies no space of this type in this building.

2.2.2 TA-35 Facilities

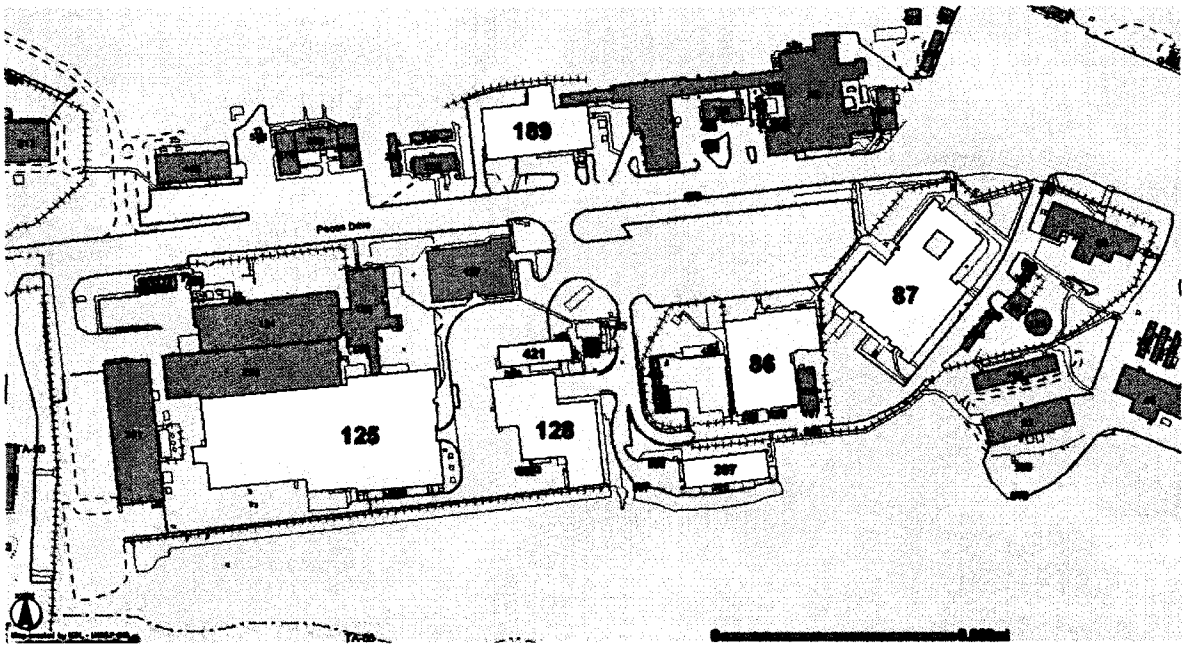


Figure 2.2-7. Map of TA-35 with the buildings in which we occupy space marked in yellow.

General: Of the buildings in which P Division occupies space, the buildings here are in the best condition. However, we have no reason to stay in TA-35 since the departure of the Atlas Facility to the Nevada Test Site (NTS) and the lack of collaborating divisions at the site.

2.2.2.1 TSL-86

Ten-Site Laboratory (TSL) Building 86 is an 18,284-gross-sq-ft office and lab facility constructed in 1977. P Division occupies 13,013 billable sq ft of this facility. Building tenancy and use are as follows:

TA-35-TSL-86 (18,284 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	34 (84.7 sq ft/FTE)	2,710 (15)	6,716 (3)	1,337	1,563	687	13,013
MST Division	n/a*	-	1,853 (3)	-	-	-	1,853

* n/a = "not applicable" because the Division has no staff with assigned offices in this building.

Assessment: P Division occupies mostly office space with a few light labs and conference rooms. The offices, labs, and conference rooms are adequate. However, the cooling system and roof both need to be replaced.

This building has a Deferred Maintenance Cost of $263,165 resulting in a CAS score of 'Good.' However, repairs are required to ensure the continued health and safety of P Division employees. These repairs include electrical, roof, and HVAC upgrades—at an estimated cost of $775,000 (this figure includes similar repairs to building 87).

P Division rates this building 18 for offices and 14 for labs. TSL-86 is a relatively newer building designed for offices and some light labs. Lab spaces are co-located with building utilities and have been cramped to the point of safety concerns in some instances. The major failing is that the P Division personnel located here are isolated from the rest of the Division and removed from most of their collaborators located at TA-3. As with most buildings this age, the electrical systems were not designed with the electronic office in mind, and thus infrastructure is graded as only fair. WEIGHTED SCORE(S): Offices = 18; Labs = 14.

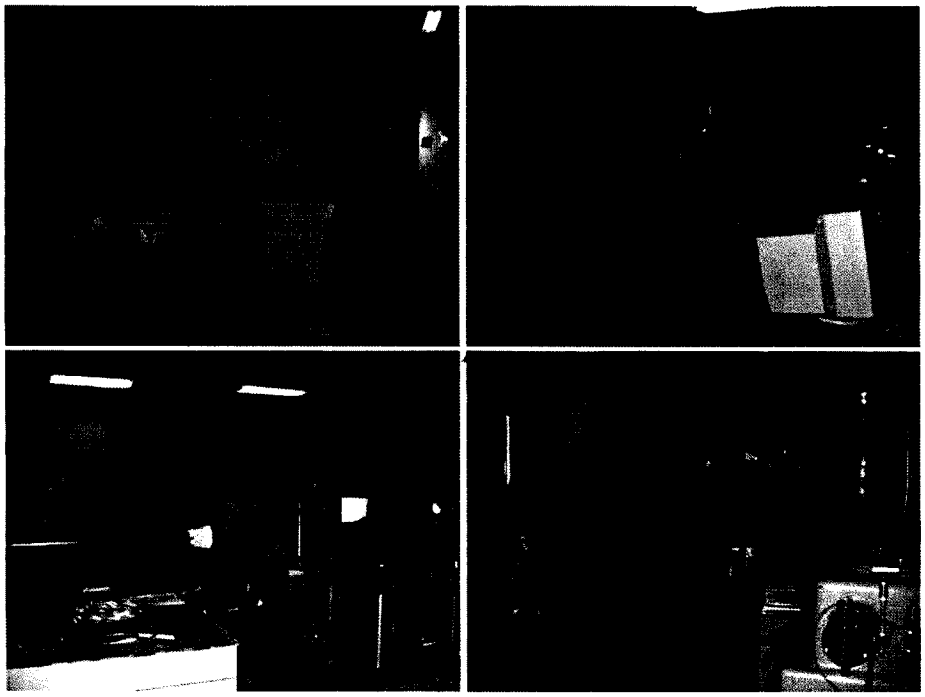


Figure 2.2-8. The first three views (from the top, left to right) are of room 101B in the basement of TSL-86 (at TA-35). The bottom-right-hand picture is of the pathway (through a storage area) to the emergency exit for this lab space.

2.2.2.2 TSL-87

TSL-87 is an office and light lab building, which is 39,267 gross sq ft and was constructed in 1977. P Division occupies 13,444 billable sq ft. Building tenancy and use are as follows:

TA-35-TSL-87 (39,267 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	36 (133.9 sq ft/FTE)	4,821 (27)	4,657 (10)	1,527	914	1,525	13,444
ADWP	5 (234.8 sq ft/FTE)	1,174 (5)	-	45	228	43	1,490
MST Division	1 (119.0 sq ft/FTE)	119 (1)	-	-	-	-	119
NIS Division	35 (151.1 sq ft/FTE)	5,289 (37)	-	71	299	3,040	8,699
C Division	12 (171.1 sq ft/FTE)	2,053 (17)	-	-	86	426	2,565
X Division	1 (119.0 sq ft/FTE)	119 (1)	-	-	-	-	119

Assessment: This facility contains high-quality classified office and lab space. The electrical system at present is not adequate to handle its current load and a cooling system. To ensure proper temperature control the electrical system must be upgraded. This building is in a secure area.

This building has a Deferred Maintenance Cost of $416,831 resulting in a CAS score of 'Good.' However, repairs are required to ensure the continued health and safety of P Division employ-

ees. These repairs include electrical, roof, and HVAC upgrades—at an estimated cost of $775,000 (this figure includes similar repairs to building 86).

Building 87 rates 19 for both offices and labs. The significant problem is lack of adjacency with the Division and all their collaborators. The infrastructure is fair and systems are aging or stretched to the limit. WEIGHTED SCORE(S): Offices = 19; Labs = 19.

2.2.2.3 TSL-125 (Atlas)

TSL-125 is 58,892 gross sq ft and was constructed in 1980. Physics Division occupies 13,746 billable sq ft of this office/laboratory facility. Building tenancy and use are as follows:

TA-35-TSL-125 (58,892 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	14 (203.6 sq ft/FTE)	2,851 (8)	6,457 (12)	-	-	4,438	13,746
MST Division	1 (169.0 sq ft/FTE)	169 (1)	-	312	-	94	575
DX Division	n/a*	-	-	-	-	94	94

* n/a = "not applicable" because the Division has no staff with assigned offices in this building.

Assessment: The Atlas project was recently housed in this facility and occupied 27,039 sq ft of heavy experimental space. The Atlas project is in the process of being dismantled and moved to NTS for continued experimental use. Currently there are no major infrastructure issues.

This building has a Deferred Maintenance Cost of $1,125,790 resulting in a CAS score of 'Good.' However, expensive repairs are required to ensure the continued health and safety of P Division employees. These repairs include electrical, roof, and HVAC upgrades—at an estimated cost of $1,580,000.

TSL-125 rates 17 for offices and 20 for labs. Two P Division groups maintain a common, well-equipped machine shop in the building. Some offices have been installed in rooms meant for labs and so the work environment and function are rated only fair. This is a good building for both light and heavy experimental laboratory space. The major drawback is lack of adjacencies. WEIGHTED SCORE(S): Offices = 17; Labs = 20.

2.2.2.4 TSL-128

P Division uses TSL-128 mostly as heavy laboratory space. This structure is 15,053 gross sq ft and was constructed in 1980. P Division occupies 7,078 billable sq ft. Building tenancy and use are as follows:

TA-35-TSL-128 (15,053 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	2 (127.0 sq ft/FTE)	254 (2)	5,983 (11)	741	-	100	7,078
ESA Division	n/a*	-	4,734 (2)	-	-	-	4,734

* n/a = "not applicable" because the Division has no staff with assigned offices in this building.

Assessment: There are no outstanding infrastructure issues with this facility. This building has a Deferred Maintenance Cost of $55,358 resulting in a CAS score of 'Excellent.' This building requires no urgent repairs.

TSL-128 offices rate 16 and the labs rate 19. The offices are perfunctory and provide a minimal work environment, while the lab space is generally good except that experiments of different organizations are located in close proximity to one another. WEIGHTED SCORE(S): Offices = 16; Labs = 19.

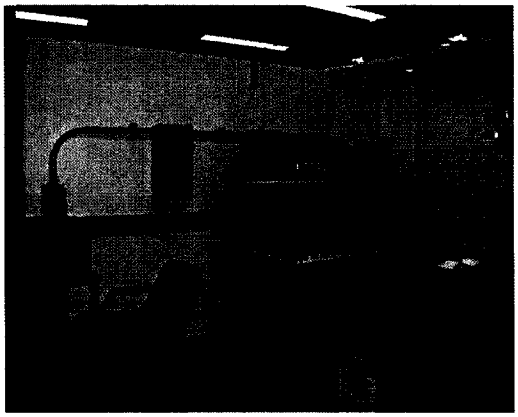


Figure 2.2-9. A technician's cubicle in the recently converted high-bay space in TSL-128 at TA-35. This space is in good condition but suffers from overcrowding as two technicians have desk and lab-bench space in this 9-ft by 16-ft room.

2.2.2.5 TSL-189 (Trident)

TSL-189 is 12,394-gross-sq-ft facility constructed in 1977 and occupied entirely by P Division. Building tenancy and use are as follows:

TA-35-TSL-189 (12,394 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	8 (121.1 sq ft/FTE)	969 (7)	8,720 (13)	126	264	197	10,276

Assessment: The Trident building is a multipurpose laboratory for developing instrumentation and conducting experiments requiring high-energy-laser light pulses. It is operated primarily for inertial confinement fusion research, weapons physics, and basic research and features flexible-driver characteristics and illumination geometries, broad resident diagnostic capability, and flexible scheduling. The facility includes a frequency-doubled, neodymium-glass laser driver; a high-vacuum target chamber; a basic optical and x-ray diagnostic suite; and ancillary equipment and facilities. The HVAC system currently in use is woefully inadequate and needs to be upgraded to fulfill its current mission.

This building has a Deferred Maintenance Cost of $101,796 resulting in a CAS score of 'Excellent.' However, expensive repairs are required to ensure the continued health and safety of P Division employees. These repairs include HVAC upgrade—at an estimated cost of ~$1,000,000.

Offices here are quite good with a rating of 20. As a laboratory, Trident rates only 16 because only fair HVAC affects the laser and optics. Maintenance costs are high because of the needed HVAC tight specifications for environmental control. WEIGHTED SCORE(S): Offices = 20; Labs = 16.

2.2.2.6 TSL-207

TSL-207 is 4,564 gross sq ft and was constructed in 1981. P Division occupies 2,667 billable sq ft. Building tenancy and use are as follows:

TA-35-TSL-207 (4,564 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	2 (43 sq ft/FTE)	86 (2)	2,496 (4)	85	-	-	2,667
MST Division	n/a*	-	846 (1)	-	-	-	846

* n/a = "not applicable" because the Division has no staff with assigned offices in this building.

Assessment: TSL-207 is essentially a light-lab building, which includes small office spaces in two of the labs. The labs are used for Plasma and Class I Laser experiments and electronic assembly.

This building has a Deferred Maintenance Cost of $82,851 resulting in a CAS score of 'Good.' However, repairs are required to ensure the continued health and safety of P Division employees. These repairs include HVAC upgrades—at an estimated cost of $70,637.

TSL-207 serves as a light laboratory space, with some small, embedded offices for the laboratory technicians. It rates 17 for offices and 20 for labs. WEIGHTED SCORE(S): Offices = 17; Labs = 20.

2.2.2.7 TSL-421 (Pulsed-Power Research Facility)

TSL-421 was built in 1994. This building is 5,679 gross sq ft; P Division occupies 2,233 billable sq ft. Building tenancy and use are as follows:

TA-35-TSL-421 (5,679 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	12 (166.8 sq ft/FTE)	2,002 (8)	-	-	190	41	2,233
MST Division	1 (109.0 sq ft/FTE)	109 (1)	2,171 (1)	-	-	-	2,280

Assessment: TSL-421 is essentially a two-story office building with a light-duty laser lab occupying much of the ground floor. Currently, P Division has 12 staff and students residing in this unclassified building. There are no infrastructure issues at this time that require anything other than routine building maintenance.

CAS data for this building is incomplete at this time. This building requires no urgent repairs.

The Division utilizes this space for offices, and as such it rates 20. The significant drawback is lack of adjacency to the rest of the Division and collaborators. WEIGHTED SCORE(S): Offices = 20.

Table 2.2-2
Summary of TA-35 Weighted Suitability Assessment Scores†

Building	Room Type	
	Office	Lab
TSL-86	18	14
TSL-87	19	19
TSL-125	17	20
TSL-128	16	19
TSL-189	20	16
TSL-207	17	20
TSL-421	20	n/a

† Total possible score is 24.

* n/a = "not applicable" because P Division occupies no space of this type in this building.

2.2.3 TA-53 Facilities (LANSCE)

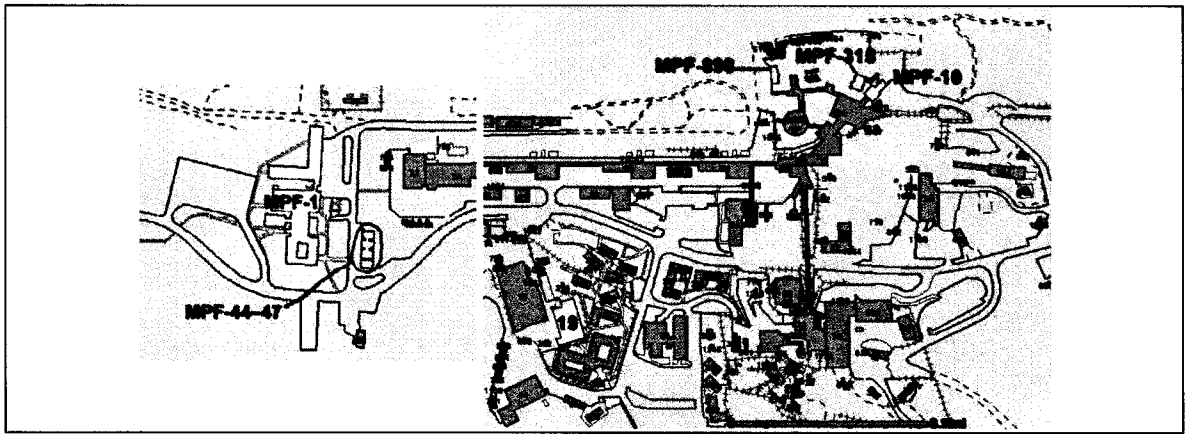


Figure 2.2-10. Truncated map of TA-53 with the buildings in which we occupy space marked in yellow.

General: Approximately 75% of this space is adequate. The remainder of the space that P Division occupies at TA-53 is among the very worst, for the uses we must put it to, in the entire Laboratory—some of these spaces were never meant for human occupation. Some of the leading physics researchers in the world work in office and laboratory spaces that would shame a gulag jailer.

New space for office and data acquisition supporting classified work is urgently needed to support ongoing proton radiography research.

Figure 2.2-11. Photos of D123 in MPF-1. Four technicians work in this lab. Physics instrumentation development is being conducted in a room still configured for long-past radiochemistry research with contamination still present in the vent hood behind the computer work station.

2.2.3.1 MPF-1

Figure 2.2-12. The lack of proper storage space in this building is so acute that a main hallway in C-Wing of MPF-1 is being used for this purpose. Most storage space in the basement has been converted into makeshift lab space.

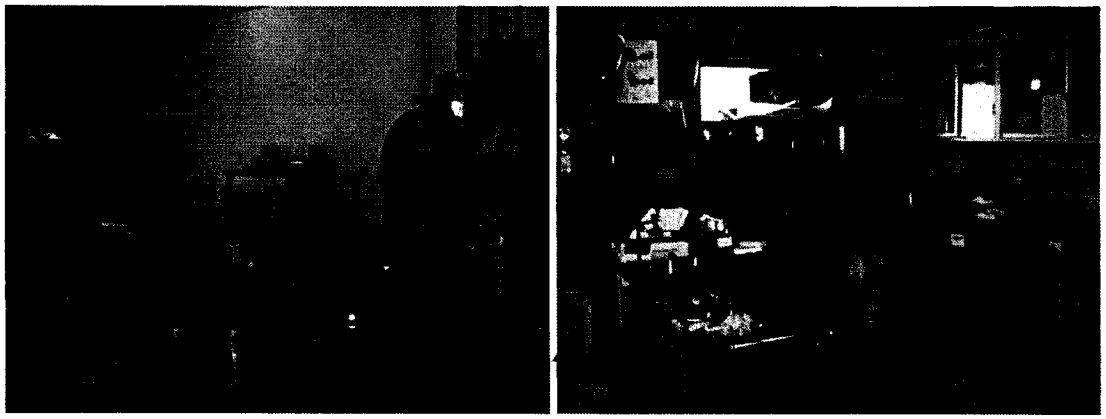


Figure 2.2-13. A machine shop space in MPF-1 (room C114A). Inadequate floor space results in machine equipment being placed in too close proximity. Rollaway cabinets "float" in the center of the space because of a lack of adequate wall storage space. And a computer workstation must be kept in an environment where it is exposed to filings and machine dust.

Meson Physics Facility (MPF) Building 1 is a 78,166-gross-sq-ft building constructed in 1971. Physics Division occupies 31,854 billable sq ft. Building tenancy and use are as follows:

TA-53-MPF-1 (78,166 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	117 (135.3 sq ft/FTE)	15,827 (75)	12,557 (35)	2,136	799	535	31,854
LANSCE Division	54 (181.4 sq ft/FTE)	9,796 (43)	481 (2)	60	2,703	-	13,040

Assessment: The facility was originally designed for offices and light labs and is currently used in this capacity. P-23 occupies space in both the C and D wings, and P-25 occupies space in the A, B, and C wings. The current HVAC system in C wing only controls temperature in the labs, not the offices. Radiators heat exterior offices and some are cooled by window units. D wing in MPF-1 has a central HVAC system. Both C and D wings were constructed with subterranean basements, which were originally designed for housing facility mechanical equipment and storage. The basements are currently also being used as housing for several labs and offices. Since the original design was for storage, the basement does not meet the required electrical or ventilation needs of laser labs, data-acquisition labs, or office space. This space currently does not meet electrical or ADA codes. An upgrade of electrical, HVAC, and water systems is needed. An upgrade to configure this space into proper laboratories or replacement facilities is essential to meet programmatic needs.

This building has a Deferred Maintenance Cost of $398,908 resulting in a CAS score of 'Good.' However, expensive repairs are required to ensure the continued health and safety of P Division employees. These repairs include electrical, roof, HVAC, waste mitigation, and water upgrades—at an estimated cost of ~$2,250,000

MPF-1 rates 14 for offices and only 7 for labs. Adjacency continues to be an issue, but overcrowding is even more of an issue. There is simply no space at TA-53 to accommodate the growth in P-23 and P-25. While offices are reasonably appointed for one and sometimes two

occupants, they are now being pushed to even higher occupancies. While labs in the C wing of the building may be thought fair or even good on an individual basis, the labs (and offices) established in the basement of the D wing are of poor quality with work proceeding under very trying circumstances. The overcrowding has led to major projects being transferred out to other groups and thus changing the receiving group's mission. WEIGHTED SCORE(S): Offices = 14; Labs = 7.

Figure 2.2-14. More lab space in the basement of MPF-1 at LANSCE. The left-hand photo is of a cramped lab space (room D7) crammed with equipment. The right-hand photo is of a laser light table being used in the industrial plant/mechanical room. This space is beyond the low wall (made of fibrous cardboard) at the back of the left-hand photo.

2.2.3.2 MPF-3 (Accelerator Injector)

MPF-3 is a 301,654-gross-sq-ft accelerator building constructed in 1971. P Division occupies 9,649 billable sq ft. Building tenancy and use are as follows:

TA-53-MPF-3 (301,654 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	n/a*	-	2,575 (5)	350	-	6,724	9,649
HFC-PO	n/a*	-	-	198	-	-	198
C Division	n/a*	-	526 (1)	-	-	-	526
LANSCE Division	4 (273.8 sq ft/FTE)	3,850 (4)	24,241 (35)	9,012	960	88,479	126,542

* n/a = "not applicable" because the Division has no staff with assigned offices in this building.

Assessment: MPF-3 houses the LANSCE proton linear accelerator, comprising a number of sectors that house its injectors, accelerators, beam transport, and experimental areas. Only the sector housing the control room is designed for offices. Several sectors house heavy experimental lab space where P Division routinely conducts research into basic neutron science and advanced radiography concepts.

This building has a Deferred Maintenance Cost of $8,042,460 resulting in a CAS score of 'Adequate.' However, expensive repairs are required to ensure the continued health and safety of

P Division employees. These repairs include electrical and HVAC upgrades—at an estimated cost of $8,500,000

P Division utilizes space in MPF-3 for some light labs but principally for the heavy experimental space. Light labs rate 8 and the heavy areas rate 24. The poor light-lab rating reflects that light-lab activities have been forced to find any spare nooks and crannies in which to conduct their work. The heavy space is specifically designed for the work in a suitable location. WEIGHTED SCORE(S): Light Labs = 8; Heavy Labs = 24.

2.2.3.3 MPF-10 (High Resolution Atomic Beam)

MPF-10 is a 1,527-gross-sq-ft building constructed in 1987. Physics Division occupies 1,317 billable sq ft. Building tenancy and use are as follows:

TA-53-MPF-10 (1,527 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	n/a*	-	1,260 (?)	57	-	-	1,317

* n/a = "not applicable" because the Division has no staff with assigned offices in this building.

Assessment: MPF-10 is a building designed for experimental particle physics at the end of the LANSCE accelerator's Line B. This lab recently served as the fabrication shop for the PHENIX Project.

This building has a Deferred Maintenance Cost of $0 resulting in a CAS score of 'Excellent.' However, repairs are required to ensure the continued health and safety of P-Division employees. These repairs include HVAC repairs and upgrades—at an estimated cost of $38,000.

P Division utilizes space in MPF-10 for experiment development and operation. It is "Heavy Experimental" space designed for receiving a particle beam from the LANSCE Accelerator. The heavy space is specifically designed for the work in a suitable location. WEIGHTED SCORE(S): Heavy Labs = 18.

2.2.3.4 MPF-19 (classified lab)

MPF-19 is a 15,075-gross-sq-ft building constructed in 1978. P Division occupies 1,416 billable sq ft. Building tenancy and use are as follows:

TA-53-MPF-19 (15,075 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	n/a*	-	1,416 (4)	-	-	-	1,416
NIS Division	2 (387.5 sq ft/FTE)	757 (2)	4,275 (4)	263	282	-	5,577
LANSCE Division	n/a	-	-	817	-	-	817

* n/a = "not applicable" because the Division has no staff with assigned offices in this building.

Assessment: MPF-19 is a light-lab building for classified work. This building has a Deferred Maintenance Cost of $98,054 resulting in a CAS score of 'Good.' However, repairs are required

to ensure the continued health and safety of P Division employees. These repairs include HVAC upgrades—at an estimated cost of $116,000.

MPF-19 rates 19 as a laboratory space. The major problem is lack of adjacency with the rest of the Division. The work in MPF-19 is not dependent on the LANSCE accelerator facility. WEIGHTED SCORE(S): Labs = 19.

2.2.3.5 MPF-44, -45, -46, and -47

MPF-44, -45, -46, and -47 are trailers used for office and some technician lab space. These buildings have 936, 982, 1,092, and 936 gross sq ft, respectively. P Division occupies 749 billable sq ft in MPF-44, 780 sq ft in MPF-45, 516 sq ft in MPF-46, and 734 sq ft in MPF-47. Building tenancy and use are as follows:

TA-53-MPF-44 (936 gross sq ft)							
		Tenant Occupancy (Billable Space, in sq ft)					
Tenant	Tenant Occupancy (Personnel, in FTEs)	Office	Lab	Storage	Conf.	Other	Total
Physics Division	6 (124.8 sq ft/FTE)	749 (6)	-	-	-	-	749

TA-53-MPF-45 (982 gross sq ft)							
		Tenant Occupancy (Billable Space, in sq ft)					
Tenant	Tenant Occupancy (Personnel, in FTEs)	Office	Lab	Storage	Conf.	Other	Total
Physics Division	6 (130 sq ft/FTE)	780 (6)	-	-	-	-	780

TA-53-MPF-46 (1,092 gross sq ft)							
		Tenant Occupancy (Billable Space, in sq ft)					
Tenant	Tenant Occupancy (Personnel, in FTEs)	Office	Lab	Storage	Conf.	Other	Total
Physics Division	6 (86.0 sq ft/FTE)	516 (6)	-	-	-	-	516

TA-53-MPF-47 (936 gross sq ft)							
		Tenant Occupancy (Billable Space, in sq ft)					
Tenant	Tenant Occupancy (Personnel, in FTEs)	Office	Lab	Storage	Conf.	Other	Total
Physics Division	4 (119.5 sq ft/FTE)	478 (4)	-	-	256	-	734

Assessment: MPF-44 through -46 each hold four offices. MPF-47 holds three offices and a conference room. These buildings were placed as temporary structures in the early 1970s and have deteriorated over the last 30 years. The temperature controls are inadequate to either heat or cool the buildings. There are also serious rodent-control issues.

- MPF-44 has a Deferred Maintenance Cost of $7,508 resulting in a CAS score of 'Fair.'
- MPF-45 has a Deferred Maintenance Cost of $7,215 resulting in a CAS score of 'Fair.'
- MPF-46 has a Deferred Maintenance Cost of $7,215 resulting in a CAS score of 'Adequate.'
- MPF-47 has a Deferred Maintenance Cost of $7,215 resulting in a CAS score of 'Fair.'

Each of these structures requires repairs to ensure the continued health and safety of P Division employees. These repairs include HVAC upgrades—at an estimated cost of $50,000 for each structure.

These buildings are of extremely poor quality, rating only a 5 out of 24. Designed as temporary office space, they are of a construction suitable for only a relatively limited time span, not the 30 years they have been in service. They are infested with rodents, with very poor environmental controls and power systems. WEIGHTED SCORE(S): Offices = 5.

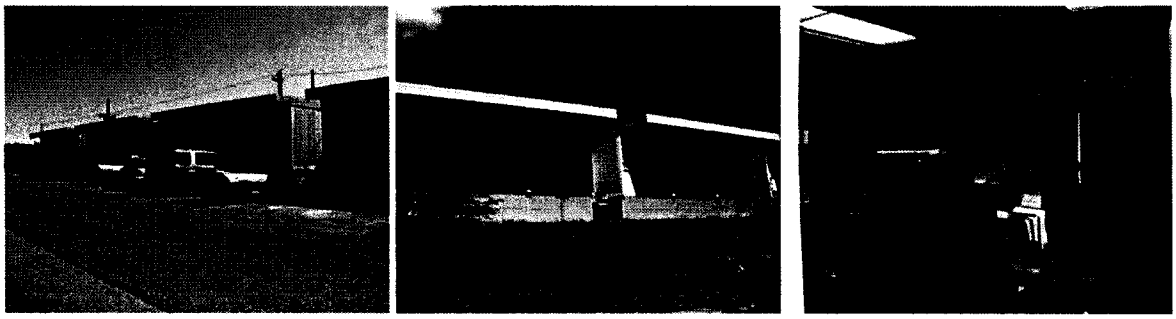


Figure 2.2-15. Exterior photos (front and rear) of MPF-44 through 47 at TA-53 and an interior photo of a typical office. In the right-hand photo a person barely visible in the center must stand up and move from a work area so the other occupant can pass to leave the room.

2.2.3.6 MPF-315

MPF-315 is a 1,665-gross-sq-ft building constructed in 1989. P Division occupies 1,291 billable sq ft. Building tenancy and use are as follows:

TA-53-MPF-315 (1,665 gross sq ft)							
	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
Tenant		Office	Lab	Storage	Conf.	Other	Total
Physics Division	n/a*	-	1,281 (1)	-	-	10	1,291

* n/a = "not applicable" because the Division has no staff with assigned offices in this building.

Assessment: MPF-315 was designed as a data-acquisition and control building; it is now used as a clean room and for other light lab activities. This building has a Deferred Maintenance Cost of $0 resulting in a CAS score of 'Excellent.' This building requires no urgent repairs.

MPF-315 rates 18. Its HVAC was not designed for its current function and so supplemental structures and systems are needed for the current work. It is not necessary to conduct this work at TA-53. WEIGHTED SCORE(S): Labs = 18.

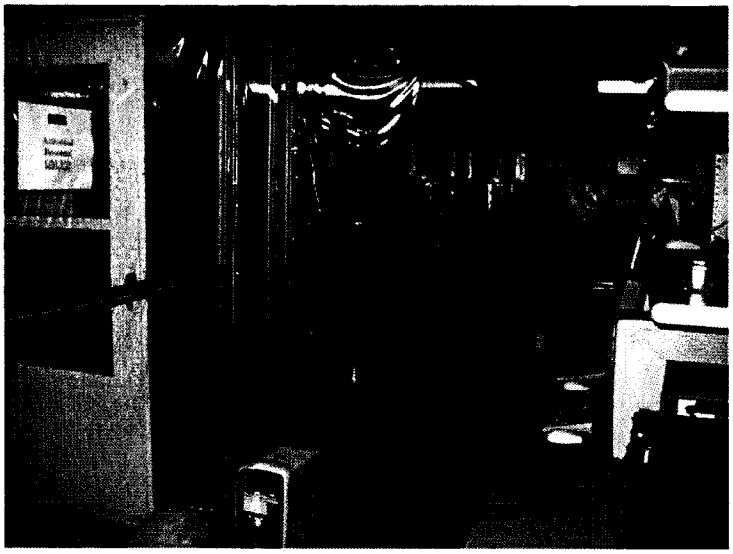


Figure 2.2-16. A photo of the detector-development lab in MPF-315, a P-25 space at LANSCE. Note the lack of proper space between the scientists' workstations and the clean-room workspace.

2.2.3.7 MPF-898 (Electronics Shop)

MPF-898 is a 1,588 gross sq ft transportable building emplaced in 1987. Physics Division occupies 1,303 billable sq ft. Building tenancy and use is as follows:

TA-53-MPF-898 (1,588 gross sq ft)							
Tenant	Tenant Occupancy (Personnel, in FTEs)	Tenant Occupancy (Billable Space, in sq ft)					
		Office	Lab	Storage	Conf.	Other	Total
Physics Division	4 (43.3 sq ft/FTE)	173 (4)	518 (1)		-	612	1,303

Assessment: MPF-898 contains an electronics lab, one shared office, and a small machine shop. This building has a Deferred Maintenance Cost of $0 resulting in a CAS score of 'Excellent.' This building requires no urgent repairs.

MPF-898 rates 14 for its office spaces and 18 for its shop and electronics lab space. It provides a needed capability for the adjacent experimental areas. It is a very cheap structure, and thus the cost of improvements would be equivalent to new costs. WEIGHTED SCORE(S): Offices = 14 Shops/Labs = 12.

Table 2.2-3
Summary of TA-53 Weighted Suitability Assessment Scores†

Building	Room Type	
	Office	Lab
MPF-1	14	7
MPF-3	n/a	8 (light) 24 (heavy)
MPF-10	n/a	1
MPF-19	n/a	19
MPF-44-47	5	n/a

Table 2.2-3
Summary of TA-53 Weighted Suitability Assessment Scores†

Building	Room Type	
	Office	Lab
MPF-315	n/a	18
MPF-898	14	12

† Total possible score is 24.

* n/a = "not applicable" because the Division occupies no space of this type in this building.

2.2.4 TA-57 Facilities (Fenton Hill)

General: The Laboratory's Fenton Hill site is located approximately 35 miles northwest of Los Alamos in the Jemez Mountains. The Laboratory has managed the Fenton Hill site for more than 25 years for the purpose of research and development. P Division, in collaboration with the National Science Foundation, currently operates the Milagro Project, a gamma-ray telescope. Milagro is the first example of a large continuous pool being used as a gamma-ray telescope. The telescope has a surface area equivalent to 3 football fields, is 25 feet deep, and holds more than 5 million gallons of water. The Nonproliferation and International Security Division's (NIS) Space and Remote Sensing Science Group (NIS-2) is conducting several astronomy projects such as RAPTOR, as well as the 30-in. Berkeley telescope. EES Division is currently in the process of closing out the Hot Dry Rock geothermal energy project. Closure of the EE2-A well and associated pond as well as clean up of the main site began in the summer of 2002. Remediation of the well and original pond should be complete by June of 2003. During the clean-up process, 14 buildings were salvaged, relocated, or demolished. P Division will retain ownership of building 74 (Milagro Counting House), building 115 (Office Trailer and Electronics Fabrication) and building 118 (Computational Lab), as well as the remaining structures on the Milagro site. Building 74 is a trailer used for data acquisition that was sited in 1987 and is 471 gross sq ft. Building 115 is an office trailer, which is 620 gross sq ft., and was sited in 1995. Building 118 was sited in 1969 and is 38 gross sq ft.

Building 74 has a Base Deferred Cost of $15,876 and a Deferred Maintenance Cost of $27,167, but because the HVAC failed, the resulting CAS score is that of 'Fail.' Repairs are required to ensure the continued health and safety of P-Division employees. These repairs include HVAC repairs and upgrades—at an estimated cost of $26,173.

Building 115 has no current CAS data.

Building 118 has a Deferred Maintenance Cost of $0 resulting in a CAS score of 'Excellent.' This building does not require any repairs or upgrades at this time.

The few P Division structures at TA-57 rate 14 for both offices and lab spaces. Offices are housed in low-cost trailers as are the majority of labs. The general concerns are vulnerability to forest fire, and the costs of services and maintenance are relatively equal to the cost of the structures. WEIGHTED SCORE(S): Offices = 14 Labs = 14.

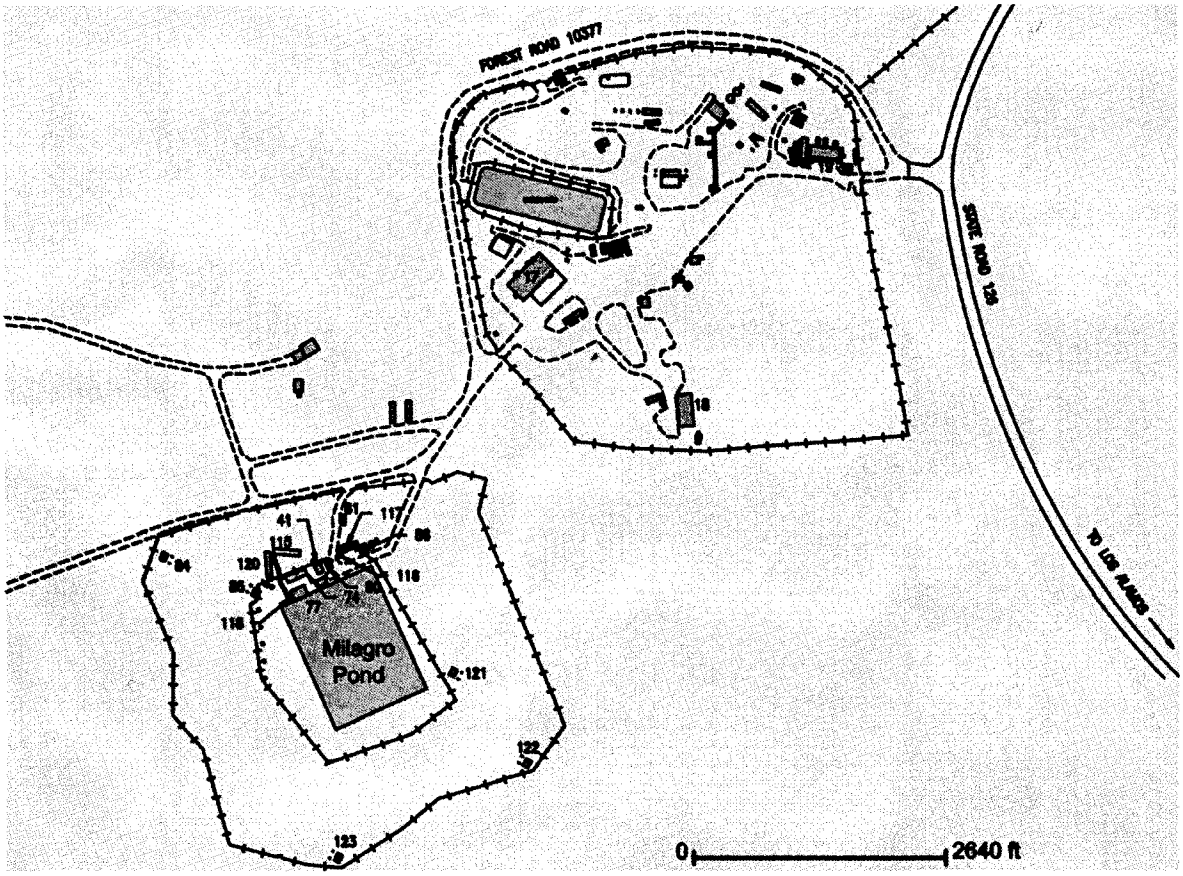


Figure 2.2-17. Map of TA-57 with the buildings in which we occupy space labeled in red.

2.3 Division Personnel

P Division currently employs about 391 staff and students, contractors, and deployed personnel. Approximately 10% of the population at TA-35 and -53 are office workers. This number is ~20% at TA-3.

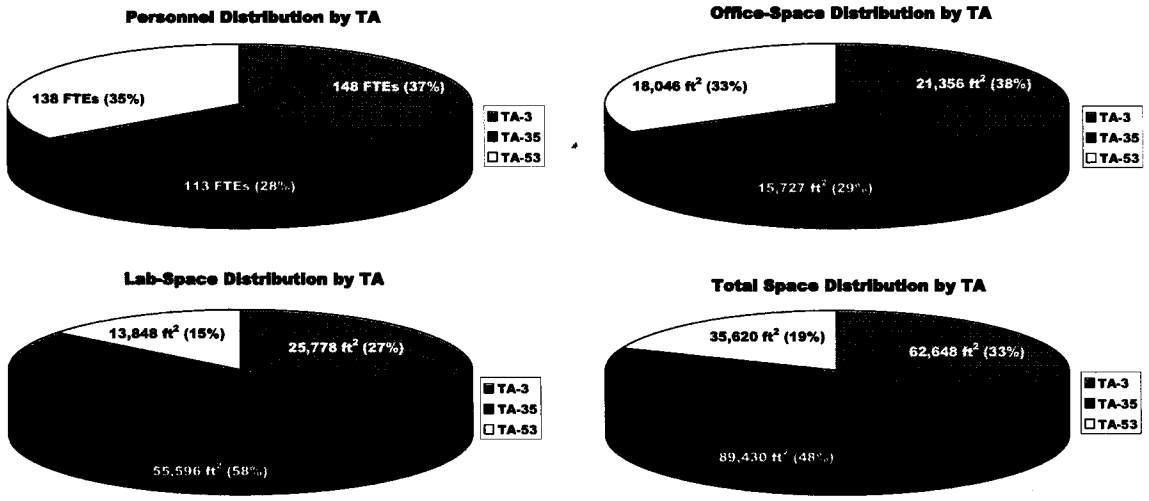


Figure 2.3-1. Physics Division personnel and space distributions across the major TAs we occupy.

2.4 Equipment

P Division conducts experiments in a wide variety of physics disciplines, using numerous technologies. The physical scale of these technologies varies from bench-top, light-lab operations to those requiring large bays or halls with heavy-equipment access, high-capacity overhead cranes, heavy-duty utility supplies, and high-radiation shielding. The heavy laboratory space described below will be retained along with some nearby offices. These labs and offices will continue to be used while personnel develop new experiments and then run them.

- The LANSCE accelerator facility at TA-53 provides nuclear particle beams for use in neutron research and proton radiography. Several of the heavy-duty experimental facilities at LANSCE will continue to be utilized by P Division researchers for the foreseeable future.
- The FRX-L (magnetized target fusion) and CTX (plasma acceleration) experimental devices at TA-35-128 require a heavy-duty, high-bay location with crane coverage. These devices also require large electrical supplies, water-cooling, and floor space.
- A wide variety of x-ray generating devices are developed and employed by the Division as diagnostic tools for dynamic systems. Similarly, a wide variety of lasers are utilized in the Division, either as diagnostic tools or as principle experiment drivers.
- The Trident laser facility is a dedicated high-powered laser driver used in inertial-confinement-fusion studies and the development of advanced diagnostics. Its large size has necessitated a dedicated building for the device and its operating/research team.

- The Milagro detector makes advantageous use of a five-million-gallon pond at the Fenton Hill site. The altitude, over 8,000 feet, is important for operating the detector with the desired sensitivity and detection range for cosmic rays.
- A large, air-cooled superconducting solenoid magnet is used for functional magnetic-resonance-imaging (fMRI) development and studies. Control of the widely distributed fringe of the magnetic field requires large, thick, very heavy plates of iron and a wide buffer area (tens of feet) in a high-bay space.
- Pulsed-power electrical machines with large capacitor banks are occasionally developed to support specific physics research. Devices operating at cryogenic temperatures are frequently utilized, as are microwave and radio-frequency generating devices. Specialized detector and sensor development, fabrication, and testing are essential capabilities in the Division. Biophysics experiments utilizing animal and human subjects are occasionally conducted and need specialized areas for dealing with sensitive living subjects. High-pressure water is often needed for cooling experimental apparatuses.

2.5 Organizational and Functional Adjacencies

Table 2.5-1
Division Functional Adjacencies Matrix

Group \ Division	B	C	DX	LANSCE	MST	NIS	T	X
Biological and Quantum Physics (P-21)	△	△	■	■	△	●	△	■
Hydrodynamics and X-Ray Physics (P-22)	■	■	●	■	△	■	■	●
Neutron Science and Technology (P-23)	■	■	●	△	■	■	■	●
Plasma Physics (P-24)	■	■	■	■	●	■	△	●
Subatomic Physics (P-25)	△	■	●	△	■	●	●	●

Legend: ● = High: groups interact on a daily basis; adjacencies required.
△ = Medium: groups interact frequently; adjacencies highly desired, but not required.
■ = Low: groups interact rarely or not at all; adjacencies not required.

Table 2.5-2
Location of Collaborators with a High-Demand (●) Adjacency Requirement

Group	TA-3	TA-15	TA-22	TA-35	TA-53
P-21	NIS-2, -3, and -4				
P-22	X-1, -2, -4, and -5	DX-3 and -7	DX-1		P-23
P-23	X-1, -2, -4, and -5; P-22	DX-3 and -7		P-22	P-25
P-24	X-1, -2, -4			MST-7	
P-25	NIS-2, -6; X-1, -4; T-5;	DX-3			P-23

P Division has a long history at the Laboratory of generating "spin-off" divisions because of its ability to readily work between groups in pursuit of developing new ideas. Staff members should meet and talk without having to schedule a meeting and drive to get there. The dispa-

rate groups of the Division now work in relative isolation, and the interaction level among the staff is greatly decreased.

Groups P-22, -23, -24, and -25 have significant interactions with X-Division groups, particularly X-1, -2, -4, and -5. Most of these P Division groups are not located at TA-3, whereas all X-Division groups are. These are among P Division's strongest interactions.

Groups P-22, -23, and -25 also have strong interactions with a few DX-Division groups, particularly DX-1, -3, and -7 located at the southwestern end of the Laboratory. Our groups P-23 and -25 are located at LANSCE (TA-53)—the northeastern end of the Laboratory. Only parts of our P-23 and -25 staff require space at TA-53—and then only when they have active experiments under development and/or execution.

2.6 Strengths, Weaknesses, Opportunities, and Threats Analysis

Laboratory reorganizations since 1990 have had the effect of dispersing P Division from a relatively compact configuration centered in TA-3 to a sprawl across TA-3, TA-35, and TA-53. Some groups have had elements scattered across multiple areas of these widely separated TAs. Let us now consider how the current structures housing Division activities affect the Division and its mission.

2.6.1 Strengths

TA-3: P-DO and P-21 are co-located in the "Physics Complex" of buildings 3-40, 3-215, and 3-218. SM-40 is currently undergoing renovation of its electrical power systems and houses some newly renovated laboratories for P-21. SM-215 has a good office environment. SM-218 provides open space and utility infrastructure for clean rooms and the medium-scale experimental apparatus of P-21.

P-22 has good office space and light laboratories in 3-216. The laboratories are in the vicinity of the staff offices. This large building is within the TA-3 security fence, providing adequate space for classified work.

TA-35: Groups P-22 and P-24 are major tenants of buildings 86, 87, 125, 128, 189, 207, and 421. TSL-86, -87, and -127 are relatively modern office structures with some light-lab space in TSL-86 and -87. TSL-87 is behind a security fence and provides adequate classified workspace for P-24. TSL-125 and -128 offer good space for medium- and large-scale experimental operations requiring high bays or large spaces. TSL-207 provides a number of light-lab spaces. TSL-189 is dedicated as the site of P-24's Trident laser facility. TSL-421 provides space for about 8 small offices and a large room accommodating a bullpen arrangement for about 10 people.

TA-53: P Division groups P-23 and P-25 have large portions of their groups co-located in MPF-1. MPF-1 also provides some light-lab space for both groups, and a wing supports a classified office work environment. Both P-23 and P-25 utilize the LANSCE User Facility for collaborative work in proton radiography and fundamental neutron research.

2.6.2 Weaknesses

TA-3: SM-40 is a 50-year-old building. Many offices occupy converted laboratory space with high ceilings. Environmental controls are antiquated with heating and air conditioning systems in need of extensive upgrade. Frequent hot-water heating system leaks have repeatedly flooded rooms and leaked through to lower-level occupants, damaging office materials and computer equipment. Labs dealing with potentially hazardous materials and energies are intermixed with administrative offices. The advent of the modern electronic office environment has strained the electrical power supply capacity to its limit; small additional loads trip breakers feeding multiple rooms. Large, high-volume copiers are sited either in hallways or located in staff offices. Elevators usually do not work even though they have been serviced many times. Staff frequently carries bulky equipment up and down stairs, often without using the handrails because of the nature of the burden. Renovation and repair is becoming increasingly expensive. Laboratory space is severely limited. The near vicinity has no room for expansion for either P-DO or P-21 for either offices or laboratories.

SM-215 cannot support P-21's anticipated growth needs, is already crowded, and is in need of electrical and computer-network upgrades.

SM-216 cannot support P-22's unclassified space needs for visitors, students, and recent hires. Many uncleared P-22 personnel are housed in temporary or permanent quarters at TA-35, a significant distance from their colleagues. This building is also in need of large-scale roof repairs and extensive ventilation upgrades.

SM-218 sits adjacent to a street and a small office structure. An experimental magnetic apparatus in the building affects equipment in the adjacent office structure and those co-located in SM-218. Liquid helium is stored immediately adjacent to parking areas, and magnet quench cold gasses ventilate very near areas occupied by non-technical personnel with little understanding of cryogenic systems and magnetic energies and to passersby in the street and parking area.

Parking areas around the complex are frequently crowded and vehicles frequently block fire lanes and areas directly in front of a number of building exits.

TA-35: TSL-86 and -87 need electrical and HVAC upgrades. TSL-86 experiences a number of roof leaks.

TSL-189 needs extensive HVAC upgrades to support stable operation of the laser and a new roof.

The current space offers no room for personnel growth in the programs, outside of subdividing the high bays of TSL-125 with office cubicles. Some team members are geographically dispersed because of the lack of contiguous office or experimental and support areas.

TA-53: P-23 is experiencing severe overcrowding in the available space in MPF-1 and has inadequate or very inappropriate light-lab space in that building. There is no room for

relief. There is inadequate space for classified analysis activities. A significant portion of group space, in the basement of MPF-1, is inappropriate for the uses the group must put it to. Lack of a classified data-acquisition area for proton radiography forces a cumbersome process of converting normally unclassified space into a secured work area for classified experiments. Some staff members occupy over 30-year-old temporary buildings with inadequate HVAC controls and continuous rodent-infestation problems. Some operational and support activities in the experimental areas are hampered by a lack of amenities such as changing rooms, showers, and toilet facilities. There is no room to co-locate continuous collaborators from DX-Division.

General comment on weaknesses of P Division space. Division staff members have become geographically separated and are less able to engage in the multidisciplinary approach to physics engendered by close association of a wide variety of experimental scientists.

2.6.3 Opportunities

TA-3: The pending move of HSR-2 could make available the current occupational medicine facility footprint for a general plant project (GPP) office and laboratory structure supporting P-21's growth in the quantum information science and technology field.

TA-35: A potential significant decrease in NIS Division presence at TA-35, caused by NIS staff moving to the new NISC building at TA-3, could make more classified space available in TSL-87, which would give P-24 room for growth in classified programs, but this will not help P-22's need for unclassified space, let alone help with achieving proximity to P-22's main operation at TA-03/SM-216.

TA-53: LANSCE has proposed a GPP project to construct an additional classified office area near the existing P-23 classified office wing of TA-53/MPF-1. This would give P-23 limited room to reduce, though not eliminate, the overcrowding.

A GPP proposal is being prepared to construct additional space in the experimental area to accommodate separating the classified and unclassified data-acquisition functions and provide for additional operational-support space.

2.6.4 Threats

TA-3: P-21 will be unable to pursue current research directions involving biotoxins and animal subjects in the current facilities, and the nationally recognized excellence of the rapidly developing quantum information, science, and technology field at the Laboratory will be compromised by lack of adequate office and laboratory space. P-21 will lose ability to recruit the excellent staff needed for well-regarded programs.

Projects requiring space upgrades, funded by the Division, are becoming very difficult to support because of the costs for modifying old facilities.

P-22 will be unable to recruit or retain some staff because of inadequate co-location of staff working on both classified and unclassified projects.

Physical access to the Division Office from outlying sites is already compromised by the lack of available parking and will become worse when the new NISC building is occupied.

TA-35: P Division facilities in this area may become subject to access restrictions because of their location along the "nuclear corridor." Current space limitations adversely affect the group's abilities to recruit because of inadequate uncleared office space.

TA-53: P Division groups are becoming unable to recruit because of lack of adequate facilities. Groups have had to drop some programmatic mission projects because of lack of adequate space.

General comment on threats to P-Division space. Lack of adjacency is limiting the cross fertilization among P Division groups that we had previously enjoyed until the early 1990s. Additionally, we have strong interactions with a number of X- and T-Division groups at TA-3 and with DX-Division groups at TA-8 and -15.

3.0 PHYSICS DIVISION TOMORROW

3.1 Concentration of Personnel at TA-3

P Division has developed different planning scenarios for renewing the concentration of P Division staff at TA-3 in a Physics Campus. We believe that P Division must relocate its widely scattered groups in order to facilitate the synergistic interactions essential to producing great collaborative science. We also believe that this planning must focus on TA-3 as the site for concentrating our staff. As you can see from Table 2.5-2, a strong majority of our high-demand adjacencies are with groups that reside at TA-3 (or very close to it). Furthermore, among the groups with which we have medium- or low-demand adjacencies, nearly 75% reside at TA-3 or nearby. As described in detail in the text of Section 2.1.5, P Division loses significant time each week to travel across the Laboratory. Co-locating our separated groups at TA-3 is a remedy to these problems. It will also facilitate interactions between groups and with other divisions that are not possible now—the kind of casual, informal, and/or impromptu contacts that can only happen when the scientists reside in close proximity.

Recently, a large Laboratory-Directed Research and Development (LDRD) proposal came out of the newly created Quantum Institute (QI), which co-locates quantum scientists from six divisions across the Laboratory in newly renovated space in SM-40. This proposal is a direct result of the co-location of these scientists. The authors have said that the ideas behind their proposal would not have been formed if they had not been working in close proximity and had been aware of exactly how much progress each had made in each area of specialty and had frequent discussions on how their science fits together. It is this networking between all levels of different organizations that truly creates the collaborative synergy that P Division has had in the past and seeks to recapture.

3.2 Physics Division Space Requirements

3.2.1 Current Occupancy

P Division has 405 people (this figure includes students but excludes visitors) who occupy a total of 206,900 sq ft of billable space in TA-3, -35, -53, -46, and -57. It breaks down into roughly the following manner:

- office space: 57,300 sq ft,
- laboratory space (of all types): 95,000 sq ft,
- storage space: 32,000 sq ft,
- meeting space: 8,300 sq ft, and
- miscellaneous space: 14,300 sq ft (including current shop space, 9,274 sq ft).

The Division personnel breakdown at the time of this report is given in Table 3.2-1. The Division provides full office space to most University of California (UC), contractor, and deployed personnel. For a limited number of technicians, their office space is co-located with their laboratory space. Students are allotted reduced office space (usually multiple desks in a 'bullpen' arrangement). Visitors (only ~20% of whom are present at any one time) are also allotted

reduced office space. The numbers given for students in Table 3.2-1 are from the summer of 2002. The head count for full office space is 293. The head count for reduced office space is 125.

Table 3.2-1
Current P Division Personnel Profile[a]

Group	UC Employees[b] (350)			Contractors (28)			Deployed Personnel	Visitors	Total	% in Cl. space	% in Uncl. space
	TSM[c]	TEC	AS/OS /SSM	TSM	TEC	AS/OS /SSM					
P-DO	11|0	1|2	7|1	0	0	0	14	8	44	0	100
P-21	34|12	10|12	3|0	0	1	2	0	1	75	2	98
P-22	24|3	21|3	1|0	1	2	5	0	0	60	90	10
P-23	38|3	12|19	1|1	0	2	3	0	24	103	50	50
P-24	41|7	17|16	3|0	1	4	6	0	9	104	40	60
P-25	32|4	8|13	3|0	0	0	1	0	23	84	19	81
Total	180|29	69|65	18|2	2	9	17	14	65	470	35	65

[a] These figures were drawn from the relevant Laboratory databases on March 31, 2003. Because student levels peak during the summer, student levels from July 2002 are used for the student numbers.

[b] In the columns below, the number on the left is for full-time staff; the number on the right represents students.

[c] Post-doctoral appointees are included in the TSM full-time figures.

Table 3.2-2 provides an analysis of the space that the Division currently occupies by type. We provide this information as a baseline for comparison for our space requests in Section 3.2.2.

Table 3.2-2
P Division Current Billable Space Occupancies

Type of Space and Parameters	Space Amount (in sq ft)	Running Total
Office Space (staff, contract staff, deployed personnel, students, and visitors)	57,277	57,277
Lab Space: Light-Lab Space (165 labs) (40% classified/60% unclassified)	70,673	
Heavy Experimental Space	49,407	
subtotal	120,080	177,357
Machine Shops (including shop-support space)	9,274	186,631
Conference Space (dedicated rooms and in management offices)	8,291	194,922
'Other' Space	5,072	199,994
Storage: Large-item storage	600	
P-Division common experimental-equipment storage	31,517	
subtotal	32,117	207,111
Total billable space currently occupied by the Division		232,111

3.2.2 Future Projections

All of the facility-development scenarios we present in this FSP request building sizes and numbers based on a projected absolute growth of P Division, over the next five years, of ~10%. Table 3.2-3 identifies the types of space we see as necessary for P Division to continue fulfilling its mission obligations for the institution.

Table 3.2-3
P Division Projected Space Requirements

Space Requirement	Space Amount (in sq ft)	Running Total
Office Space: Division managers (3) (at 288 sq ft/person)	864	
Group managers (16) (at 144 sq ft/person)	2,304	
Technical staff (230) (at 120 sq ft/person) (40% classified/60% unclassified)	27,600	
Technicians (150), students (60), and visitors (10) (220 at 80 sq ft/person)	17,600	
Office staff (AS/OS/SSM/deployed personnel) (56 at 80 sq ft/person)	4,480	
subtotal	52,848	52,848
Lab Space: Light lab space (177 labs @ 450 ft²)	77,880	
Heavy experimental space (including space retained at LANSCE and TA-35)	30,000	
subtotal	107,880	160,728
Shops (4 @ 1000 ft² [machine, optical, welding])[a]	4,000	164,728
Electronics Shop (including inventory-storage space)[b]	1,500	166,288
Meeting Rooms: Small conference rooms (4 @ 350 ft²)	1,400	
Medium conference rooms (2 @ 750 ft²)	1,500	
Large conference room (1 @ 900 ft²)	900	
Auditorium (1 @ 4,000 ft²)	4,000	
subtotal	7,800	174,028
Storage: Large-item storage	622	
P Division experimental-equipment storage requirements	18,420	
subtotal	19,042	193,070
Total programmatic space requirements for the Division for this FSP		193,070

[a] Shop space can be reduced from current levels because of consolidation.

[b] Our plan includes this allotment for a centralized electronics shop and inventory storage. Currently, this function is spread throughout the Division. This combined with the fact that our storage is also spread across the Laboratory (mostly in transportainers) results in our technicians often procuring new electronics because they cannot locate for reuse serviceable equipment from old experiments.

As you can see, even accounting for 10% growth over the next decade, concentrating the Division in one location reduces its space footprint from its current standing by ~17%.

3.3 Facility Plan Vision

Our first facility-planning scenario calls for two GPP buildings† and an additional large line-item Center for Stockpile Stewardship Research Building in the central TA-3 area. Our second scenario supports the Associate Director for Strategic Research (ADSR) planning vision of a "Strategic Research Complex" established at Two-Mile Mesa (TA-58). The final planning scenario calls for two GPP buildings and requires major renovations to a majority of the spaces we currently occupy.

The first two of our building scenarios focus on our two-pronged strategy set out in this FSP—that is, to

- co-locate Division scientists at or very near the TA-3 area to facilitate interactions that will enhance our collaborative synergy within the Division and with other divisions at the Laboratory and
- acquire modern scientific space that will enable us to attract and retain the finest scientific talent available.

The third scenario does not achieve either of these goals. It partially clusters Division personnel but does not relieve us of the maintenance, repair, or renovation burdens of our currently occupied spaces.

In all scenarios, Trident operations would remain at TA-35 due to the unique facility requirements and equipment located there and we will continue to occupy a minimum of space at TA-53 to support our experimental operations at LANSCE. The space we currently occupy in TA-03/SM-40 and TA-03/SM-215 will serve as the swing space as we move through any of the building strategies. This swing space will allow us to clear personnel out of buildings to be returned to the institution with a minimum of disruption to the Laboratory community as a whole.

3.3.1 Building Scenario 1: One Large Line-Item Building and Two GPP Buildings

Our preferred scenario contains proposals to construct two GPP buildings and an additional large line-item *Center for Stockpile Stewardship Research Building* in the central TA-3 area. This scenario is preferred because it allows us to be able to consolidate all of Physics Division at TA-3 and provide improved office and lab space and allow for the excessing of current space and elimination of some substandard buildings.

We will construct the first GPP building on the footprint of the decommissioned Occupational Medicine clinic (SM-409, -1635, and -1636). We have submitted a request for the first GPP building in response to calls for FY03 and FY04 funding. It specifies a QI building that would provide unclassified offices at a minimum and some light labs if possible for the divisions that participate in the QI and for most of the P-21 Biological and Quantum Physics group. This building would relieve the overcrowding pressure on two P Division groups and would establish an important presence for the institute, which has been slated by the SET to become one of

† The $5M GPP buildings are ~15,000 sq ft each. One building can house ~85–90 people in offices if it is an office-only building. It can hold ~20 light labs if it is a lab-only structure. A mixed building is less flexible and holds less than half of each kind of facilities.

the few laboratory centers supported by institutional funds. At this point we will also clear personnel from the small structures between Pajarito Road and SM-40/-502 (the Space Science Center) across the street from the Shops building (SM-39). [These buildings are SM-218 (magnetic energy and storage facility); SM-253 (prototype electron accelerator lab); and many small trailers and transportainers.] These structures will undergo decommission and demolition (D&D) in preparation for the next phase of construction.

The second GPP building will be constructed on the footprint of the cleared site between SM-40/-502 and Pajarito Road. This building will contain unclassified lab spaces.

The third phase of this scenario will be the construction of a large, line-item building on the footprint of cleared site of the current buildings: SM-287 (the Scyllac building), SM-100, SM-510, SM-28, and SM-1559/1566 (transportables next to SM-28), which will contain approximately 127,000 sq ft of office spaces and laboratories. It will have a classified-space wing and an unclassified-space wing. The plan is to build one large building with two separate, parallel wings joined by a glass-enclosed atrium. One wing will be "inside the fence" and contain classified labs, office space, and conference rooms. The other wing will be outside the fence and provide unclassified lab and workspace.

At the end of this scenario, the Division will have returned to the institution for reuse all of the space that it currently occupies at TA-53, TA-35, and TA-3 (except for the heavy laboratory space described in Section 2.4 of this plan).

Figure 3.1-1 shows the locations of the proposed construction.

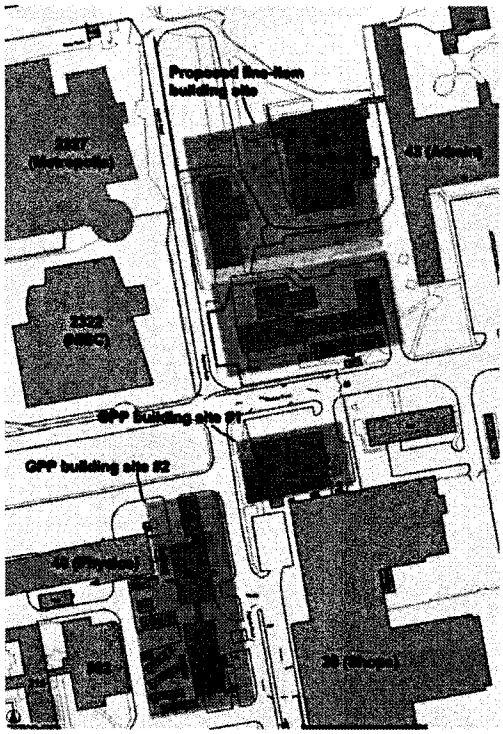


Figure 3.3-1. A partial map of TA-3 identifying proposed building sites of this scenario.

3.3.2 Migration Sequencing for Building Scenario 1

Step 1: Construct first GPP building on the footprint of the decommissioned Occupational Medicine clinic (SM-409). This building will contain unclassified offices.

Move (a) We will move P-23 and P-25 personnel into new offices, thus vacating MPF-1 A, C, and D Wings high-rent offices (~50% of P Division LANSCE space will be returned to the institution). P-23 and P-25 will maintain labs at LANSCE until TA-3 space becomes available.

Move (b) At this point, we will also clear personnel from the small structures between Pajarito Road and SM-40/-502 (the Space Science Center) across the street from the Shops building (SM-39). [These are the buildings SM-218 (magnetic energy and storage facility); SM-253 (prototype electron accelerator lab); and many small trailers and transportainers.] These buildings will undergo D&D in preparation for Step No. 2.

Other We will use a portion of SM-39 as transition space for **Move (b).**

Step 2: Construct second GPP building on the footprint of cleared sites between SM-40/-502 and Pajarito Road. This building will contain unclassified lab space.

Move (a) P-23 and P-25 non-LANSCE-related, unclassified labs will relocate to the new building.

Other This step will vacate at least three-quarters of P Division space at LANSCE (*i.e.*, at the end of this step, ~75% of P Division space at LANSCE will have been returned to the institution).

Step 3: Construct a large line-item building (~127,000 ft²) on the footprint of the cleared site of the current buildings: SM-287 (the Scyllac building), SM-100, SM-28, and SM-1559/1566 (transportables next to SM-28).

Move (a) Relocate the rest of P Division personnel in the new building.

Other This step will vacate all of P Division space at LANSCE, at TA-35 (TSL-86, -87, -127, -128, -207 and -421) and SM-40, -215, -216, and other, smaller structures the Division occupies at TA-3 (*i.e.*~ 60% of P Division's entire footprint will be returned to the institution).

3.3.3 Building Scenario 2: Strategic Research Complex

The Strategic Research Directorate is sponsoring a plan to build a new "Strategic Research Complex" at Two-Mile Mesa (TA-58) within walking distance of TA-3 (see LA-UR-03-1238). This scenario supports that initiative. In addition to the space allotted to P Division in the main buildings of the Strategic Research Complex, this planning scenario includes two GPP buildings—either within the space of the planned Strategic Research Complex or in the central TA-3 area (at locations discussed below).

The Strategic Research Complex allots 127,000 sq ft of space for P Division in its planned buildings. In order to reach our projected space needs of 193,070 sq ft, we will need to construct two additional GPP buildings. We have discussed this requirement with those involved with devel-

oping the Strategic Research Complex plan, and they believe that footprints for these structures can be accommodated within their planning scenario.

In the event that the Strategic Research Complex planning scenario cannot provide footprints necessary for our required GPP buildings within their planned Strategic Research Complex space, we propose to build the two buildings in the central TA-3 area. We will construct the first GPP building on the footprint of the decommissioned Occupational Medicine clinic (SM-409, -1635, and -1636). We have submitted a request for the first GPP building in response to calls for FY03 and FY04 funding. It specifies a QI building that would provide unclassified offices at a minimum and some light labs if possible for the divisions that participate in the QI and for most of the P-21 Biological and Quantum Physics group. This building would relieve the overcrowding pressure on two P Division groups and would establish an important presence for the institute, which has been slated by the SET to become one of the few laboratory centers supported by institutional funds. At this point we will also clear personnel from the small structures between Pajarito Road and SM-40/-502 (the Space Science Center) across the street from the Shops building (SM-39). [These buildings are SM-218 (magnetic energy and storage facility); SM-253 (prototype electron accelerator lab); and many small trailers and transportainers.] These structures will undergo D&D in preparation for the next phase of construction.

The second GPP building will be constructed on the footprint of cleared site between SM-40/-502 and Pajarito Road. This building will contain unclassified office spaces.

At the end of this scenario, the Division will have returned to the institution for reuse all of the space that it currently occupies at TA-53, TA-35, and TA-03 (except for the heavy laboratory space described in Section 2.4 of this plan).

Figure 3.3-2 shows the locations of the proposed Strategic Research Complex and the alternate proposed locations of the two GPP buildings in the central TA-3 area.

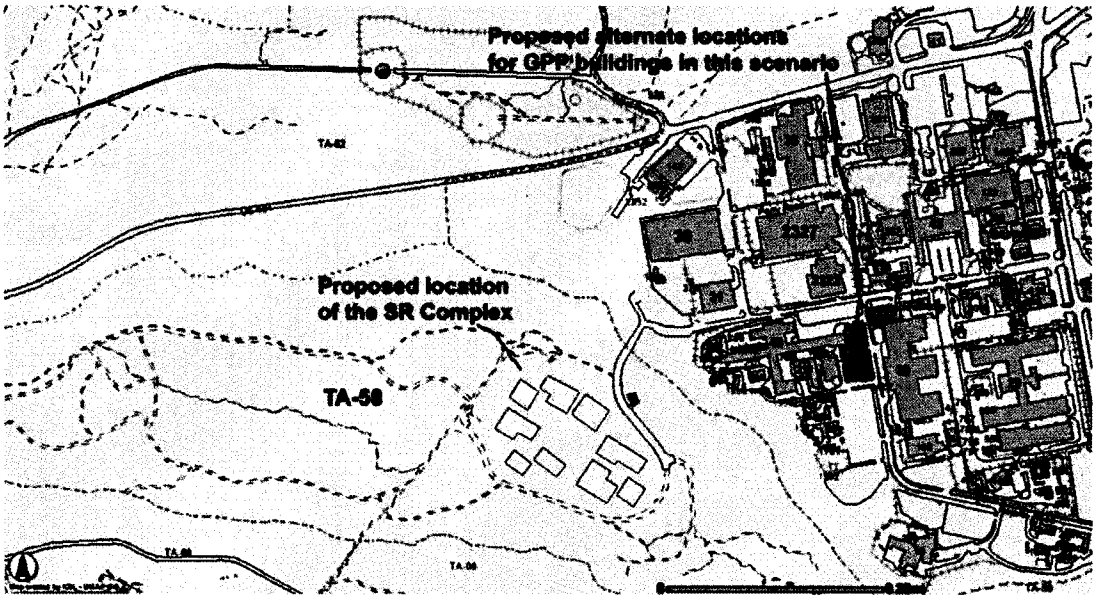


Figure 3.3-2. Map of TA-58 and the southwestern corner of TA-3 identifying this scenario's proposed Strategic Research Complex and alternate locations of GPP buildings in the central TA-3 area.

3.3.4 Migration Sequencing for Building Scenario 2

Step 1: Occupy (~127,000 ft²) of space provided by the Strategic Research Complex, both classified and unclassified office and lab space.

Move (a) We will move P-23 and P-25 personnel into new offices, thus vacating MPF-1 A, C, and D Wings high-rent offices (~50% of P Division's LANSCE space will be returned to the institution). P-23 and P-25 will maintain labs at LANSCE until TA-3 space becomes available.

Move (b) We will move all P Division personnel from TA-35, vacating TSL-86, -87, -125, -127, -128, -207 and -421 [*i.e.*, at the end of this step, 95% of P Division space (51,957 ft²) at TA-35 will have been returned to the Institution, except Trident].

Move (c) We will move P-22's classified offices and labs from SM-216.

Other At this point, we will also clear personnel from the small structures between Pajarito Road and SM-40/-502 (the Space Science Center) across the street from the Shops building (SM-39). [These are the buildings SM-218 (magnetic energy and storage facility); SM-253 (prototype electron accelerator lab); and many small trailers and transportainers.] These buildings will undergo D&D in preparation for Step No. 2.

We will use a portion of SM-39 as swing space for this move.

Step 2: Construct first GPP building on the footprint of the site between SM-409, -1635, and -1636. This building will contain a mixed space of unclassified offices and light labs to house scientists from the newly formed cross-divisional Quantum Institute.

Move (a) We will move 10 labs and 35 people from P-21 (SM-215/SM-40) to this new building in addition to quantum scientists from five other divisions.

Step 3: Construct second GPP building on the footprint of the site between SM-40/-502 and Pajarito Road. This building will contain a mixed unclassified space of offices and light labs.

Move (a) We move the remainder of P-21 from SM-215 and all of P-DO out of SM-40 to this new building (*i.e.*, ~35,000 ft^2 of prime TA-3 space returned to the Institution).

3.3.5 Scenario 3: Two GPP Buildings and Remain in the Majority of Existing Costly Space

Our final (and least desired) scenario is a proposal for the construction of two GPP buildings. The proposed construction includes 36,000 sq ft of new construction at TA-3. In this scenario, we will continue to reside in the space we currently occupy throughout the Laboratory. In this respect, this scenario does not achieve either of the major goals of this plan, which are to

1. co-locate Division scientists at or very near the TA-3 area to facilitate interactions that will enhance our collaborative synergy within the Division and with other divisions at the Laboratory and
2. acquire modern scientific space that will enable us to attract and retain the finest scientific talent available.

It partially clusters Division personnel, but does not relieve the Division of the maintenance, repair, or renovation burdens of some of our oldest spaces.

We will construct the first GPP building on the footprint of the decommissioned Occupational Medicine clinic (SM-409, -1635, and -1636). We have submitted a request for the first GPP building in response to calls for FY03 and FY04 funding. It specifies a QI building that would provide unclassified offices at a minimum and some light labs if possible for the six divisions that participate in the QI. This building would relieve the overcrowding pressure on two P Division groups and would establish an important presence for the institute, which has been slated by the SET to become one of the few laboratory centers supported by institutional funds. It would not be problematic for the Quantum Institute building to be all offices and no light labs, if the institution prefers a "cookie cutter" building plan. At this point we will also clear personnel from the small structures between Pajarito Road and SM-40/-502 (the Space Science Center) across the street from the Shops building (SM-39). [These are the buildings SM-218 (magnetic energy and storage facility); SM-253 (prototype electron accelerator lab); and many small trailers and transportainers.] These buildings will undergo D&D in preparation for the next phase of construction.

The second GPP building will be constructed on the footprint of the cleared site between SM-40/-502 and Pajarito Road. This building will contain office spaces.

In order to maintain our scientific and experimental viability, we will be required to undergo major renovations to much of the space we currently occupy. This renovation requirement will certainly include our space in SM-40 and SM-216 at TA-3 and our space in MPF-1 at TA-53. The costs for this scenario must factor in the unknown renovation costs for these very old spaces.

3.3.6 Migration Sequencing for Scenario 3

Step 1: Construct first GPP building on the footprint of the decommissioned Occupational Medicine clinic (SM-409, -1635, and -1636). This building will be a mix of offices and light labs.

Move We will first begin moving ~1/2 of P-23 personnel out of LANSCE.

Other At this point, we will also clear personnel from the small structures between Pajarito Road and SM-40/-502 (the Space Science Center) across the street from the Shops building (SM-39). [These are the buildings SM-218 (magnetic energy and storage facility); SM-253 (prototype electron accelerator lab); and many small trailers and transportainers.] These buildings will undergo D&D in preparation for the next phase of construction.

We will use a portion of SM-39 as transition space for this move.

Step 2: Construct a second GPP building on the footprint of the cleared site between SM-40/-502 and Pajarito Road. This building will contain office spaces.

Move Consolidate the remainder of P-23 at TA-3 and move as much of P-25 out of LANSCE as possible.

Step 3: Renovate existing space in MPF-1 at LANSCE and SM-40 and SM-216 at TA-3 to maintain our scientific and experimental viability at an estimated cost of ~$3.5M.

Other We will retain all of our existing space at TA-35 and most of the space at TA-3 (SM-40, -215, and -216).

3.4 Space to be Vacated by the Division

After implementation of either Building Scenario 1 or Building Scenario 2, the Division will vacate all of the space that it currently occupies at TA-53, TA-35, and TA-03, except for the heavy laboratory space described in Section 2.4 of this plan. The space that we retain will also include ~ 20 offices in the LANSCE facility to be used while personnel develop new experiments and then run them.

4.0 COST SAVINGS FOR THE PHYSICS DIVISION FACILITY STRATEGIC PLAN

4.1 Summary

With the assistance of D Division, we completed a cost-savings and financial analysis for the P Division FSP. The analysis, using information from the Spring 2003 report, resulted in a payback time estimate after building completion of 6 years and 9 months (see Figure 4.1-1, below). The break-even or payback time measured from completion of construction of this potential $65M, five-year construction project is estimated to be approximately 6 years and 9 months. After construction completion, it is estimated that an average net savings of approximately $11.8M per year (undiscounted) may be realized for several years if the plan is completed as written. Detailed calculations that support this analysis are available from the Physics Division Office upon request.

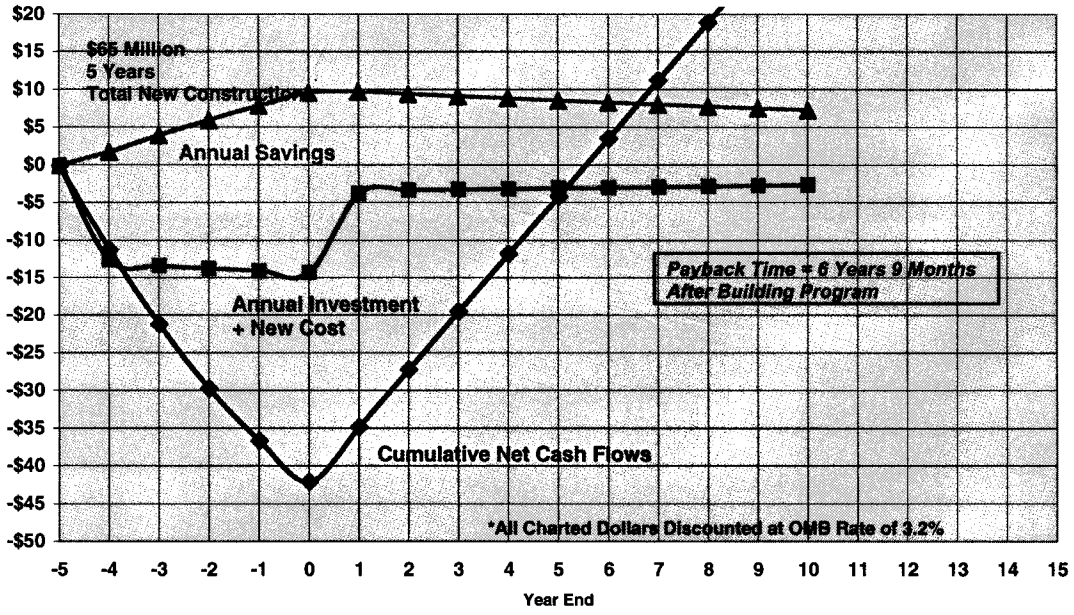


Figure 4.1-1. Summary financial profile for the P Division FSP.

This analysis is limited to dollar denominated costs and benefits. It does not include other potentially substantial non-dollar denominated benefits associated with

- mission capability expansion,
- mission risk reduction,
- safety and security enhancement,
- environmental stewardship improvements,
- recruiting and retention benefits,
- flexibility in response to future mission changes, and
- superior regulatory compliance.

The overall value to the institution of the proposed business plan is likely to exceed the measurable financial benefits by a significant amount that cannot be easily quantified.

Six general categories of expenditures and cost savings were reviewed and included in this analysis. The categories are construction costs/avoided facility upgrade expenditures, space cost savings, maintenance cost savings, operating efficiency improvements that can be quantified, potential increased collaborations, and expenditures to vacate closed space. The current Office of Management and Budget real discount rate of 3.2% was used. The chart below shows the cost savings (undiscounted) that will offset the $65M P Division FSP investment.

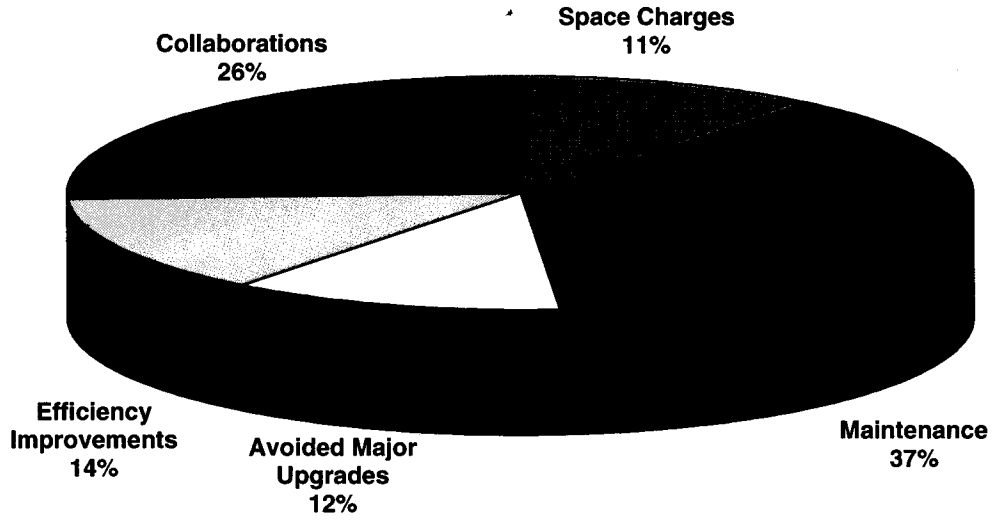


Figure 4.1-2. Savings categories that offset the $65M investment for the P Division Facility Business Plan.

The definitions, descriptions, and the P Division FSP cost savings are discussed below followed by sensitivity analyses to demonstrate the importance of various expenditures and cost savings on payback time.

4.2 Construction Expenditures for New Facilities

4.2.1 Cost Estimate

The primary source of funding for the P Division FSP $65M investment will come from a *Congressional Line Item and General Plant Project* funds or *Third Party Financing*. Innovative and efficient design and construction processes can add variability to construction cost estimates. For example, the Design/Build process has resulted in lower square footage costs for other Laboratory projects. The current cost estimate based upon conceptual designs by P Division and Project Management is subject to considerable future uncertainty.

4.2.1.1 One-time Cost Savings from Avoided Planned Upgrade Projects

The P Division FSP implementation will result in one-time cost savings of $9.3M (undiscounted) from avoided planned upgrade projects for facilities that will be closed. The specific projects are listed in Table 4.2-1. Organizations typically produce lists of planned upgrades with associated costs for programmatic and facility planning. Planned projects that will be eliminated because

of implementing the business plan result in realistic cost savings. Upgrade projects are separate and discrete from maintenance, repair, code upgrades, and unexpected facility expenses.

Table 4.2-1
Immediate/Urgent Major Upgrades for Facilities Proposed to be Closed or Relocated*

Facility	Total Upgrade Cost (Thousands of Dollars)
TA-3-40 HVAC/Electric/Roof/Ceiling Upgrades, Fire Safety Issues, Potable Water Issues, Correction of Unsafe Conditions	$1,262
TA-3-215 HVAC Upgrades	$42
TA-3-216 Roof/HVAC Upgrades, Lightning Repairs	$905
TA-3-218 HVAC Upgrades	$87
TA-3-253 HVAC/Electric/Roof Upgrades	$6
TA-35-86 HVAC/Electric/Roof Upgrades	$339
TA-35-87 HVAC/Electric/Roof Upgrades	$197
TA-35-127 HVAC/Electric/Roof Upgrades	$1,553
TA-35-127 HVAC Upgrade	$42
TA-35-207 HVAC Upgrade	$54
TA-53-1 HVAC/Electric/Roof/Water Upgrades, Water Mitigation	$1,596
TA-53-3 HVAC/Electric Upgrades	$599
TA-53-10 HVAC Upgrades	$38
TA-53-19 HVAC Upgrades	$21
TA-53-44 HVAC Upgrades	$50
TA-53-45 HVAC Upgrades	$50
TA-53-46 HVAC Upgrades	$50
TA-53-47 HVAC Upgrades	$50
TA-3-40 Laboratory Upgrade	$400
TA-3-40 Laboratory Upgrade	$400
TA-3-40 Laboratory Upgrade	$400
TA-3-40 Laboratory Upgrade	$400
TA-3-40 Laboratory Upgrade	$400
TA-3-40 Laboratory Upgrade	$400
Total	$9,341

* Provides $1.86M annual cost savings spread over 5 years.

4.2.1.2 Annual Cost Savings from Unexpected Facility Expenses

P Division FSP implementation will result in annual estimated cost savings of $500,000 (undiscounted) from avoided annual expenses for facilities that will be vacated. These savings have been phased in over the five-year project and have been estimated by averaging unexpected costs that have arisen in past years requiring that P Division spend programmatic funds for facility related expenses above and beyond facility management charges. The past expenses for FY02 and FY03 are listed in Table 4.2-2. Often tenants such as P Division (see Section 4.4.1, *Tenant Organization Maintenance Cost Savings* below) are faced with unexpected expenditures that

come out of their programmatic funds for emergency facility needs that are not covered in the facility management charge. These facility-related expenses are separate and discrete from maintenance, repair, and code upgrades.

Table 4.2-2
Potential Annual Savings for Expenditures on Facilities
(Based on P Division Experience)

Project	Cost (Thousands of Dollars)	Comments
Quantum Conference Room	$134.1	Actual cost exceeded estimated cost due to design and construction errors and differing site conditions
Dave Viera's Lab	$185.5	Actual cost exceeded estimated cost due to design and construction errors and differing site conditions
Dana Berkland's Lab	$167.2	Actual cost exceeded estimated cost due to design and construction errors and differing site conditions
Malcolm Boshier's Lab	$136.2	Actual cost exceeded estimated cost due to design and construction errors and differing site conditions
P-DO HVAC	$270	
HVAC for 2 offices	$22.5	
HVAC for Clean room	$56.8	
Sink Replacement	$12	
Network Upgrade in SM-40	$16	
Annual Average Facility Costs	$500	

4.3 Space Cost Savings for New and Closed Space

Space cost savings arise from reducing the total amount of billable square feet charged to the organization. Energy savings due to more efficient new facilities may generate potential additional cost savings. The space-cost-savings category includes basic charges for use of institutional/lease space and utility costs. The P Division FSP calls for an estimated net reduction of 58,970 billable sq ft with 189,246 billable sq ft of closed space and an estimated 120,000 billable sq ft (200,000 gross sq ft with an assumed efficiency rating of 60%) of new construction. P Division will be retaining 10,276 sq ft of currently occupied space.

4.3.1 Annual Cost Savings for Institutional/Lease Space Costs and Unmetered Utilities

Annual cost savings from reduced expenditures for institutional space and unmetered utilities for new versus closed space are captured at an unburdened FY02 rate of $11.6649 per billable sq ft of space. This typically includes institutional costs for the space, institution-wide facility management costs, and unmetered utilities (water, gas steam, and sewer). This does not include costs for maintenance, local facility management, or burden. The P Division FSP, with a net

reduction in billable space of 58,970 sq ft, results in net savings of approximately $688,000 per year (undiscounted) phased in over the five-year project.

4.3.2 Annual Cost Savings for Electricity

The Laboratory's electricity is metered and tracked separately from other space costs. Annual cost savings from reduced expenditures for electricity for new versus closed space are captured at an unburdened rate of $4 per billable sq ft of space. The P Division FSP will result in net savings for electricity of approximately $236,000 per year (undiscounted) phased in over the five-year project. Considerable added cost savings can be attained if "green" or energy efficient/ environmentally friendly design and construction methods are used for new or renovated facilities. However, these savings must be determined on a case-by-case basis contingent on the consolidating organization's requirements.

4.4 Maintenance Cost Savings

Facility management literature reveals that typical annual budgets for maintenance and repair (including preventative and corrective maintenance, facility management, and code upgrades) are between 2 to 4% of the current replacement value of the facilities, excluding land. This amount is over and above the amount to overcome a backlog of maintenance and repair resulting from previously insufficient annual maintenance and repair. The replacement value for Laboratory facilities is over $5.6 billion. The annual budget for the Laboratory facility maintenance budget is approximately $96M (about 1.7% of facility replacement value). This does not include budgets for construction, institutional infrastructure costs, or utilities.

Organizations at the Laboratory reside in space as either landlords or tenants. In either case, a facility management charge for billable square footage is tagged onto the space charge. Charges range from approximately $12 to over $30 per billable square foot depending on type of space and various institutional conditions. Although all organizations pay the facility management charge, landlord organizations have additional facility management responsibility for their space and must plan and coordinate facility management functions. Although tenants do not have the facility management responsibility, they have little control over the condition of their space or the facility management costs. Potential cost savings for vacated space are evaluated differently for landlords and tenants.

4.4.1 Tenant Organization Maintenance Cost Savings

P Division will save approximately $2.5M per year in facility management savings after completion of the five-year project. For tenant organizations, potential maintenance cost savings are calculated by subtracting the facility management charges for the new space from the current facility management charges that are being paid for the space that will be vacated. It is not uncommon for tenants to have several different facility management rates if they are not co-located. Because consolidation and modernization should result in reasonable facility management costs for new space, we have used a moderate Laboratory facility management cost of $16 per billable square foot for this analysis.

Tenant Facility Management Cost Saving	=	Facility Management Charges for Space to be Vacated	-	(No. of Billable Square Feet of New Space * $16)

P Division is currently paying facility management costs of approximately $4.9M per year for the 189,246 billable sq ft that will be vacated. The estimated facility management cost for the portion of the 130,276 billable sq ft at a charge of $16/sq ft is projected to be $1.5M per year. As a rule of thumb, the new facility management costs should be roughly 2% of the total cost of the new building.

4.4.2 Landlord Organization Maintenance Cost Savings

Because P Division is a tenant organization, landlord maintenance cost savings are not applicable. For landlord organizations, two maintenance-cost-savings categories are appropriate for business-case justification:

1. annual cost savings from reduction in code replacement expenditures for new versus closed facilities and
2. one-time cost savings for backlog maintenance and repair.

Cost savings from facility management costs applied to tenant organizations are not applicable for landlord organization cost savings.

4.5 Operating Efficiency Improvements Cost Savings

4.5.1 Annual Personnel Efficiency Cost Savings

The P Division FSP will result in a net savings of $600,000 per year (undiscounted) for personnel and other efficiencies. Table 4.5-1 shows the personnel that can be unambiguously eliminated from certain duties under the P Division FSP. Annual personnel efficiency savings can be claimed if there are resulting staff transfers to productive programmatic work through averted hires, attrition, or transfers out of the consolidating organization. Consolidation and improved facilities may free up support personnel and increase organizational productivity because these FTEs will no longer be required. FTE efficiency cost savings can be claimed if FTEs will be transferred out of the existing organization or moved to a new productive position that the organization must fill to perform mission-related work. Contracts may be reduced since consolidation may result in fewer trips with people consolidated into one area.

Table 4.5-1
Personnel and Other Efficiency Savings

Savings Category	Number FTEs	Annual Savings (Thousands of Dollars)
Management and Administration	3	$200
Information and Systems Support	0.5	$40
Property and Financial Support	1	$80
Maintenance and Improvement of Work Orders	n/a	$280
Total		$600

4.5.2 Annual Cost Savings from Consolidation and Closure of Sites Due to Reduced Trips Between Technical Areas

The P Division FSP will result in a net cost savings of up to $600,000 per year (undiscounted) from reduced travel time between sites (see Table 4.5-2, below). Travel time for regular daily trips to other sites can be claimed as an annual cost savings since consolidation in one central area will reduce them. A substantial number of daily trips will be eliminated with the consolidation of personnel at TA-3, TA-35, and TA-53. P Division conducted a survey of their staff to determine the number of trips made between TAs. Based on the survey sample of 76 responses (out of approximately 370 employees), P Division estimates that approximately 3% of their employees time is spent in transit. This number is conservative because an effort was made to intentionally statistically underestimate this value to obtain a realistic approximation. This value was then applied to the P Division payroll to obtain the annual savings of $600,000. Again, this is a conservative estimate, since only the payroll portion of the P Division annual budget was utilized in the calculation.

Table 4.5-2
Annual Savings from Reduced Trips between Sites Due to Consolidation

Consolidation Category	Annual Savings (Thousands of Dollars)
Elimination of Weekly Trips for Communication and Collaboration	$600
Total	$600

4.5.3 Annual Cost Savings for Waste Disposal Due to More Environmentally Efficient Systems (If Quantifiable)

Annual cost savings from more environmentally efficient systems can be claimed if they can be quantified. New facilities have the potential to substantially decrease environmental waste disposal costs. However, potential cost savings are highly dependent on the design and specific future requirements of the organization. Documentation of current and projected costs must be available to claim this cost savings. Although savings could be possible for the P Division FSP, we have not been able to quantify them yet or include them in the current analysis.

4.5.4 Annual Cost Savings from Reduced Regulatory Expense from Facility Enhancements for Safety and Health (If Quantifiable)

Annual cost savings from reduced regulatory expenditures from facility enhancements for safety and health can be claimed if they can be quantified. New facilities that do not contain emissions of potentially hazardous substances have the potential for significant savings. However, expenditures that would be averted with the new facilities must be documented to claim this cost savings. Although savings might be possible for the P Division FSP, we have not been able to quantify them yet or include them in the current analysis.

4.6 Cost Expenditures to Transfer Out of Closed Space

In addition to future cost savings, it is important not to overlook expenditures that will be undertaken to implement the new business plan. These one-time expenditures involve costs to move personnel, prepare the closed space for transfer to the institution, and, if applicable, to perform D&D activities on the space.

4.6.1 One-Time Costs to Move Employees as New Space Becomes Available and Old Space Is Closed

Approximately 370 people will be moved during implementation of the P Division FSP. The cost to move these employees is approximately $1.16M. The Facilities and Waste Operations Division Support Services Contract Management (FWO-SSCM) group uses a low-end estimate of approximately $3,000 for basic move costs for one employee and a high-end estimate of $10,000 to move one employee and fully equip an empty office. These costs will vary depending on the specific organizational plan.

4.6.2 One-Time Cost to Transfer Buildings from User Organizations to the Institution

A preliminary estimate to transfer closed P Division space to the Laboratory's surveillance and maintenance group is $946,000. A rule of thumb range of $3 to $7 per square foot to transfer buildings from the user organization to the institution has been provided by FWO-SSCM. This covers all costs required to address the Laboratory Implementing Requirement (LIR) 250-02-01.0, *Occupying or Vacating Work Space*. If radiological contamination is found, the cost will rise significantly. This does not include the institutional costs of actual facility deactivation, decommissioning, and demolition.

4.6.3 One-time Cost to Decommission and Demolish Spaces that Will Be Closed

There is no standard square foot cost estimate for D&D activities at the Laboratory. Costs vary dramatically depending on whether contamination is present. Rough D&D costs at the Laboratory range from $80 to $100 per gross square foot for uncontaminated space to $1,000 per gross square foot for transuranic waste contamination. Traditionally, the Laboratory as an institution has taken the responsibility for D&D costs either through Environmental Management or Defense Programs funding. The cost of D&D has not been included in the P Division FSP.

4.7 Potential Increased Collaboration Opportunity Resulting in Increased Productivity

The potential gains in the frequency of research collaborations were investigated to estimate the probable increase in productivity resulting from the proposed P Division FSP. There are many personnel and management efficiency advantages both obvious and subtle to be gained by co-locating most of any work group. Collaborations, whether in the form of formal discussions, the formation of groups to submit funding proposals, or bumping into someone in the hall who can spontaneously offer insight into a problem, are important for increasing intellectual productivity. This brief analysis uses actual empirical data from the literature to estimate what analogous results might be expected at P Division using actual personnel location and organizational data.

Kraut (1990)* dedicates a chapter to patterns of contact and communication in scientific research collaborations. Pages 155–169 discuss a study of personnel location issues in a research and development company (anonymous, but likely a Bell Labs unit) of 500 Ph.D.- and M.S.-level researchers in the physical, engineering, computer, and behavioral sciences. This quantitatively analyzed organization appears to be demographically very much like P Division. Empirical data collected indicated that collaborations were strongly related to the physical proximity of researchers with 10.3% of potential collaborations coming to fruition in same-corridor pairs of people, but only 0.4% for pairs on different floors or buildings. Collaborations were much more likely between people from the same department as opposed to different departments but still with strong proximity effects. (The word "Department" was adapted to become "Group" in the model of the Laboratory's situation.) In Figure 4.7-1, tables 6.2 and 6.3 are reproduced from Kraut.

TABLE 6.2
Distance Between Offices and Probability of Research Collaboration

Office Location	*Actual Collaborations*	*% of Actual*	*Potential Collaborations*	*% of Potential*
Same corridor	25	46	243	10.3
Same floor	20	36	1038	1.9
Different floors	5	9	1736	.3
Different buildings	5	9	1261	.4

TABLE 6.3
Numbers of Research Collaborations by Organizational and Physical Proximity

	Organization			
	Same Department		*Different Department*	
Office Location	*Pairs*	*% Collaborating*	*Pairs*	*% Collaborating*
Same floor	271	10.3	909	1.87
Different floors	23	4.3	1708	.29
Different buildings	0	NA	1261	.40

1

Figure 4.7-1. Tables 6.2 and 6.3 reproduced from Kraut.*

Parametric data from these tables were utilized to model a computation of the potential effects on P Division research collaborations of the P Division FSP. Because of the fluidity and uncertainty concerning the specifics of current and proposed locations of P Division people, the same-corridor and same-floor cases were combined into "easy" collaboration proximity while

* R.E. Kraut, C. Egido, and J. Galegher, "Patterns of Contact and Communication in Scientific Research Collaborations," in *Intellectual Teamwork – Social and Technological Foundations of Cooperative Work* (Lawrence Erlbaum Associates, Inc., New Jersey, 1990).

different-floor and different-building cases were combined into "difficult" collaboration proximity. See the graph below for the exact parameters* used.

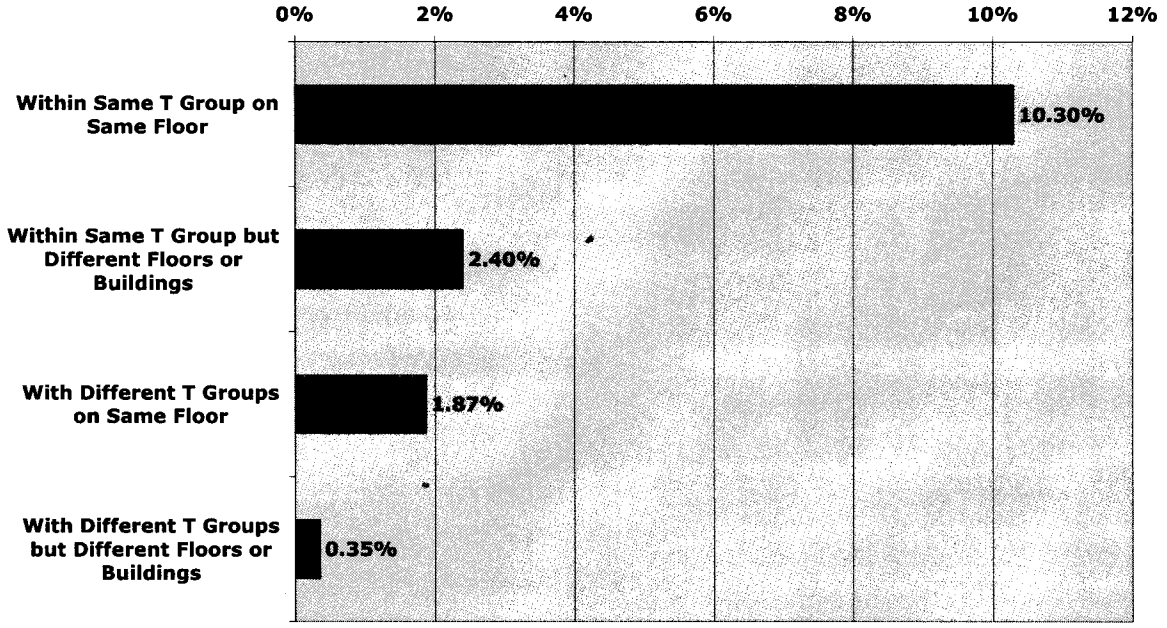


Figure 4.7-2 Probability of collaboration between two people—as a function of group membership and physical proximity.

P-DO identified the current locations by buildings and groups of all Division personnel, as provided in the P Division FSP. Each cluster of people from one specific group in one building was defined as a "work group." There are currently 25 work-group locations for 366 people. For example, there are 15 P-21 people in the Physics Building, 18 P-24 people at Ten-Site Laboratory, and so forth. One purpose of the P Division FSP is to better co-locate people in the same group so that there are not so many smaller, dispersed work groups. Currently, P-22 is divided between six buildings. The P Division FSP would consolidate them, along with the rest of P Division into one large building and two GPP buildings while vacating many smaller and dispersed facilities. The number of separate occupied facilities in the plan declines from the current 16 down to 3. A proposed redistribution of people that we used in our model results in a decline from the current 25 work groups down to 8 work-group locations.

	Current Situation	After Business Plan Implemented
Number of Work Groups (Partial P-X at Location Y)	25	8
Number of Occupied Facilities	16	4

The strong parametric effect on collaborations of co-locating people in the same group ensured that the reduction from 25 to 8 work groups would show good increases in collaboration. The specific redistribution of people that we used is far from final, and, in fact, only moderate care was given to attempt to optimize the distribution of groups into facilities. For the most part, the two groups, P-23 and P-25, were split between the two GPP buildings. The other four groups,

P-21, P-22, P-24, and P-DO were split between two floors of the large building. Some consideration was used to place groups on the same floor that currently interact with each other. The work groups that reside in a facility that was not going to be vacated were left in their present location. This tends to make the modeling results conservative. This conservatism is offset by the fact that some optimization is undoubtedly already in place at present in regards to co-locating people from different groups in support of programmatic or other functions rather than group functions. Such trade-offs in assumptions can appear in many speculative guises, and it is possible to second-guess the data structure and assumptions almost without limit. This is why it is analytically satisfying to fall back on the simple empiricism of the Kraut data, which has most of the same theoretical issues embedded within the data set and therefore inherently incorporated into the measured collaborative data results.

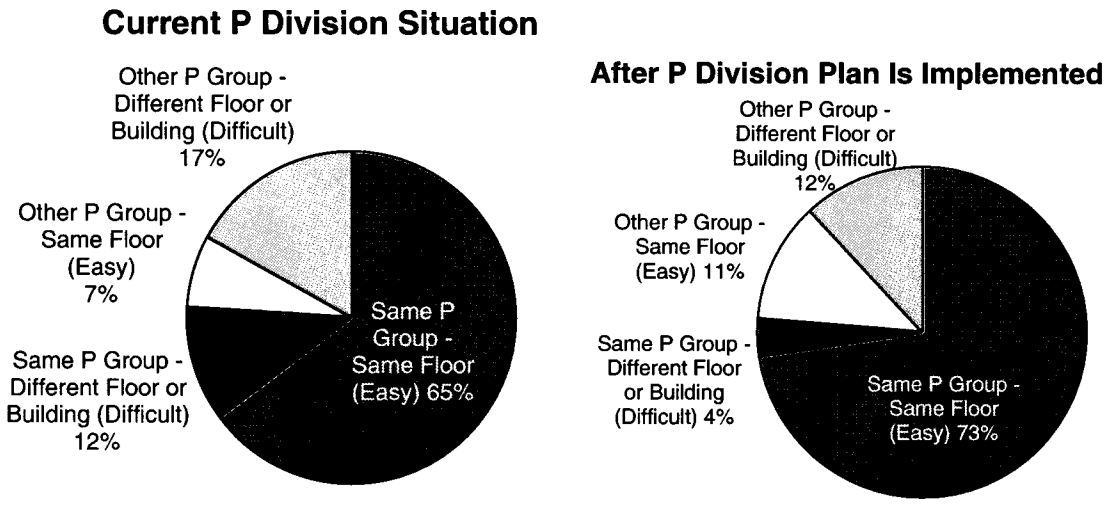


Figure 4.7-3. Estimated increase and distribution of P Division research collaborations.

The modeling estimates, as well as common sense and good judgment, indicate unambiguously that significant personnel collaborative gains should be expected from the P Division FSP. The estimated collaboration increases were calculated to be 28%. However, as a conservative estimate, this factor was reduced by an order of magnitude when determining possible productivity increases given the following analytical circumstances:

1. There is continuing fluidity in the actual P Division FSP.
2. Statistical confidence numbers are not available to develop quantitative variances for the empirical parameters or their computational implications.
3. Speculations can be made about transformations in the technical and social nature of scientific collaboration that challenge the continuing constancy of the parameters.
4. There may be unforeseeable intervention by current or future management to directly influence collaboration.

A potential 2.8% increase in collaborations should lead to a similar increase in productivity, which results from an increase in the number of research proposals generated and possibly funded, from the generation of fresh topics of research, or from the reduction in the amount of time currently spent by staff tracking down answers that a person in another building may

have. For a division with an annual budget of $80M, this potentially could result in a yearly increase of productivity approximately equal to $2.2M.

4.8 Summary of Spreadsheet Data

Table 4.8-1
Current P Division Population Distribution

Group	Number of Occupants	Number of Potential Collaborators				Number of Collaborations Estimated by Model
		Easy Same Group	*Difficult* Same Group	*Easy* Other P Group	*Difficult* Other P Group	
TA-3, Bldg 40 (Physics Building)						
P-21	15	14	43	23	285	59
P-22	1	0	63	37	265	3
P-DO	22	21	9	16	319	83
TA-3, Building 215 (Physics Analytical Center)						
P-21	42	41	16	0	308	239
TA-3, Building 216 (Weapons Test Support)						
P-22	48	47	16	4	298	304
P-DO	4	3	27	48	287	11
TA-3, Building 218 (Magnetic Energy and Storage Facility)						
P-21	1	0	57	0	308	2
TA-8, Building 21						
P-DO	1	0	30	0	335	2
TA-35, Building 2						
P-24	1	0	80	0	285	3
TA-35, Building 86 (Ten-Site Laboratory)						
P-22	4	3	60	18	284	12.3184
P-24	18	17	63	4	281	78
TA-35, Building 87						
P-24	39	38	42	3	282	233
P-DO	3	2	28	39	296	8
TA-35, Building 125 (Atlas)						
P-22	3	2	61	5	297	8
P-24	5	4	76	3	282	16
TA-35, Building 127						
P-22	4	3	60	0	302	11

Group	Number of Occupants	Number of Potential Collaborators				Number of Collaborations Estimated by Model
		Easy Same Group	*Difficult* Same Group	*Easy* Other P Group	*Difficult* Other P Group	
TA-35, Building 128						
P-24	2	1	79	0	285	6
TA-35, Building 189 (Trident)						
P-24	8	7	73	0	285	28
TA-35, Building 421 (Pulsed-Power Research Facility)						
P-24	8	7	73	0	285	28
TA-53, Building 1						
P-23	69	68	8	44	245	612
P-25	43	42	12	70	241	291
P-DO	1	0	30	112	223	4
TA-53, Building 44, 45, 46, and 47 (Trailer Complex)						
P-23	8	7	69	12	277	29
P-25	12	11	43	8	303	41
TA-53, Building 898 (Electronics Shop)						
P-22	4	3	60	0	302	11
Current Total Estimated Collaborations						2123

Table 4.8-2
Proposed P Division Building Population Distribution

Group	Number of Occupants	Number of Potential Collaborators				Number of Collaborations Estimated by Model
		Easy Same Group	*Difficult* Same Group	*Easy* Other T Group	*Difficult* Other T Group	
New GPP Building 1						
P-23	40	39	37	27	262	253
P-25	27	26	28	40	271	136
New GPP Building 2						
P-23	37	36	40	28	261	226
P-25	28	27	27	37	274	142
New Line-Item Building						
P-21	58	57	0	64	244	459
P-22	64	63	0	58	244	539
P-24	81	80	0	31	254	786

Group	Number of Occupants	Number of Potential Collaborators				Number of Collaborations Estimated by Model
		Easy Same Group	*Difficult* Same Group	*Easy* Other T Group	*Difficult* Other T Group	
P-DO	31	30	0	81	254	170
New Total Estimated Collaborations						**2713**
Percentage Increase						**28%**

4.8.1 Sensitivity Analyses: Other Cases

Tables 4.8-3, 4.8-4, and 4.8-5 show results of performing sensitivity analyses for the cost savings categories and investment parameters. Table 4.8-3 eliminates each of the major categories of cost savings, one at a time, and demonstrates the various increases in payback time resulting from fewer dollar savings. Elimination of the facility management charges increases the payback time by over 6 years, whereas removing productivity increases resulting from an improvement in the number of collaborations increases the payback time by over 4 years. Of lesser individual importance in the base-case payback bottom-line are savings from space charges, efficiencies, unexpected facility expenses, travel-time reductions, and major upgrades. Nonetheless, all cost-savings items contribute to the overall financial case, and all are helpful in making the business plan robust.

Table 4.8-3
Sensitivity Analysis to Evaluate Impact of Cost-Savings Category Compared to Base-Case Payback Time

Base-Case Modification	Payback Time	Impact to Base-Case Payback Time
No Modification	11 Years 9 Months	None
Eliminate Net Annual Savings for Facility-Management Charges	18 Years 2 Months	Added 6 Years 5 Months
Eliminate Net Annual Savings for Space Recharge	12 Years 9 Months	Added 1 Year 0 Months
Eliminate Annual Efficiency Savings	12 Years 7 Months	Added 10 Months
Eliminate Savings from Unexpected Facility Expenses	12 Years 5 Months	Added 9 Months
Eliminate Savings from Reduced Travel Time	12 Years 7 Months	Added 10 Months
Eliminate Savings from Avoided Major Upgrades	13 Years 5 Months	Added 1 Year 8 Months
Eliminate Collaboration Productivity Improvements	16 Years, 2 Months	Added 4 Years 5 Months

Table 4.8-4 demonstrates the potential effects of not using the current OMB 3.2% discount rate and reducing or increasing the construction project schedule. Not using the OMB 3.2% discount rate reduces the payback time to 10 years and 7 months (shortened by 1 year and 2 months). Lengthening the project to 6 years from 5 years will lengthen payback time by 5 months, whereas shortening the project to 4 years will reduce the payback time by 6 months.

Table 4.8-4
Sensitivity Analysis for Discount Rate and Construction Period Compared to Base-Case Payback Time

Base-Case Modification	Payback Time	Impact to Base-Case Payback Time
No Modification (Discount Rate of 3.2%)	11 Years 9 Months	None
No Discount Rate (0%)	10 Years 7 Months	Reduced 1 Year 2 Months
Lengthen Construction Project by One Year	12 Years 3 Months	Added 5 Months
Shorten Construction Project by One Year	11 Years 3 Months	Reduced by 6 Months

Table 4.8-5 shows how the discount factor of the potential increase in productivity affects the project payback time. In the base case, the potential increase in collaborations was reduced by an order of magnitude. If only 5% of the 28% increase in productivity were achieved, the payback time would increase to 13 years and 6 months. However, if the potential productivity was underestimated and 15% of the potential increase was realized, the payback rate would be reduced to 10 years and 10 months. Better still, if 25% of the potential increase in productivity were attained, the payback time would be further reduced to 8 years and 10 months.

Table 4.8-5
Sensitivity Analysis for Discount Rate of Potential Collaboration and Productivity Increases Compared to Base-Case Payback Time

Base-Case Modification	Payback Time	Impact to Base-Case Payback Time
No Modification (2.8% Potential Increase)	11 Years 9 Months	None
5% Discount Rate (1.4% Potential Increase)	13 Years 6 Months	Added 1 Year 9 Months
15% Discount Rate (4.2% Potential Increase)	10 Years 10 Months	Reduced 1 Year 1 Month
25% Discount Rate (7% Potential Increase)	8 Years 10 Months	Reduced 2 Years 11 Months

Physics Facility Strategic Plan

Implementation of this plan will result in

- the demolition of several small general utility buildings east of SM-40 and north of SM-502,
- the return of 50,000 sq ft of space (including the Atlas high bay) to the institution,
- a reduction in management and administration of 5% ($200 K),
- a reduction in Information Systems Support of 5% ($40 K),
- a reduction of maintenance and improvement work orders of 40% ($280 K),
- a reduction in property and financial support of 10% ($80 K), and
- a reduction in staff time spent driving and parking ($600 K annually).

The FSP achieves institutional goals of

- reducing the Division's footprint while increasing planning for 10% growth in personnel (by 17%: 39,000 sq ft),
- reducing maintenance costs (by 30%: from $7 M to $4.9 M),
- improving the desirability and functionality of laboratory space,
- reducing P-Division costs (by $600 K in the first year after the completion of construction), and
- increasing P-Division productivity by co-locating personnel near major collaborators at TA-3 (at an annual cost savings of $600 K).

The benefits accrued from implementing this plan will

- provide scientists with state-of-the-art facilities to better perform world-class science;
- improve our ability to attract and retain the best scientists in the world with our first-rate laboratories;
- enhance synergy among scientists and minimize nonproductive travel/parking time by locating most employees in the TA-3 area;
- improve safety, security and productivity by designing space for the required functions with the right balance of lab and office, and classified and unclassified;
- reduce annual operating costs significantly by returning large amounts of space to the institution to be either destroyed or put into effective use for other needs; and
- reduce maintenance costs through the use of new facilities over the old.