LA-UR-97-1000

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# ALTERNATIVES FOR INCREASING THE NUCLEAR MATERIALS PROCESSING SPACE AT LOS ALAMOS FOR FUTURE MISSIONS

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*Submitted to:*

**http://lib-www.lanl.gov/la-pubs/00326510.pdf**

Los Alamos
NATIONAL LABORATORY



Form No. 836 R5
ST 2629 10/91

LA-UR-97-1000

# Alternatives for Increasing the Nuclear Materials Processing Space at Los Alamos for Future Missions

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April 25, 1997

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*Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENF-36.*

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Table of Contents

List of Tables

List of Illustrations

## 1. Abstract

Los Alamos has considered five alternative facility configurations to meet the mission requirements that the Department of Energy has established for nuclear materials processing at Los Alamos. The preferred alternative, based on several criteria, is to reconfigure the floor layout of Wings 3, 5, and 7 in the Chemistry and Metallurgy Research (CMR) building, place all analytical chemistry functions in Wings 3 and 7, and move displaced functions from Technical Area (TA)-55 to CMR Wing 5. This configuration fulfills the floorspace requirements for Defense Programs (DP), non-DP, and support functions, and provides for efficient and cost-effective operation of the two primary actinide-handling facilities, PF-4 and the CMR building, at Los Alamos. Cold/light laboratory and office space requirements are also integrated into the analysis. Wings 2 and 4 of the CMR building will be used as cold/light laboratory, PF-3 will be minimally used for cold laboratory, and new offices will be constructed at both TA-55 and adjacent to the CMR building to fulfill office space requirements.

## 2. Introduction

The Capability Maintenance and Improvement Project (CMIP) will provide for improvements in infrastructure, containment purchases, and equipment purchases so that Los Alamos will be able to fulfill the anticipated programmatic requirement of producing 50 war reserve (WR) pits per year for the enduring nuclear weapons stockpile starting in 2005. However, pit manufacturing will not be the only program at Los Alamos that requires dedicated floorspace in a Category 1 nuclear materials facility. Other programs, such as pit surveillance, milliwatt heat source processing, neutron source recovery, special recovery, and others, currently exist in Plutonium Facility-4 (PF-4) at TA-55 (with the associated analytical chemistry functions located in the CMR building) and will continue after 2005. Examination of the floorspace requirements indicates that increased floorspace for Category 1 nuclear materials processing and analytical chemistry will be required to meet programmatic commitments after 2005.

The CMR Upgrades Project is intimately linked with the CMIP in that it has already provided for improvements of the infrastructure at the CMR building and will provide for improvements in the CMR main vault, the operations center, and improvements to Wings 1, 3, 5, 7, and 9 in the future. The upgrades include a mix of maintenance and safety projects such as chilled water improvements, communication upgrades, and operations center upgrades, as well as some major facility infrastructure improvements, such as the bracing of the facility to meet current seismic codes, the improvement of the facility confinement barrier, and the upgrade of the ventilation and confinement zone system. The CMR Upgrades Project is intended to extend the useful life of the CMR building for at least twenty years. The Nuclear Materials Safeguards and Security Upgrades Project is also closely linked to the CMIP as several of the exterior security upgrades pertain directly to facilities used for implementation of the CMIP, including TA-55 and the CMR building.

With the requirements for additional processing and analytical chemistry floorspace, the question of how to most efficiently and cost-effectively configure the functions in the nuclear facilities at Los Alamos arises. The ideal configuration may also include construction of new facilities to house specific functions. Five potential configurations of the Los Alamos nuclear materials facilities (including new construction) are examined. A set of non-cost qualitative criteria and metrics is presented, and each alternative is ranked according to the metrics. Then, cost information for the five alternatives is presented. The analysis of the configuration for the preferred alternative is then expanded to include locating cold/light laboratory space and office space. Examining the qualitative criteria and cost information for each configuration then leads to a preferred alternative.

## 3. Core Programmatic Requirements

Comparison of current programmatic requirements with future programmatic requirements helps define the programs that will require additional floorspace and/or equipment in the future. Seven Defense Programs (DP), six non-DP programs, and several supporting functions currently require floorspace and equipment allocations.

Two steps are involved in determining the floorspace requirements for CMIP programs and functions. First, subject matter experts provided the total floorspace that their program or function would require based on the associated program requirements for post-2005 years. This information was provided without regard to the final location of the program or function. Results of this analysis indicated that approximately 15,000 square feet are required in addition to floorspace presently available in PF-4. This additional required floorspace is approximately equal to one “area” in PF-4, which is approximately 25% of the Category 1 floorspace in PF-4, or the floorspace in a reconfigured wing in the CMR building. In the configuration alternatives that are described in a subsequent section, placing the additional Category 1 functions in Wing 5 of the CMR building is considered as the preferred alternative for the location of the additional floorspace.

Second, the following criteria were employed to select the programs that are located in PF-4 or Wing 5 of the CMR building:

(1) total floorspace should fulfill all programmatic and functional requirements;
(2) only low-level radioactive liquid waste should be generated at the CMR building;
(3) major equipment, such as the evaporator, should not be moved;
(4) both locations should dedicate space to materials handling and waste management functions;
(5) functions, such as Pu-238 operations, that would require significant decontamination will not move; and

(6) additional ancillary functions that specific programs require will be moved if the program is moved.

With the information and criteria above, the floorspace allocations for DP programs, non-DP programs, and support functions were determined.

**Defense Programs**

3.1 Pit Fabrication

3.1.1 Pit Rebuild (1996-2004)

The goal of the pit rebuild program is to develop and maintain the technology base required to build pits so that War Reserve (WR)-quality pits can replace units removed from the stockpile for surveillance purposes or other directed assignments by DOE. The pit manufacturing and quality capabilities required to build WR-qualified pits at Los Alamos will be developed, and these capabilities will be demonstrated by building pits that can be qualified. The equipment, tooling, and inventory transfers from Rocky Flats and the design required by the changes in the manufacturing infrastructure will be completed. The weld parameters, the coating parameters, the necessary plutonium technologies, and non-nuclear fabrication technologies will be developed.

Los Alamos will produce a few War Reserve (WR) pits per year during this period. Present floorspace allocations for the pit rebuild program, which includes general pit fabrication, disassembly, assembly, and radiography are 11,400 sq. ft.

3.1.2 Pit Fabrication (2005 and Beyond)

Los Alamos will produce approximately fifty War Reserve (WR) pits per year during this period, while establishing the capacity to produce eighty pits per year with multiple shifts. Future floorspace allocations for pit fabrication programs are 18,500 sq. ft., of which 3,200 sq. ft. will be located at the CMR building. The space at the CMR building will be used primarily to test new technologies outside of the production lines and to prepare components for testing.

3.2 Pit Surveillance

3.2.1 Pit Surveillance (1996-2004)

Los Alamos conducts destructive and nondestructive evaluations on pits to evaluate stockpile reliability and staging safety. Each destructive evaluation, depending on pit type, includes the following operations: leak testing, weighing, dimensional inspection, dye penetrant inspection, radiography, metallography, chemical analysis, and micro-tensile testing. Most of these operations, except radiography, are performed at TA-55 and share lathes and other equipment with pit fabrication. Each evaluation culminates in a detailed evaluation report on the condition of the pit. Approximately 20 pits are examined each year. The pit material remaining after the evaluations is properly stored in the TA-55 vault.

Los Alamos will destructively or nondestructively examine between twenty and forty pits per year during this period. Present floorspace allocations for the pit surveillance program are 2,300 sq. ft. Pit surveillance floorspace allocations do not include space shared with the pit rebuild program.

### 3.2.2 Pit Surveillance (2005 and Beyond)

Los Alamos will destructively or nondestructively examine twenty to forty pits per year during this period. Future floorspace allocations for pit surveillance programs are 4,500 sq. ft., all of which will be located at the CMR building.

## 3.3 Nuclear Materials Operations

### 3.3.1 Nuclear Materials Stabilization and Packaging (1996-2004)

Currently, Los Alamos uses aqueous nitrate and chloride chemical techniques to extract plutonium from waste materials and residues. Processes include dissolution, ion exchange, solvent extraction, precipitation, pyrolysis, and carbonate oxidation/salt distillation. Pyrochemical recovery operations, or electrorefining, convert impure actinide metal to pure actinide metal.

The nuclear materials stabilization and packaging program was initiated to place actinide-bearing wastes and residues into more stable forms such as metal or oxide. Soon after this program was established at Los Alamos, the Defense Nuclear Facilities Safety Board (DNFSB) issued the 94-1 Recommendation, which stipulated a similar nuclear materials stabilization program. The stabilization program has an eight year lifetime and is currently scheduled to be completed in 2002-2004 years. Present floorspace allocations for the aqueous and pyro recovery program are 13,400 sq. ft.

### 3.3.2 Aqueous and Pyro Recovery (2005 and Beyond)

Future floorspace allocations for aqueous and pyro recovery functions remain at 13,400 sq. ft. in PF-4. Increased capacity for this function to support the production of fifty pits per year is provided by completion of the nuclear materials stabilization and packaging program.

## 3.4 Pu-238 Heat Source and Recovery

### 3.4.1 Pu-238 Heat Source and Recovery (1996-2004)

The Pu-238 recovery program includes $^{238}PuO_2$ fuel recycle and reprocessing, $^{238}PuO_2$ heat-source recovery, disposition, and stabilization operations. The $PuO_2$ removed from excess and retired milliwatt radioisotope thermoelectric generators (MWGs) and other heat sources received from Pantex, Sandia, and other facilities is processed at Los Alamos. In the Los Alamos fuel recycle and reprocessing areas, aqueous and high-temperature (ceramic) processing are conducted to ensure the availability of fuel for heat source fabrication operations, to recover fuel from process waste steams, and to stabilize process residues. Approximately 8.0 kg of $^{238}$Pu have been reprocessed through these operations.

Los Alamos will maintain the capability to recover and handle Pu-238 from both defense-related and nondefense-related heat sources. Because these are potentially high-dose operations, special glovebox lines are required. Present floorspace allocations for the Pu-238 heat source and recovery program are 6,000 sq. ft. for the DP activities.

### 3.4.2 Pu-238 Heat Source and Recovery (2005 and Beyond)

Los Alamos will maintain the capability to recover and handle Pu-238 from both defense-related and nondefense-related heat sources to support the safety of the milliwatt power sources in the stockpile. Future floorspace allocations for Pu-238 work are 6,000 sq. ft. in PF-4 for DP-related programs. Moving Pu-238 operations out of PF-4 would require significant decontamination of the area before other functions could use that space. Moving Pu-238 operations away from TA-55 would require installation of new storage tanks (i.e., a vault) for Pu-238 materials, which are currently stored in the PF-4 working vault in the basement.

## 3.5 Stockpile Stewardship Programs

### 3.5.1 Stockpile Stewardship Programs (1996-2004)

These programs utilize the actinide processing technologies developed at TA-55 for use in nuclear weapons-related experimental tests. The actinide processing technologies include reprocessing and fabrication functions.

Los Alamos will maintain the current capability for actinide production and processing for Stockpile Stewardship programs. Present floorspace allocations for these programs are 2,300 sq. ft. in PF-4.

### 3.5.2 Stockpile Stewardship Programs (2005 and Beyond)

Los Alamos will maintain the current capability for actinide production and processing for Stockpile Stewardship programs. Future floorspace allocations for Stockpile Stewardship programs are 2,300 sq. ft. in PF-4.

## 3.6 Special Recovery Line

### 3.6.1 Special Recovery Line (1996-2004)

The Special Recovery Line supports the disassembly and recovery of plutonium and other actinides that are potentially contaminated with tritium. Special precautions are used in these cases to ensure that any tritium operations are within DOE guidelines.

Los Alamos will disassemble between twelve and forty pits per year that are potentially contaminated with tritium. Present floorspace allocations for the Special Recovery Line are 700 sq. ft.

### 3.6.2 Special Recovery Line (2005 and Beyond)

Los Alamos will disassemble up to forty pits per year that are potentially contaminated with tritium. Future floorspace allocations for the Special Recovery Line are 1,200 sq. ft. in Wing 5 of the CMR building.

## 3.7 Actinide Research & Development Support

### 3.7.1 Research & Development Support (1996-2004)

As part of the efforts to better understand the material science aspects of nuclear weapons aging and performance, various materials research activities are conducted at and supported by TA-55. Better understanding of the aging characteristics of plutonium is required to continually assess the safety of nuclear weapons. Experiments are also conducted on research and development aimed at the scientific underpinnings of stockpile activities, such as improved welding and bonding processes, development of special mold coatings to resist plutonium attack, and fire-resistance tests. Some activities are related to the dynamic experiments conducted by Los Alamos and involve experiments at other sites as well as TA-55. At TA-55, materials testing uses the 40 mm Impact Test Facility and the Kolsky bar apparatus for determining the shock wave properties of materials and stress-strain curves for solids in compression and tension. Much of the experimentally derived data from these experiments are used as benchmark data for computer simulation codes. Although these research efforts involve relatively small amounts of plutonium compared to other activities at TA-55, the work is a crucial part of the TA-55 efforts. The elimination of underground nuclear testing has magnified the need for better material knowledge of plutonium, and fundamental research is central to this understanding. Research efforts also focus on actinide chemical separation techniques and waste management issues.

Los Alamos will maintain the capability to perform general research and development of plutonium chemistry and metallurgical processes. Present floorspace allocations for general actinide research and development programs are 3,400 sq. ft.

### 3.7.2 Research & Development Support (2005 and Beyond)

Los Alamos will maintain the capability to perform general defense-related and nondefense-related research and development of plutonium chemistry and metallurgical processes. Future floorspace allocations for actinide research and development are 3,400 sq. ft. in PF-4 and 1,000 sq. ft. in Wing 5 of the CMR building.

**Non-DP Programs**

## 3.8 Pu-238 Heat Source and Recovery

### 3.8.1 Pu-238 Heat Source and Recovery (1996-2004)

Activities in the Pu-238 heat source production program are conducted to maintain the technology base required for MWG heat source production, the design and development of new MWG heat sources, and to ensure the safety of deployed or proposed MWG heat source designs and configurations. Program activities support national and international space exploration programs, provide heat sources for national defense purposes, and provide heat sources for use as calorimetric and radiation sources. Currently, approximately 24 kg of Pu-238 are processed yearly.

Los Alamos will maintain the capability to produce and recover Pu-238 from both defense-related and nondefense-related heat sources. Because these are potentially high-dose operations, special glovebox lines are required. Present floorspace allocations for the non-DP Pu-238 heat source and recovery program are 3,000 sq. ft.

### 3.8.2 Pu-238 Heat Source and Recovery (2005 and Beyond)

Los Alamos will maintain the capability to produce and recover Pu-238 from both defense-related and nondefense-related heat sources. Future floorspace allocations for Pu-238 work are 3,000 sq. ft. in PF-4 for non-DP related programs.

## 3.9 Neutron Source Materials Recovery

### 3.9.1 Neutron Source Materials Recovery (1996-2004)

A large number of neutron sources (approximately 20,000) were provided by the Atomic Energy Commission (AEC) and its successors to universities, industry, and government agencies. Most of these sources are no longer in use, and many source owners would like to transfer their sources to other owners or to dispose of them. Typical sources in this category generate neutrons by an alpha-neutron reaction between a radionuclide and a light metal or light metal oxide such as beryllium, Be, or beryllium oxide, BeO. The radionuclides most commonly in use are $^{239}$Pu, $^{241}$Am, and $^{238}$Pu. Separation (recovery) of the radionuclide from the light metal or light metal oxide before material storage is desirable.

Los Alamos will recover the plutonium from 110 neutron sources (usually PuBe sources) per year during this period. These neutron sources produce large dose rates during initial material transfers and recovery processes until the plutonium or americium is separated from the beryllium. Present floorspace allocations for neutron source materials recovery programs are 800 sq. ft.

### 3.9.2 Neutron Source Materials Recovery (2005 and Beyond)

Los Alamos will recover the plutonium from 110 neutron sources (usually PuBe sources) per year during this period. Future floorspace allocations for neutron source materials recovery are 800 sq. ft. in PF-4.

## 3.10 Fissile Material Disposition – ARIES and MOX Fuels

### 3.10.1 ARIES and MOX Fuels (1996-2004)

The goal of the National Fissile Materials Disposition (MD) Program is to implement the disposition of excess fissile material from the US nuclear weapons program. Los Alamos has been asked to provide technical support to this program in two key areas: pit disassembly/material conversion and nuclear fuels technology.

The Advanced Recovery and Integrated Extraction System (ARIES) is an integrated system that can disassemble a pit in a lathe cutting operation, convert the plutonium with a hydride-dehydride furnace into a plutonium pellet, place the material in a welded storage container, decontaminate, and assay the container. An alternate output, with some modifications, is to provide the plutonium as an oxide suitable for fabrication into mixed-oxide (MOX) reactor fuel, or for immobilization in a glass, ceramic, or other material matrix.

Los Alamos will demonstrate the ability to declassify the plutonium from specific older pit types using ARIES. Los Alamos will also demonstrate the ability to produce mixed oxide fuel from older pits for use in nuclear reactors. Present floorspace allocations for fissile materials disposition programs are 1,000 sq. ft. and 3,000 sq. ft for ARIES and MOX demonstration programs, respectively.

### 3.10.2 Material Disposition and MOX Fuel (2005 and Beyond)

Los Alamos will retain the ability to declassify the plutonium from specific older pit types using ARIES. The plutonium is converted from a classified form in the pit to a declassified pellet of plutonium metal. Los Alamos will continue to produce mixed oxide fuel from older pits for use in nuclear reactors. Future floorspace allocations for the ARIES system and MOX fuels are 1,500 sq. ft. and 3,000 sq. ft. in PF-4, respectively.

## 3.11 EM Technology Support (1996-2002)

Los Alamos provides continuing technical support to the Environmental Management (EM) Office of the DOE to assist in better understanding selected issues associated with clean-up activities around the DOE Complex. Los Alamos was designated as the lead laboratory by DOE for stabilization process development. The efforts for EM are in three general areas, including (1) issues associated with stabilization, chemical processing, storage shelf-life, surveillance, and skid mounted processing techniques; (2) technical transfer matters involving mock-ups and operator training of personnel from other DOE sites; and (3) stabilizing minor quantities of specialty items from other DOE sites at TA-55. Present floorspace allocations for EM technology support programs are 800 sq. ft. The need for this space by EM technology support eventually ends.

## 3.12 Non-Proliferation Technologies

### 3.12.1 Non-Proliferation Technologies (1996-2004)

The TA-55 non-proliferation technologies involve development of safeguards methodologies and instrumentation for plutonium non-destructive assay (NDA). A typical example is the development of NDA equipment for the ARIES program. Plutonium NDA devices developed for non-proliferation purposes are routinely tested at TA-55. TA-55 provides Los Alamos with a unique capability to determine needs for and development of non-proliferation technology. Although the direct non-proliferation technology funding is not large, TA-55 supports the development of safeguards instrumentation that contributes to non-proliferation technology.

Los Alamos will develop safeguards instrumentation for non-proliferation technologies, yet no dedicated floorspace will be allocated, as the equipment can be shared with materials management activities.

### 3.12.2 Non-Proliferation Technologies (2005 and Beyond)

Los Alamos will continue to develop safeguards instrumentation for non-proliferation technologies, yet no dedicated floorspace will be allocated, as the equipment can be shared with materials management activities.

## Supporting Functions

### 3.13 Materials Management and Radiation Control

#### 3.13.1 Materials Management and Radiation Control (1996-2004)

Materials management and radiation control includes all support activities that track material movements to and from processing function spaces and storage areas such as the PF-4 vault. Also, all facilities that process nuclear materials must allocate space for radiation measurement and control support staff. Present floorspace allocations for the materials management and radiation control functions are 4,400 sq. ft.

#### 3.13.2 Materials Management and Radiation Control (2005 and Beyond)

Future floorspace allocations for the materials management and radiation control functions are 4,400 sq. ft. in PF-4 and 2,000 sq. ft. in the CMR building.

### 3.14 Waste Management

#### 3.14.1 Waste Management (1996-2004)

The processing and recovery programs produce waste materials that contain trace amounts of actinides. The presence of actinides requires that the waste material must be properly packaged and assayed prior to disposal. Present floorspace allocations for the materials management and radiation control functions are 2,400 sq. ft.

#### 3.14.2 Waste Management (2005 and Beyond)

Future floorspace allocations for the materials management and radiation control functions are 2,400 sq. ft. in PF-4 and 1,200 sq. ft. in the CMR building.

### 3.15 Analytical Chemistry - Metallography

#### 3.15.1 Analytical Chemistry - Metallography (1996-2004)

A core capability at TA-55 is the fundamental and applied analysis of plutonium using metallography. This supports the nuclear materials processing activities at TA-55. Present floorspace allocations for analytical chemistry metallography functions in PF-4 are 4,700 sq. ft.

#### 3.15.2 Analytical Chemistry - Metallography (2005 and Beyond)

Future floorspace allocations for analytical chemistry metallography functions are 2,600 sq. ft. in PF-4 and 1,500 sq. ft. in the CMR building. This reduction in floorspace is the result of including analytical chemistry functions that are specific to pit surveillance with the pit surveillance function and reduced floorspace requirements that result from improvements in analytical chemistry technologies.

### 3.16 Contingency Space

1,500 sq. ft. and 700 sq. ft of contingent space have been allocated in PF-4 and the CMR building, respectively. Programs that could use this space include Enhanced Surveillance. A contingency space analysis was not performed; however, the contingency space, based on estimated excess floorspace, has been built into the requirements. This amounts to a minimal rate of 3% contingency.

Table 1 summarizes the present and future floorspace allocations for Category 1 laboratory space by program and function.

Table 1. Category 1 Laboratory Space Requirements.

| | Present PF-4 | Future PF-4 | Future CMR | Change |
|---|---|---|---|---|
| **DP-Programs** | | | | |
| Pit Fabrication - General | 11,400 | 11,500 | 2,200 | 2,300 |
| Pit Fabrication - Disassembly | 0 | 0 | 1,000 | 1,000 |
| Pit Fabrication - Assembly | 0 | 3,100 | 0 | 3,100 |
| Pit Fabrication - Radiography | 0 | 700 | 0 | 700 |
| Pit Surveillance | 2,300 | 0 | 4,500 | 2,200 |
| Pu-238 Heat Sources & Recovery | 6,000 | 6,000 | 0 | 0 |
| Stockpile Stewardship Programs | 2,300 | 2,300 | 0 | 0 |
| Special Recovery Line | 700 | 0 | 1,200 | 500 |
| Actinide Research & Development | 3,400 | 3,400 | 1,000 | 1,000 |
| **Non-DP Programs** | | | | |
| Pu-238 Heat Sources & Recovery | 3,000 | 3,000 | 0 | 0 |
| Neutron Source Mat'ls Recovery | 800 | 800 | 0 | 0 |
| Fissile Materials Disposition - ARIES | 1,000 | 1,500 | 0 | 500 |
| Fissile Materials Disposition - MOX | 3,000 | 3,000 | 0 | 0 |
| EM Technology Support | 800 | 0 | 0 | –800 |
| Non-Proliferation Technologies | 0 | 0 | 0 | 0 |
| **Support Functions** | | | | |
| Aqueous and Pyro Recovery | 13,400 | 13,400 | 0 | 0 |
| Mat'ls Management and Rad. Control | 4,400 | 4,400 | 2,000 | 2,000 |
| Waste Management | 2,400 | 2,400 | 1,200 | 1,200 |
| Analytical Chemistry - Metallography | 4,700 | 2,600 | 1,500 | –600 |
| Contingency Space | 0 | 1,500 | 700 | 2,200 |
| Totals | 59,600 | 59,600 | 15,300 | 15,300 |

## 4. CMIP/CMR Configuration Alternatives Analysis

In this section, five alternatives of the coarse (locations of specific analytical chemistry functions are not specified) floorspace allocations for PF-4 and the CMR building are presented, along with floorspace allocations in newly constructed facilities if such buildings are associated with a particular alternative. The current facility configuration serves as a baseline for the alternatives that will fulfill the future programmatic requirements associated with the expanded pit manufacturing mission scheduled to begin in 2005.

### 4.1 Current Facility Configuration

The current mission and programmatic requirements for nuclear materials processing space are fulfilled with the current facility configuration. This configuration is composed of a fully utilized PF-4 with approximately 60,000 sq. ft. of useable laboratory space and full utilization of Wings 3, 5, 7, and 9 in the CMR building. Wings 3, 5, and 7 are dedicated to analytical chemistry operations and account for a total of approximately 24,000 sq. ft. of useable laboratory space. Wing 2 of the CMR building is utilized for light laboratory support for various programs, and Wing 4 contains a few low-hazard activities. A schematic drawing of PF-4 and the CMR building is provided in Figure 1. Only laboratory space exists on the processing floor in PF-4. In the CMR building, offices are located on the outer portions of each wing, adjacent to the laboratories.

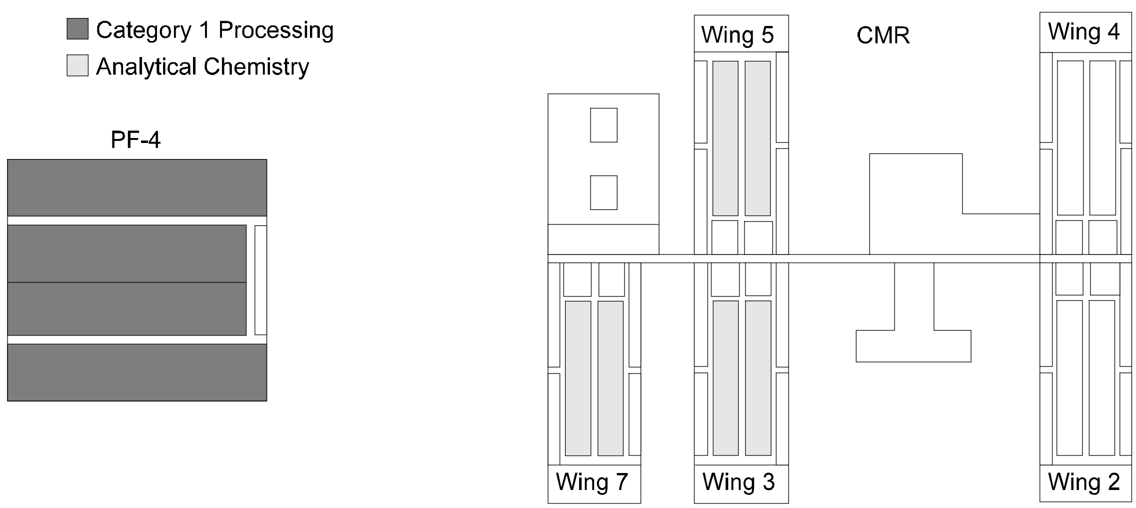



Figure 1. Current PF-4 and CMR configuration and utilization.

## 4.2 Alternative Future Facility Configurations

For Los Alamos to establish a pit production capability and capacity to produce approximately 50 WR pits per year, significant alterations to existing space within PF-4 and the purchase and installation of additional specialized plutonium handling equipment are required. The reconfiguration of existing space within PF-4 was examined as a first step. PF-4 is currently the only operable Hazard Category 2, non-reactor nuclear space that meets Category 1 Safeguards & Security requirements at Los Alamos. However, all laboratory floorspace is utilized. Reconfiguration of the space to support the required pit manufacturing process flow would displace other current programs within the facility. Currently several programs, including pit rebuild, pit surveillance, Stockpile Stewardship programs, and R&D, share equipment. This arrangement is impractical for operations required for a dedicated pit fabrication mission. To ensure that all programs can be accommodated, an additional 15,300 sq. ft. of Hazard Category 2, non-reactor nuclear space that meets Category 1 Safeguards and Security Requirements, as discussed in the previous sections, are needed. This can be accomplished through a number of alternative approaches, which are discussed below.

Each alternative assumes that office space will be separated from the laboratory space. Currently in the CMR building, staff office space is located adjacent to the analytical chemistry laboratories. The Safety Authorization Basis of the CMR building relies on administrative controls (for example, “tie wraps” on laboratory doors prevent access to laboratories from the office hallways) for cold office space adjacent to nuclear laboratory space. The easiest means of replacing such administrative controls with engineered controls is to remove the offices from the wings that house nuclear material handling laboratories. Whether or not a wing is reconfigured, future office space will not be located in a wing where nuclear materials are being handled. Therefore, each alternative will have a fixed cost associated with relocating or constructing offices to replace those in Wings 2, 3, 4, 5, and 7.

### 4.2.1 Alternative A

By reconfiguring CMR Wing 4 for Category 1 operations and upgrading Wing 2 for analytical chemistry operations, mission and functional requirements can be fulfilled by retaining the current configuration of PF-4 and Wings 2, 3, 5, and 7 of the CMR building.. The following function locations are specified and are also shown in Figure 2:

(1) pit manufacturing is completely housed in PF-4;
(2) upgraded CMR Wings 3, 5, and 7 continue to perform analytical chemistry functions;
(3) additional analytical chemistry capacity (approximately 8,000 sq. ft.) is installed in CMR Wing 2;
(4) CMR Wing 4 is upgraded and reconfigured to house the functions and programs displaced by expanded pit manufacturing requirements (15,300 sq. ft.); and
(5) a Perimeter Intrusion Detection Alarm System (PIDAS) is placed around the entire CMR building.

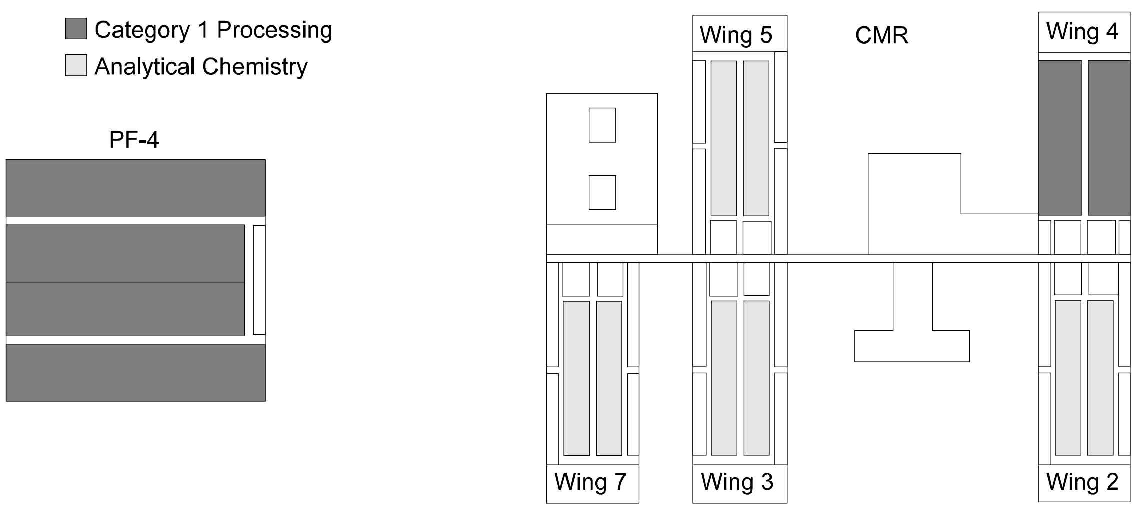



Figure 2. Alternative A PF-4 and CMR configuration and utilization.

Alternative A has the following features:

- all floorspace in PF-4 and the CMR building is utilized;
- full utilization of PF-4 and the CMR building implies new construction if future missions require nuclear materials laboratory space;
- exterior space in four high-value laboratory wings is used for storage; and
- the Materials Access Area (MAA) boundary includes all wings.

### 4.2.2 Alternative B

Mission and functional requirements can be fulfilled while maintaining the current configuration of both the CMR building and PF-4 by constructing new facilities to house the required additional analytical chemistry functions and Category 1 functions displaced by expanded pit manufacturing operations. The following function locations are specified and are also shown in Figure 3:

(1) pit manufacturing is completely housed in PF-4;
(2) upgraded CMR Wings 3, 5, and 7 continue to perform analytical chemistry functions;
(3) additional analytical chemistry capacity (greater than 8,000 sq. ft.) is located in a new facility at TA-55; and
(4) the functions and programs displaced by expanded pit manufacturing requirements are located in a new facility at TA-55 (15,300 sq. ft.).

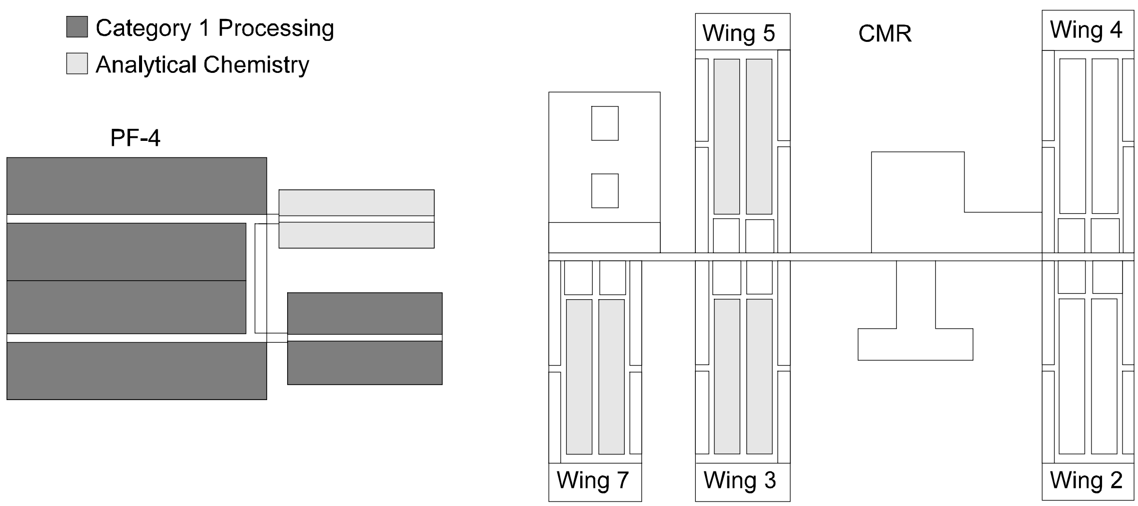



Figure 3. Alternative B PF-4 and CMR configuration and utilization.

Alternative B has the following features:

- very little nuclear material is handled at the CMR building, which potentially eliminates the need for a PIDAS at the CMR building;
- no additional laboratory space, in the form of reconfiguration, is required at the CMR building;
- office space in three high-value laboratory wings is used for storage;
- analytical chemistry functions are separated, thus creating the need for large sample shipment requirements and duplication of key functions such as sample management and waste handling; and
- new construction, which may complicate regulatory compliance issues and compete with the Nuclear Materials Storage Facility (NMSF) construction, is required at TA-55.

### 4.2.3 Alternative C1

Mission and functional requirements can be fulfilled by constructing a new facility at TA-55 to house the Category 1 functions displaced by expanded pit manufacturing operations while maintaining the current configuration of both the CMR building and PF-4. The following function locations are specified and are also shown in Figure 4:

(1) pit manufacturing is completely housed in PF-4;
(2) upgraded CMR Wings 3, 5, and 7 continue to perform analytical chemistry functions;
(3) additional analytical chemistry capacity (approximately 8,000 sq. ft.) is located in CMR Wing 2;
(4) the functions and programs displaced by expanded pit manufacturing requirements are located in a new facility at TA-55 (15,300 sq. ft.); and
(5) a PIDAS is placed around the entire CMR building.

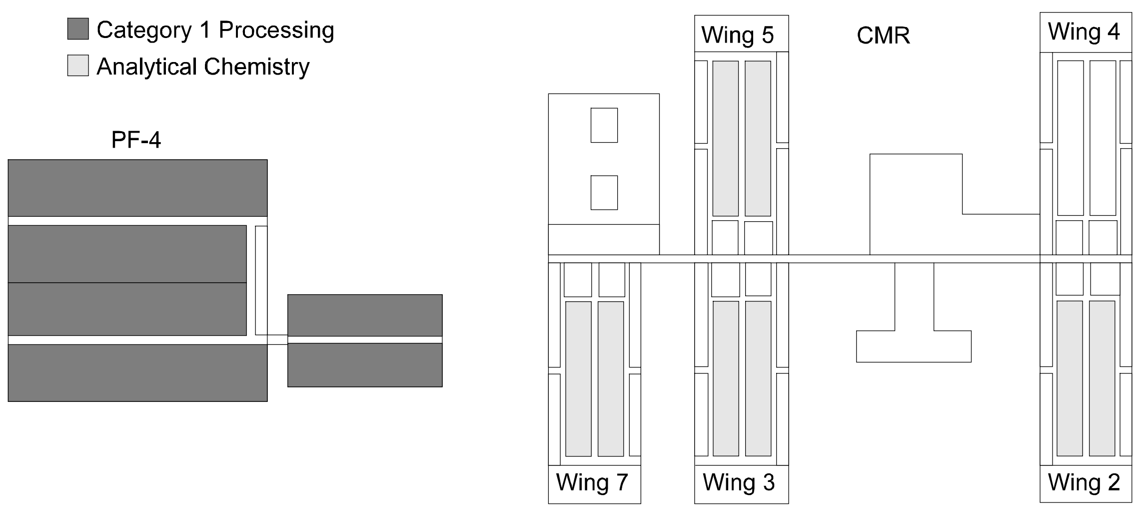



Figure 4. Alternative C1 PF-4 and CMR configuration and utilization.

Alternative C1 has the following features:

- no additional laboratory space, in the form of reconfiguration is required at the CMR building;
- office space in four high-value laboratory wings is used for storage; and
- new construction, which may complicate regulatory compliance issues, and compete with the Nuclear Materials Storage Facility (NMSF) construction, is required.

### 4.2.4 Alternative C2

Mission and functional requirements can be fulfilled by constructing a new facility at TA-55 to house the Category 1 functions displaced by expanded pit manufacturing operations and reconfiguring two wings in the CMR building. The following function locations are specified and are also shown in Figure 5:

(1) pit manufacturing is completely housed in PF-4;
(2) CMR Wings 3 and 7 are reconfigured and continue to perform analytical chemistry functions;
(3) additional analytical chemistry capacity (approximately 8,000 sq. ft.) is located in space created by the CMR wing reconfiguration;
(4) the functions and programs displaced by expanded pit manufacturing requirements are located in a new facility at TA-55 (15,300 sq. ft.); and
(5) a PIDAS is placed around one-half of the CMR building.

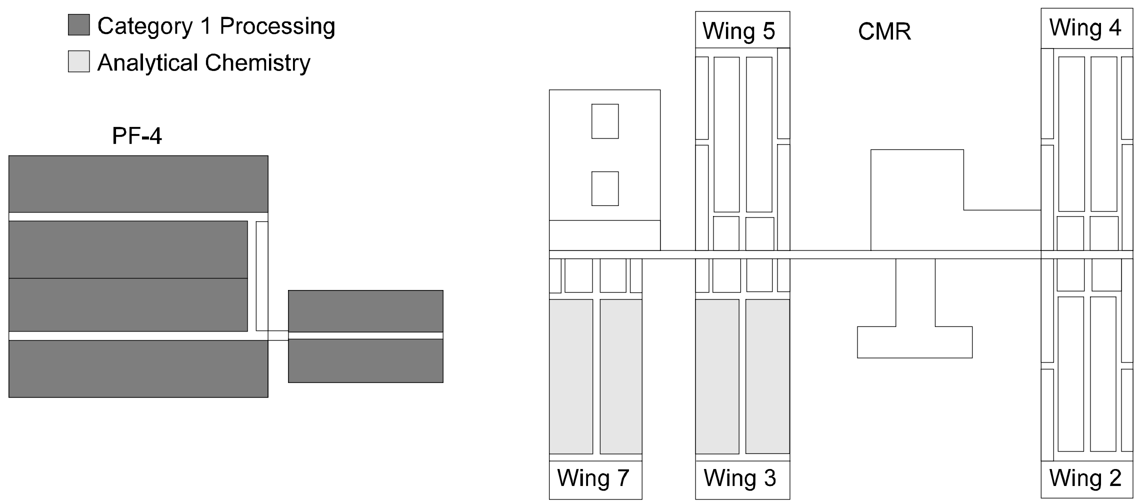



Figure 5. Alternative C2 PF-4 and CMR configuration and utilization.

Alternative C2 has the following features:

- there is abundant space available in the CMR building for potential future missions;
- the CMR building is poorly utilized (Wing 5 placed in safe standby); and
- new construction, which may complicate regulatory compliance issues and compete with the Nuclear Materials Storage Facility (NMSF) construction, is required at TA-55.

### 4.2.5 Alternative D

Mission and functional requirements can be fulfilled by reconfiguring the CMR building to house additional analytical chemistry functions and the Category 1 functions displaced by expanded pit manufacturing operations. The following function locations are specified and are also shown in Figure 6:

(1) pit manufacturing is completely housed in PF-4;
(2) CMR Wings 3 and 7 are reconfigured and continue to perform analytical chemistry functions;
(3) additional analytical chemistry capacity (approximately 8,000 sq. ft.) is located in space created by the reconfiguration of CMR Wings 3 and 7;
(4) the functions and programs displaced by expanded pit manufacturing operations are located in the reconfigured CMR Wing 5; and
(5) a PIDAS is required around one-half of the CMR building.

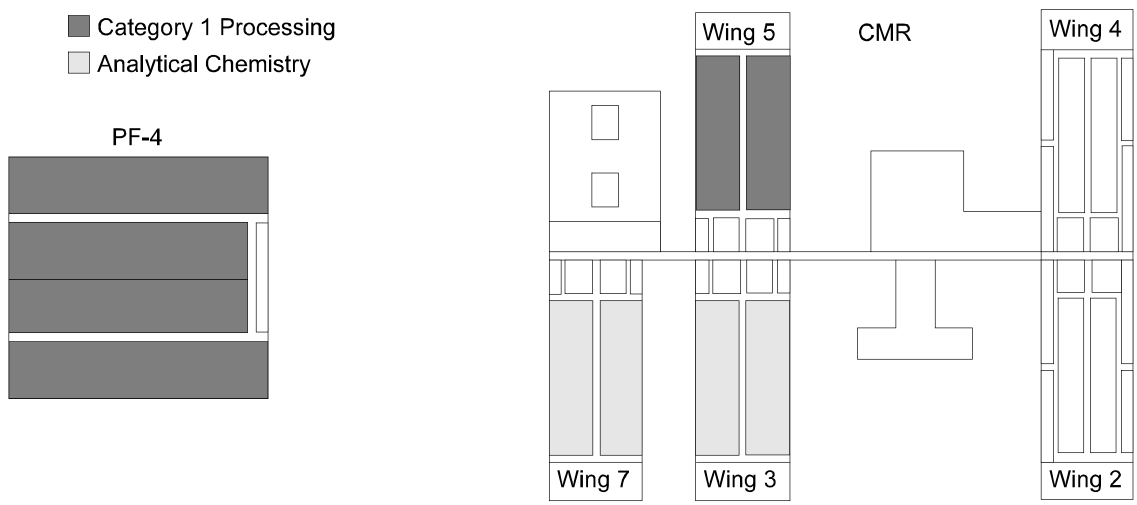



Figure 6. Alternative D PF-4 and CMR configuration and utilization.

Alternative D has the following features:

- there is abundant space available in the CMR building for potential future missions;
- no additional laboratory space is required at the CMR building;
- the CMR building is efficiently utilized;
- no construction of new nuclear facilities is required; and
- shipments of nuclear materials and analytical chemistry samples are reduced.

4.3 Systematic Non-Cost Comparisons

Ten qualitative criteria have been established to evaluate and compare the five alternatives. The criteria, along with explanatory metrics and rank ordering of the alternatives are provided below (the higher an alternative is in the order, the better it meets the criterion). Alternatives shown in parentheses are of equal ranking. A more specific basis for the rank ordering is also provided. Following the list of criteria and rankings, Table 2 contains a summary with the alternatives assigned numerical values according to rank, with 5 being the highest ranking and 1 being the lowest rank. For alternatives that have equal value, the highest ranked alternative(s) is(are) assigned a value of 5, the next highest ranked alternative(s) is(are) assigned a rank of 4, etc. Totaling the rank provides a metric for establishing a preferred alternative based on the non-cost qualitative measures. Summing the ranks to establish a preferred alternative implies equal weighting to the ten criteria.

(1) Operational Effectiveness – Co-location of facilities reduces sample and material shipments, thereby increasing production efficiency.
Rank Order: (C1, C2), B, D, A
Basis: Proximity of Category 1 processing functions and proximity of analytical chemistry to the processing functions.

(2) Flexibility of Facilities – Facilities should be able to perform a variety of missions and be capable of support potential future missions.
Rank Order: C2, (D, B), C1, A
Basis: Future available space in CMR.

(3) Regulatory Compliance – The final configuration should be able to easily comply with Federal regulations that apply to nuclear facilities.
Rank Order: B, C2, C1, D, A
Basis: Maximum new construction versus upgrades of existing facilities.

(4) Category 1 Facility Utilization – Well-utilized, efficient, and cost-effective use of existing facilities should enhance the ability of the CMIP to be implemented at Los Alamos.
Rank Order: D, A, C2, C1, B
Basis: Maximum use of existing facilities.

| | |
|---|---|
| (5) Impact on Other Lab Programs – | Modification of existing facilities should produce as little disruption as possible to ongoing Laboratory programs.<br>Rank Order: (D, A), (B, C1, C2)<br>Basis: Minimal function and equipment relocations. |
| (6) MC & A and Health and Safety – | Security of sensitive materials and personnel safety are enhanced and radiation exposures are reduced by minimizing the number of shipments or transfers.<br>Rank Order: B, (C2, C1), (D, A)<br>Basis: Minimal shipments of proliferation sensitive materials. |
| (7) Physical Security – | The physical security of nuclear materials facilities should be maximized.<br>Rank Order: B, (C2, D), (A, C1)<br>Basis: Minimal nuclear materials processing locations enhance operational security needs and reduce vulnerabilities. |
| (8) Protection of the Environment – | Additional Category 1 floorspace should have minimal effect on wildlife and the environment in general.<br>Rank Order: (A, B, C1, C2, D)<br>Basis: New construction outside current fenced sites. |
| (9) Employee Concerns – | Minimizing the distance between offices and laboratories enhances employee job satisfaction.<br>Rank Order: (A, B, C1, C2, D)<br>Basis: Minimal distance between offices and laboratories. |
| (10) Responsiveness to Public Concerns – | Minimizing the radioactive material inventory at the CMR building enhances public confidence in the Laboratory.<br>Rank Order: B, (C2, C1), (A, D)<br>Basis: Pit surveillance not at CMR. |

Table 2. Alternatives Rank Order Summary.

| | Numerical Value Based on Rank | | | | |
|---|---|---|---|---|---|
| Criterion | A | B | C1 | C2 | D |
| 1 | 2 | 4 | 5 | 5 | 3 |
| 2 | 2 | 4 | 3 | 5 | 4 |
| 3 | 1 | 5 | 3 | 4 | 2 |
| 4 | 4 | 1 | 2 | 3 | 5 |
| 5 | 5 | 4 | 4 | 4 | 5 |
| 6 | 3 | 5 | 4 | 4 | 3 |
| 7 | 3 | 5 | 3 | 4 | 4 |
| 8 | 5 | 5 | 5 | 5 | 5 |
| 9 | 5 | 5 | 5 | 5 | 5 |
| 10 | 3 | 5 | 4 | 4 | 3 |
| **Total** | **33** | **43** | **38** | **43** | **39** |
| Top* | 3 | 6 | 3 | 4 | 4 |
| Bottom† | 8 | 4 | 4 | 3 | 4 |

*Number of times alternative ranked the highest.
†Number of times alternative ranked the lowest.

From the results in Table 2, Alternative B would be the preferred alternative. It has both the highest overall total rank, and appears as the highest ranked alternative in six of the ten criteria. Next, cost information will be examined and combined with the non-cost qualitative comparison to determine the overall preferred alternative.

## 4.4 Systematic Cost Comparisons

Capital cost comparisons are performed based on costs that are different for each option. Each option will have several costs in common, and these common fixed costs are therefore secondary data for use in the cost-based alternatives analysis. These common costs, are provided in Table 3. The total capital fixed cost for all alternatives is $536M. The transportation corridor entails improvements to an existing road between TA-55 and TA-3. Shipments of radioactive liquid materials require closing the public road (as there are no radioactive liquid shipment containers certified for transportation over public roads); the transportation corridor would mitigate this public inconvenience and enhance public safety.

Table 3. Common Capital Costs[1] (in $M) for Each Alternative.

| Line Item | Responsible Project CMIP | CMR | Security |
|---|---|---|---|
| **TA-55** | | | |
| Capability Maintenance | 90 | | |
| Pit Manufacturing | 86 | | |
| Transportation Corridor | 2 | | |
| Pu Processing Equip. (Surv., SRL, R&D) | 56 | | |
| **CMR** | | | |
| Infrastructure (Phase 1)[2] | | 49 | |
| Wing 1, Op. Cent., Vault, Wing 9 | | 22 | |
| Wing 2/4 Transition State Upgrades[3] | | 6 | |
| Analytical Chemistry Capability Equipment | | 29 | |
| Analytical Chemistry Capacity Equipment | 27 | | |
| **Sigma Complex** | | | |
| Sigma Maintenance | 17 | | |
| Sigma Seismic | 15 | | |
| Sigma Capacity Equipment | 1 | | |
| Security Upgrades (SNM Protection) | | | 63 |
| Security Upgrades (Institutional Requirements) | | | 73 |
| **Total Capital Common Costs** | 294 | 106 | 136 |

In addition to the common capital costs, each alternative will require additional cold/light laboratory space and additional office space at the CMR building. The preferred configuration of these facilities is determined more for ease of implementation rather than cost. The costs for upgraded cold and light laboratory space and new office space are minor as compared to the other costs in the CMIP and CMR upgrades projects, and are presented later.

Each alternative has several specific costs for the nuclear materials facilities that other alternatives may or may not have. These costs include upgrading wings in the CMR building (in their current configuration), reconfiguring wings in the CMR building, and constructing new facilities at TA-55. Addition of the specific costs for each alternative provides a preferred alternative configuration for PF-4 and the CMR building for the future Los Alamos missions. A detailed variable cost listing and summary is provided in Table 4.

[1] CMIP/CMR Alternatives Analysis Presentation, C. Zerkle, 12/4/96.
[2] CMR Baseline: $51.6M - $2.6M Wing 2/4 safe standby costs - see Appendix A.
[3] $2M/wing for electrical upgrades (recoverable) + $1M/wing for unrecoverable expenses.

Table 4. Variable Cost Listing ($M) for CMIP Alternatives Analysis.

| Line Item | Alternative A | B | C1 | C2 | D |
|---|---|---|---|---|---|
| Upgrade[4] Wing 2[*] | 28.4 | | 28.4 | | |
| Upgrade Wing 4[*] | 29.1 | | | | |
| Upgrade Wing 3[*] | 31.1 | 31.1 | 31.1 | 31.1 | 31.1 |
| Upgrade Wing 7[*] | 30.4 | 30.4 | 30.4 | 30.4 | 30.4 |
| Upgrade Wing 5[†] | 30.4 | 30.4 | 30.4 | | 30.4 |
| Reconfigure Wing 3[*] | | | | 12 | 12 |
| Reconfigure Wing 7[*] | | | | 12 | 12 |
| Reconfigure Wing 5[†] | | | | | 12 |
| Reconfigure Wing 4[*] | 12 | | | | |
| Move Equipment[*] | 6 | 6 | 6 | 6 | 6 |
| Waste Handling/Removal[*] | 12 | 5 | 9 | 8 | 11 |
| CMR MAA[†] | 4 | | 4 | 4 | 4 |
| CMR PIDAS[††] | 24 | | 24 | 16 | 16 |
| Construct Cat. 1 Facility at TA-55 (15,300 sq. ft.)[†] | | 138 | 138 | 138 | |
| Construct Analytical Chemistry Facility at TA-55 (8,000 sq. ft.)[†] | | 70 | | | |
| Total Variable Nuclear Materials Facilities Costs (CMR Upgrades) | 149 | 72.5 | 105 | 99.5 | 102.5 |
| Total Variable Nuclear Materials Facilities Costs (CMIP) | 34.4 | 238.4 | 172.4 | 142 | 46.4 |
| Total Variable Nuclear Materials Facilities Costs (Security) | 24 | 0 | 24 | 16 | 16 |

[*]Funded through CMR Upgrades Project Capital.
[†]Funded through CMIP Capital.
[††]Funded through Security Upgrades Capital.

The capital costs of upgrading CMR Wings 3 and 4 are higher than the costs for upgrading CMR Wings 2, 5, and 7 because more work must be done to upgrade the ventilation systems in Wings 3 and 4 to meet current standards for buildings that contain nuclear materials. The costs in Table 4 do not include the costs for cold/light laboratory space and office space, as this topic is described in the next section.

## 5. Cold/Light Laboratory and Office Space Alternatives Analysis

Additional cold/light laboratory and office space is required to support expanded missions. Expanded missions that use additional nuclear materials laboratory will also need additional cold laboratory space for staging containment moves and performing

[4]All wing upgrades costs are derived from CMR Upgrades Project baseline; see Appendix A.

laboratory operations on materials that do not contain radionuclides. Expanded missions at TA-55 will include the need for an expanded workforce, and with office space presently in great demand at TA-55, the office space requirements at TA-55 will increase. Likewise at the CMR, expanding the work force and separating the office space from the laboratory space will result in the need for additional office space. The current configuration for light laboratory and office space at the CMR building and TA-55 is provided in Table 5. Office space at TA-55 *does not* include support areas such as the cafeteria, break rooms, and conference rooms.

Table 5. Existing Light Laboratory and Office Space at CMR and TA-55.

| | Sq. Ft. | Total |
|---|---|---|
| **Light Laboratory Space for CMR Functions** | | |
| Light Laboratory Missions in Wing 2 | 6,000 | **6,000** |
| **Light Laboratory Space for TA-55 Functions** | | |
| PF-3 Cold Laboratory | 9,300 | |
| Cold Laboratory at TA-55 (not in PF-3) | 2,900 | **12,200** |
| **Office Space for CMR Functions** | | |
| Office for Staff Currently in Wings 3, 5, and 7 (Not Useable) | (13,800) | |
| Office for Staff Currently in Wing 2 | (4,600) | **0** |
| **Office Space for TA-55 Functions** | | |
| PF-3 Office Space | 6,800 | |
| Office Space at TA-55 (not in PF-3) | 37,700 | **44,600** |

PF-3 was originally designed for approximately 30 cold laboratories with a total floorspace of 11,300 sq. ft.; much of this area is now used as office space. A recent study[5] indicates that current cold laboratory space at TA-55 totals approximately 12,200 sq. ft., and that an additional 9,100 sq. ft. would be required for effective support of future missions. A summary of the space requirements as derived from Ref. 5 is provided in Appendix B. Thus, approximately 21,300 sq. ft. of cold laboratory space will be required to support functions at TA-55. Office space requirements for different categories of personnel are based on standards developed at Los Alamos.[6] According to these standards, the number of people currently housed at TA-55 (approximately 700 people) warrants 64,000 sq. ft. of office and support space, and only 44,600 sq. ft. is available. Therefore, most office space to be built at TA-55 is needed to relieve this severe overcrowding. Estimates of future requirements for light laboratory and office space at the CMR building and TA-55 are provided in Table 6. The office space requirements for TA-55 and CMR are based on an updated analysis that is discussed in Appendix C Although the Merrick study may have overestimated the TA-55 office requirements, the results of this study are used for the cold laboratory requirements. Office space

[5] CMIP Support to Architectural Programming, Merrick Engineers and Architects, June 14, 1996, corrected
[6] Primary Office Standards, D. Bianchi, FSS-DO, May 15, 1995.

requirements listed here are for office space only - a multiplier for halls, stairways, restrooms, copy rooms, conference rooms, break rooms, etc. is needed to determine the actual building size. This multiplier may be estimated from the layout of PF-2. PF-2, which is primarily an office building, holds 10,900 sq. ft. of office space in a 17,300 sq. ft. building (1,200 sq. ft. is cold laboratory). If we neglect the cold laboratory space, the multiplier to obtain gross area from office space area for PF-2 is about 1.5.

Table 6. Future Light Laboratory and Office Space Requirements for CMR and TA-55.

| | Req'd. Sq. Ft. | Total | Currently Avail. | Deficit |
|---|---|---|---|---|
| **Light Lab. Space Requirements for CMR** | | | | |
| Cold Lab. For Dislocated TA-55 Functions | 1,400 | | | |
| Cold/light Lab. For Analytical Chem. Capacity | 4,000 | | | |
| Light Lab. Missions in Wing 2 | 6,000 | **11,400** | 6,000 | **5,400** |
| **Light Lab. Space Requirements for TA-55** | | | | |
| Cold Laboratory | 21,300 | **21,300** | 12,200 | **9,100** |
| **Office Space Requirements for CMR** | 22,000 | **22,000** | 0* | **22,000** |
| **Office Space Requirements for TA-55** | | | | |
| Office | 66,000 | **66,000** | 44,600 | **21,400** |

*Future offices will not be next to laboratories.

## 5.1 Cold/Light Laboratory and Office Space Cost Analysis

For the cost analysis of locating cold/light laboratories and offices at specific locations at TA-3 and TA-55, the following assumptions were used.

(1) A minimum of 2,000 sq. ft. of cold laboratory space must be located in close proximity to PF-4 (that is, in PF-3).
(2) The penthouse of the Materials Science Laboratory (MSL) will be fully utilized by TA-55 functions (3,000 sq. ft. cold laboratory, 1,000 sq. ft. office) at a cost of $1.4M.
(3) 16,100 sq. ft. (9,300 sq. ft. + 6,800 sq. ft.) in PF-3 will be used as cold laboratory and/or office space.
(4) The cost of moving the functions currently in Wing 2 during the transition period and for Wing 2 upgrades, $2M, will be incurred by all options.
(5) Currently existing cold laboratory and office at TA-55 not in PF-3 (2,900 sq. ft. cold lab. and 37,700 sq. ft. office) will continue to be used for these functions.
(6) If a CMR wing is upgraded, it is upgraded to house cold or light laboratory in both the central laboratories and the outer rooms that are presently used as offices. Offices will not be located next to laboratories that house nuclear or cold operations.

(7) The following areas of cold/light laboratory and office space at TA-55 and the CMR building must be located at TA-55 and CMR, respectively:
   - Cold/light laboratory at TA-55 ≥ 4,900 sq. ft. (2,900 existing + at least 2,000 in PF-3);
   - Cold/light laboratory at CMR ≥ 5,400 sq. ft. (4,000 A/C capacity + 1,400 for functions dislocated from TA-55);
   - Office at TA-55 = 65,000 sq. ft. (offices must be located near work areas);
   - Office at MSL = 1,000 sq. ft.;
   - Office at CMR = 22,000 sq. ft. (offices must be located near work areas).

One of the most restrictive constraints on the location of office space at the CMR building is that the laboratory space in CMR Wing 4 is unavailable to be reconfigured into office space until the end of the project. This laboratory space will be used by CMR functions during the transition from the current configuration with analytical chemistry functions in Wings 3, 5, and 7 into the final configuration of analytical chemistry functions in reconfigured Wing 3 and 7 and displaced functions from TA-55 in reconfigured Wing 5. Wing 4 will be entirely utilized by laboratory functions until late 2003. Prior to this time, office space will be required for analytical chemistry personnel. Most office space must be in place by 2001 when people are displaced from Wings 5 and 7. This leaves new construction as the only available alternatives for providing office space at the CMR building.

Future cold laboratory space allocations at TA-55 are based on the utilization of PF-3 and construction of new laboratory space. The costs of new office space and refurbished office space in PF-3, the costs of refurbished and new cold laboratory space, and other costs that will be incurred for the varying options for the disposition of cold laboratory space and office space are listed in Table 7. New office space capital costs are assumed to be $200/sq. ft., with a multiplier of 1.5 (to give $300/sq. ft.) to convert office space area to gross building area.

Ten options for the disposition of cold laboratory and office space are presented in Table 8 and Table 9. Each option fulfills all the requirements for cold laboratory and office space, although the options are tailored to specific alternatives (found at the bottom of the table). If a wing in the CMR building is used, then it is assumed that it is fully utilized. That is, if the laboratory space in the center is used, then the exterior space (presently used as offices) will be used for cold/light laboratory. If the wing is not used, a cost of $20 M is added to place the wing in a final condition of having been decontaminated and decommissioned (D&D).

Schematic drawings for all ten options are provided in Appendix D. The areas are approximately to scale as compared to the drawing of CMR Wings 2 and 4, and new office building are drawn using gross square footage rather than office area requirements.

Table 7. Cost and Square Footage Obtained for Cold/Light Lab and Office Options.[7,8]

| | Cost | CL sq. ft. | Off. sq. ft. |
|---|---|---|---|
| Upgrade Wing 2 for C/L Lab. ($M)* | 13 | 12,600 | 0 |
| Upgrade Wing 4 for C/L Lab. ($M)* | 18 | 12,600 | 0 |
| Use the MSL Penthouse ($M)† | 1.4 | 3,000 | 1,000 |
| Move Equipment In/Out W2 ($M)* | 2 | | |
| Wings 2, 4, 5 D&D ($M/wing)* | 20 | | |
| Wing 5 Offices (Alt. C2 Only) ($M) * | 20 | | 12,600 |
| Cold Laboratory in PF-3 ($/sq. ft.)† | 800 | | |
| Office in PF-3 ($/sq. ft.)† | 100 | | |
| New Cold Laboratory @ TA-55 ($/sq. ft.)† | 750 | | |
| New Office @ TA-55 ($/sq. ft.)† | 300 | | |
| New Cold/Light Lab. @ CMR ($/sq. ft.)* | 750 | | |
| New Office @ CMR ($/sq. ft.)* | 300 | | |

*Funded through CMR Upgrades Project Capital.
†Funded through CMIP Capital.

For the overall cost analysis, the least expensive option for cold laboratory and office space is used (if more than one option applies to a specific alternative). In general, the D&D costs for empty wings cause large increases in the cost of cold laboratory and office space. Use of all available wings in the CMR building is advantageous based on criteria of cost and utilization of existing facilities.

## 5.2 Systematic Non-Cost Comparisons for Space in PF-3

Eight qualitative criteria have been established to evaluate and compare the alternatives for placement of cold laboratory and office space in PF-3. The criteria are provided below.

(1) Waste Lines – Installation of industrial waste lines should be inexpensive and not difficult.
Favors PF-3 office space.

(2) Laboratory Ventilation – Installation of appropriate HVAC system should be inexpensive.
Favors PF-3 office space.

[7] Stark, W., Cold Laboratory Issues, February 10, 1997 (Draft).
[8] CMR Upgrades Project, Conceptual Design Report.

Table 8. Cold/Light Laboratory and Office Space Options Cost Analysis - Options 1-5.

| | Opt. 1 | Opt. 2 | Opt. 3 | Opt. 4 | Opt. 5 |
|---|---|---|---|---|---|
| Upgrade Wing 2 for C/L Lab. | | | 1 | | 1 |
| Upgrade Wing 4 for C/L Lab. | | | 1 | | 1 |
| Use the MSL Penthouse | 1 | 1 | 1 | 1 | 1 |
| Existing @ TA-55 (not in PF-3) | 1 | 1 | 1 | 1 | 1 |
| Move Equipment In/Out W2 | 1 | 1 | 1 | 1 | 1 |
| Wing 2 D&D | | | | 1 | |
| Wing 4 D&D | | | | 1 | |
| Wing 5 D&D | | | | | |
| Wing 5 Offices | | | | | |
| Cold Laboratory in PF-3 | 2,000 | 16,100 | 2,000 | 2,000 | 9,300 |
| Office in PF-3 | 14,100 | | 14,100 | 14,100 | 6,800 |
| New Cold Laboratory @ TA-55 | 12,400 | | | 12,400 | |
| New Office @ TA-55 | 13,200 | 27,300 | 13,200 | 13,200 | 20,500 |
| New Cold Laboratory @ CMR | 12,400 | 10,700 | | 12,400 | |
| New Office @ CMR | 22,000 | 22,000 | 22,000 | 22,000 | 22,000 |
| Cold Laboratory @ TA-55 | 17,300 | 19,000 | 4,900 | 17,300 | 12,200 |
| Cold Laboratory @ CMR | 12,400 | 10,700 | 25,200 | 12,400 | 25,200 |
| Cold Laboratory @ MSL | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| **Total Cold Laboratory** | **32,700** | **32,700** | **33,100** | **32,700** | **40,400** |
| Office @ TA-55 | 65,000 | 65,000 | 65,000 | 65,000 | 65,000 |
| Office @ CMR | 22,000 | 22,000 | 22,000 | 22,000 | 22,000 |
| Office @ MSL | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| **Total Office** | **88,000** | **88,000** | **88,000** | **88,000** | **88,000** |
| CMR Upgrades Capital Cost | 17.9 | 16.3 | 39.6 | 57.9 | 39.6 |
| CMIP Capital Cost | 17.7 | 23.3 | 8.4 | 17.7 | 15.7 |
| **Total Capital Cost ($M)** | **35.6** | **39.1** | **48.0** | **75.6** | **55.3** |
| Applies to Alternatives: | A | A | B, D | B, D | B, D |

(3) Impact on Other Lab Programs – Modification of existing facilities should produce as little disruption as possible to ongoing Laboratory programs, especially if the cold laboratories and offices are constructed prior to modification of nuclear materials facilities.
Favors PF-3 office space.

(4) Construction Difficulty – Modification of existing facilities or construction of new facilities should proceed with few requirements for radiation protection oversight.
Favors neither PF-3 laboratory nor office space.

Table 9. Cold/Light Laboratory and Office Space Options Cost Analysis - Options 6-10.

| | Opt. 6 | Opt. 7 | Opt. 8 | Opt. 9 | Opt. 10 |
|---|---|---|---|---|---|
| Upgrade Wing 2 for C/L Lab. | 1 | | 1 | 1 | |
| Upgrade Wing 4 for C/L Lab. | | 1 | 1 | 1 | |
| MSL | 1 | 1 | 1 | 1 | 1 |
| Existing @ TA-55 (not in PF-3) | 1 | 1 | 1 | 1 | 1 |
| Move Equipment In/Out W2 | 1 | 1 | 1 | 1 | 1 |
| Wing 2 D&D | | | | | 1 |
| Wing 4 D&D | 1 | | | | 1 |
| Wing 5 D&D | | | 1 | | 1 |
| Wing 5 Offices | | | | 1 | |
| Cold Laboratory in PF-3 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Office in PF-3 | 14,100 | 14,100 | 14,100 | 14,100 | 14,100 |
| New Cold Laboratory @ TA-55 | 12,200 | 12,200 | | | 12,400 |
| New Office @ TA-55 | 13,200 | 13,200 | 13,200 | 13,200 | 13,200 |
| New Cold Laboratory @ CMR | | | | | 12,400 |
| New Office @ CMR | 22,000 | 22,000 | 22,000 | 9,400 | 22,000 |
| Cold Laboratory @ TA-55 | 17,100 | 17,100 | 4,900 | 4,900 | 17,300 |
| Cold Laboratory @ CMR | 12,600 | 12,600 | 25,200 | 25,200 | 12,400 |
| Cold Laboratory @ MSL | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| **Total Cold Laboratory** | **32,700** | **32,700** | **33,100** | **33,100** | **32,700** |
| Office @ TA-55 | 65,000 | 65,000 | 65,000 | 65,000 | 65,000 |
| Office @ CMR | 22,000 | 22,000 | 22,000 | 22,000 | 22,000 |
| Office @ MSL | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| **Total Office** | **88,000** | **88,000** | **88,000** | **88,000** | **88,000** |
| CMR Upgrades Capital Cost | 41.6 | 26.6 | 59.6 | 55.8 | 77.9 |
| CMIP Capital Cost | 17.5 | 17.5 | 8.4 | 8.4 | 17.7 |
| **Total Capital Cost ($M)** | **59.1** | **44.1** | **68.0** | **64.2** | **95.6** |
| Applies to Alternatives | B, D | C1 | C2 | C2 | C2 |

(5) Worker Access – Modification of existing facilities or construction of new facilities should proceed with few requirements for worker security clearances.
Favors new office space.

(6) Waste Generation – Modification of existing facilities or construction of new facilities should produce as little contaminated or potentially contaminated waste as possible.
Favors PF-3 office space.

(7) Employee Concerns – Minimizing the distance between offices and laboratories enhances employee job satisfaction.
Favors PF-3 office space.

(8) Classified Work Areas – The locations of laboratory space should be able to accommodate both classified and unclassified work.
Favors neither PF-3 laboratory nor office space. Favors placement of laboratory space at MSL.

In light of the above criteria, converting most of PF-3 to office space remains the preferred use of the space in PF-3.

## 6. The Preferred Alternative

Five alternative configurations that meet the future mission requirements for nuclear materials processing space at Los Alamos have been considered. A summary of the costs as determined in the previous sections is provided in Table 10. The preferred alternative, based on ten qualitative non-cost criteria and the overall configuration cost, is to reconfigure the floor layout of Wings 3, 5, and 7 in the CMR building, place analytical chemistry functions in Wings 3 and 7, and move functions from TA-55 to Wing 5 (Alternative D). CMR Wings 2 and 4 are upgraded for cold/light laboratory use, the penthouse of the MSL is used for cold laboratory and office space, PF-3 is minimally used for cold laboratory, and new office space is built at TA-55 (~20,000 gross sq. ft.) and CMR (~33,000 gross sq. ft.) to fulfill office space requirements. The total capital cost for this alternative is $749 M. This configuration fulfills the floorspace requirements for each function and provides for an efficient and cost-effective operation of the two primary actinide-handling facilities, PF-4 and the CMR building, at Los Alamos.

Using Alternative D with cold/light laboratory and office Option 5 maintains the current layout of PF-3, but requires a 31,000 gross sq. ft. building at TA-55, with a slight cost increase of approximately $7M. Alternative A, which has all five wings in the CMR upgraded to house expanded analytical chemistry requirements and displaced functions from expanded pit manufacturing missions in PF-4, is the second choice given the cost data (however, Alternative A is the least preferable alternative given the qualitative analysis). Because the options that include new construction (Alternatives B, C1, and C2) are significantly more expensive than Alternative D, Alternative D is selected as the overall preferred alternative.

Table 10. Cost Summary ($M) for All Projects.

| | Alternative | | | | |
|---|---|---|---|---|---|
| Line Item | A | B | C1 | C2 | D |
| Fixed Costs (CMR Upgrades) | 106 | 106 | 106 | 106 | 106 |
| Fixed Costs (CMIP) | 294 | 294 | 294 | 294 | 294 |
| Fixed Costs (Security) | 136 | 136 | 136 | 136 | 136 |
| Total Variable Nuclear Materials Facilities Costs (CMR Upgrades) | 149 | 72.5 | 105 | 99.5 | 102.5 |
| Total Variable Nuclear Materials Facilities Costs (CMIP) | 34.4 | 238.4 | 172.4 | 142 | 46.4 |
| Total Variable Nuclear Materials Facilities Costs (Security) | 24 | 0 | 24 | 16 | 16 |
| Cold Laboratory and Office (CMR) | 17.9 | 39.6 | 26.6 | 55.8 | 39.6 |
| Cold Laboratory and Office (CMIP) | 17.7 | 8.4 | 17.5 | 8.4 | 8.4 |
| Total (CMR Upgrades Project) | 273 | 218 | 238 | 261 | 248 |
| Total (CMIP Upgrades Project) | 346 | 541 | 484 | 444 | 349 |
| Total (Security) | 160 | 136 | 160 | 152 | 152 |
| **Total for All Projects ($M)** | **779** | **895** | **882** | **857** | **749** |

## Appendix A - CMR Wing Upgrade Costs Information and Derivation

The CMR Upgrades Phase 1 approved baseline is $51.6M. Of this total, $2.6M are included for placing CMR Wings 2 and 4 in safe standby mode; as this is not a desirable option, this cost has been subtracted from the Phase 1 cost to give a total Phase 1 cost of $48.6M. The total CMR Upgrades Phase 2 costs are listed in Table 11, along with the fixed costs from Phase 2 that must be expended for each of the five main options for nuclear materials space. The current baseline for the CMR Upgrades Project is $174.1M, which is composed of $51.6M for Phase 1 and $122.5M for Phase 2.

Table 11. CMR Upgrades Phase 2 Validated Costs.[9]

| **Phase 2 Subprojects:** | **Total Cost ($M)** | **Cost/wing ($M)** | **Fixed Cost ($M)** |
|---|---|---|---|
| Seismic & Tertiary Confinement | $15.50 | $3.88 | $3.88 |
| Ventilation & Confinement Zone | $68.70 | | |
| Wing 3 | | $22.18 | |
| Wings 5 and 7 (each) | | $17.18 | |
| Wing 9 | | $12.18 | $12.18 |
| Standby Power | $5.90 | $1.48 | $1.48 |
| Communications | $4.20 | $1.05 | $1.05 |
| Wing 1 HVAC | $0.60 | | $0.60 |
| Operation Center | $1.60 | | $1.60 |
| Wings 2 & 4 Safe Standby | $7.50 | | |
| Process Chilled Water | $4.30 | $1.43 | |
| Main Vault | $0.70 | | $0.70 |
| Acid Vents & Drains | $8.00 | $2.67 | |
| Fire Protection | $4.30 | | |
| Wing 2 | | $0.54 | $0.54 |
| Wings 3,5, and 7 | | $3.76 | |
| Exhaust Duct Washdown Recycle | $1.20 | $0.40 | |
| **Total** | **$122.50** | | **$22.03** |

The costs of upgrading two or three CMR wings are provided in Table 12. All costs in Table 4 for upgrading individual wings are derived from this data.[10] The derivation is discussed below.

The Wing 5 Upgrade cost is determined as $91.79M – $61.43M = $30.4M per Table 12. It is assumed that the cost of upgrading Wing 7 is approximately equal to the cost of upgrading Wing 5, which leaves for the cost of upgrading Wing 3 as $31.1M. The cost to

[9] CMR Upgrades Project Conceptual Design Report.
[10] "CMR Upgrades Project Reconfiguration Options Order of Magnitude Estimates," D. H. Richardson, CST-26, Feb. 25, 1997 (corrected).

upgrade Wings 2 and 4 is assumed to be approximately equal to the cost of upgrading Wings 3 and 7, respectively. Because of higher ventilation upgrade requirements for Wings 3 and 4, the cost of upgrading Wing 4 is assumed to be $31.1M, and the cost of upgrading Wing 2 is assumed to be $30.4M. Therefore, the costs of upgrading CMR wings are

| | |
|---|---|
| Upgrade Wing 2 | $30.4M; |
| Upgrade Wing 3 | $31.1M; |
| Upgrade Wing 4 | $31.1M; |
| Upgrade Wing 5 | $30.4M; |
| Upgrade Wing 7 | $30.4M. |

Recoverable costs of upgrading the electrical systems of Wings 2 and 4 in preparation for moving functions during the transition periods are $2M; therefore, the costs of upgrading Wings 2 and 4 are $28.4M and $29.1M, respectively.

Table 12. Costs of Upgrading CMR Wings 3, 5, and 7.

| | **Total Cost ($M)** |
|---|---|
| **Upgrade Wings 3, 5, and 7** | |
| Seismic | $11.63 |
| Ventilation & Confinement Zone | $56.53 |
| Standby Power | $4.43 |
| Communications | $3.15 |
| Process Chilled Water | $4.30 |
| Acid Vents and Drains | $8.00 |
| Fire Protection | $3.76 |
| **Total** | **$91.79** |
| **Upgrade Wings 3 and 7** | |
| Seismic & Tertiary Confinement | $7.75 |
| Ventilation & Confinement Zone | $39.35 |
| Standby Power | $2.95 |
| Communications | $2.10 |
| Process Chilled Water | $2.87 |
| Acid Vents & Drains | $5.33 |
| Fire Protection | $1.08 |
| **Total** | **$61.43** |

## Appendix B - TA-55 Office and Cold/Light Laboratory Allocations Based on the Merrick Study

Table 13. Office and Cold Laboratory Floorspace Requirements Analysis for Functions that Currently Reside at TA-55, as Obtained from the Merrick Study

| | Personnel | | Office Space | | Comments |
|---|---|---|---|---|---|
| **Project Projections** | FY96 | FY06 | FY96 | FY06 | |
| AGEX | 4 | 7 | 355 | 644 | |
| ARIES | 39.4 | 31.75 | 3646 | 2830 | |
| EM Tech Support | 51 | 0 | 4613 | 0 | |
| MWG Surveillance | 3.3 | 4.25 | 322 | 400 | |
| MOX Fuel | 11 | 38 | 855 | 3126 | |
| Neutron Source Recovery | 15.25 | 0 | 1421 | 0 | |
| NM Packaging | 13.1 | 0 | 1120 | 0 | |
| NM Stabilization | 32.3 | 64.5 | 2769 | 5536 | |
| Radioactive Source Recovery | 15.25 | 0 | 1351 | 0 | |
| Pit Fabrication | 2 | 43.5 | 147 | 3538 | some to CMR |
| Stockpile Steward. R&D | 15 | 29 | 1393 | 2674 | some to CMR |
| Pit Surveillance | 52.55 | 74.62 | 4429 | 6256 | some to CMR |
| SRL | 9.75 | 17 | 1001 | 1574 | some to CMR |
| **Group Projections** | | | | | |
| CST-A/C | 23.25 | 24 | 2149 | 2197 | |
| DOE Site Representative | 2 | 2 | 256 | 256 | |
| ESH-1 | 67 | 81 | 3203 | 3912 | |
| FSS | 47 | 37 | 4821 | 3253 | |
| NMT-2 | 51 | 56 | 4487 | 4915 | Excludes AGEX, ARIES, PitFab, PitSur, Repack |
| NMT-4 | 54 | 62 | 4283 | 4871 | Excludes Repack |
| NMT-5 | 49 | 49 | 4393 | 4393 | Excludes PitFab, PitSur, Stockpile Stewardship R&D |
| NMT-6 | 47 | 51 | 4064 | 4496 | |
| NMT-7 | 33 | 33 | 2695 | 2695 | |
| NMT-8 | 78 | 102 | 5883 | 8277 | |
| NMT-9 | 71 | 71 | 5083 | 5083 | |
| NMT-10 | 33 | 38 | 2939 | 3380 | |
| IRM | 22 | 27 | 2001 | 2323 | |
| NMT-DO | 45 | 46 | 4785 | 4860 | |
| TOTAL Projects & Groups | 886.15 | 988.62 | 74464 | 81489 | We are housing 74.5k sq ft in 44.6k sq ft. |
| Projects moving to CMR | | 59.5 | | 5024 | |
| Projects remaining at TA-55 | | 929.12 | 74464 | 76465 | |
| Office available at TA-55 | | | 44569 | 44569 | |
| Office required at TA-55 | | | 29895 | **31896** | space that should be added now to meet spec. |
| Support for all TA-55 | | | 5668 | 12183 | |
| Functions that goto CMR | | | | 0 | PitSurv, Stockpile Stewardship R&D, SRL |
| Support needed at TA-55 | | | | **12183** | |
| Cold Lab for all TA-55 | | | 12252 | 22699 | 22199+500 |
| Functions that goto CMR | | | | 1400 | SRL and Stockpile Stewardship R&D |
| Cold Lab needed at TA-55 | | | | **21299** | |

**Appendix C - Updated Office Space Requirements Analysis for TA-55 and CMR**

TA-55 Office Space Requirements

An updated analysis of the current and future office space requirements for functions that currently reside at TA-55 has been performed and is based primarily on data from the space study performed by Merrick.[5] Table 14 contains the assumed office space allocations for the various personnel categories. The current list of personnel at TA-55 (as of March 28, 1997) was obtained from the Los Alamos network phone book and was compared to the personnel lists for groups and projects at TA-55 in the Merrick document. Current personnel were categorized according to their category listed in the Merrick document; where the personnel category was unknown, the "Unknown Category" from Table 14, which is an average of the technical staff member and technician area requirements, was used. Budget constraints have limited the NMT hiring during the past year to meet 1997 staffing levels. Approximately 30 persons (2-3 dozen) would have been hired during this past year to meet the anticipated personnel requirements used to construct the office space analysis in the Merrick document.[11] The current estimated office space requirements for functions at TA-55 are listed in Table 15, along with the total number of persons in each group. Using the totals of the office space and personnel at TA-55, the average office space area per person is 91.8 sq. ft., which is very close to the "Unknown" category in Table 14.

Table 14. Office Space Allocations for Personnel Categories

| Category | Area (Sq. Ft.) |
|---|---|
| Division Director | 172.5 |
| Deputy Division Director | 172.5 |
| Group Leader | 127.5 |
| Deputy Group Leader | 127.5 |
| Project Leader | 127.5 |
| Technical Staff Member* | 108 |
| Technician | 75 |
| Operational Support | 75 |
| Unknown Category† | 91.5 |
| Post-Doc | 75 |
| GRA | 75 |

*Includes all Staff Member Categories.
†Average of TSM space and Technician space.

The Merrick document also included personnel estimations from the years 1996 to 2006. The difference between the final personnel levels in 2006 and 1997 was used to

[11] Personal communications, Walter Stark, NMT-DO, April 14, 1997.

determine the additional space requirements in 2006. The additional requirements by group and project are listed in Table 16. The analysis of office space requirements, based on this revised version of the analysis, is found in Table 17. The most likely source of the discrepancy between this analysis and the Merrick study is overestimation by Merrick of the current staff loading at TA-55 by counting personnel that work at TA-55 but maintain offices at other locations.

Table 15. Current Office Space Requirements at TA-55

| Group | Number of Persons | Office Space (Sq. Ft.) |
|---|---|---|
| NMT-DO | 25 | 2,695.5 |
| NMT-FSQ | 15 | 1,441.5 |
| NMT-2 | 82 | 7,347.0 |
| NMT-4 | 56 | 5,116.5 |
| NMT-5 | 78 | 7,050.0 |
| NMT-6 | 59 | 5,493.0 |
| NMT-7 | 49 | 4,440.0 |
| NMT-8 | 80 | 7,408.5 |
| NMT-9 | 41 | 3,658.5 |
| ESH | 74 | 6,757.5 |
| Support | 78 | 7,186.5 |
| CST | 27 | 2,407.5 |
| MST | 1 | 75.0 |
| **Current Total** | **665** | **61,077.0** |
| To be Hired | 30 | 2,745.0 |
| **Total** | **695** | **63,822.0** |

Therefore, the data in Table 17 indicate that 66,000 sq. ft. of office space will be required at TA-55 to meet future anticipated personnel requirements. This requirement will be met by using the existing office space at TA-55, the office space in the MSL penthouse, a variety of possible configurations of PF-3 for office space, and a new office building. If we assume that 1,000 sq. ft. of office is available in the MSL and 37,700 sq. ft. is available at TA-55 outside of PF-3, then 27,300 sq. ft. of office space must be provided in any combination of use of PF-3 and a new building. The office area to total floorspace multiplier has not been included here. If PF-3 is left in its current configuration (9,300 sq. ft. cold laboratory and 6,800 sq. ft. office), then 20,500 sq. ft. of office space, or a 31,000 gross sq. ft. building, would be required.

Table 16. Changes in Office Space Requirements for TA-55 Functions, 1997-2006

| Group | OS | TSM | TEC | Area (Sq. Ft.) |
|---|---|---|---|---|
| NMT-DO | | -1 | | -108 |
| NMT-10 | 4 | 1 | 2 | 558 |
| NMT-8 | | 16 | 4 | 2,028 |
| NMT-6 | | 3 | | 324 |
| NMT-4 | | | 3 | 225 |
| FSS-6 | 6 | | 1 | 525 |
| ESH-1 | | 1 | 10 | 858 |
| AGEX | | | 1 | 75 |
| ARIES | | -6.75 | | -729 |
| EM Tech. | -5 | -25 | -20 | -4,575 |
| MOX | 1 | 8 | 15 | 2,064 |
| Repackaging | | -2 | -1 | -291 |
| Stabilization | | 10 | 11 | 1,905 |
| NWT R&D | | 5 | 4 | 840 |
| Pit Fab. | | 4 | 20 | 1,932 |
| Pit Surv. | | 3 | 8 | 924 |
| SRL | | 1 | 6 | 558 |
| **Total** | **6** | **17.25** | **64** | **7,221** |

Table 17. Current and Future New Office Space Requirements at TA-55

| | Personnel | | Office Space | |
|---|---|---|---|---|
| | FY97 | FY06 | FY97 | FY06 |
| Current for all TA-55 Functions | 695 | 782 | 63,822 | 71,043 |
| Projects moving to CMR | | 59.5 | | 5024 |
| Projects remaining at TA-55 | | 722.5 | 63,822 | 66,019 |
| Office available at TA-55 | | | 44,569 | 44,569 |
| **Additional Office required at TA-55** | | | **19,253** | **21,450** |

CMR Office Space Requirements

For safety reasons, offices that are currently located next to laboratories will now be separated from the reconfigured laboratories. That is, no offices for staff or technicians will be located behind the MAA barrier, except possibly for health physics and radiation measurement technicians. The only wings in the CMR building that will contain offices are Wing 1 and the Administration Wing. As the CMR Upgrades project nears completion, current project management personnel will be replaced by facilities operation personnel, which may increase by approximately twenty people. No change in office requirement is expected as a result of this personnel transition.

Several groups will require group offices at the CMR complex (CMR building plus the new office building). These groups are CST-3, CST-8, CST-9, CST-12, CST-26, MST-5, ESH-1, and the staff and a group office contingent from TA-55 in support of the functions that moved from TA-55 to CMR Wing 5. We anticipate that Wing 1 and the Administration Wing will accommodate the group offices for CST-26, ESH-1, and MST-5; all other group offices will be located in the new office building.

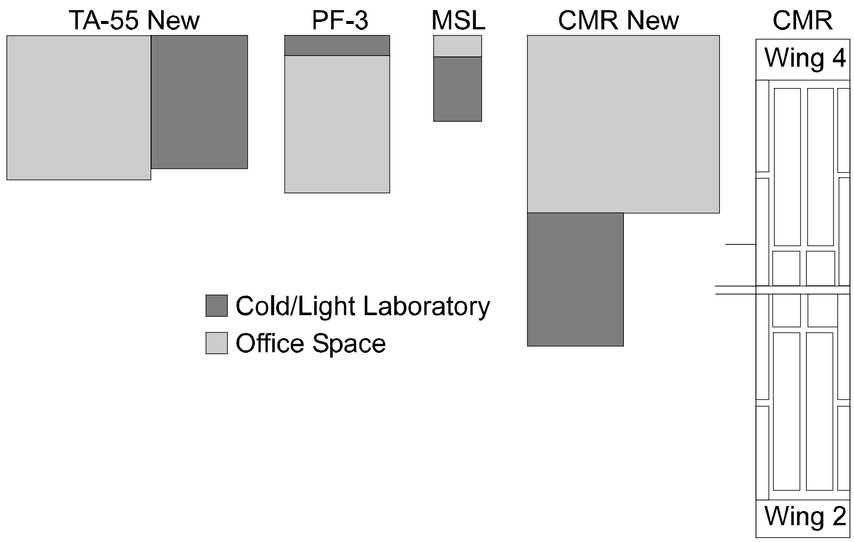
As with the TA-55 analysis, requirements for CMR office space are obtained from the Los Alamos network phone book. Those people who currently maintain an office in Wings 2, 3, 4, 5, 7, and 9 will have to be relocated. In addition, some groups, such as CST-3, will consolidate their group in the new office location for convenience. The number of people that must be relocated, the number added from group consolidation, and the number of people added by virtue of the transfer of functions from TA-55 to CMR are listed in Table 18. Only the people that will not be in the group office in the CMR building are listed in Table 18 for MST-5. The required office area for CMR personnel is obtained by multiplying the number of people requiring office space by 91.5, which was seen in the last section to be the average of all personnel at TA-55, including group and division leadership. After inclusion of the office area to total floorspace multiplier, a building with a total of 33,000 sq. ft. will be required at the CMR building.

Table 18. CMR Additional Office Requirements.

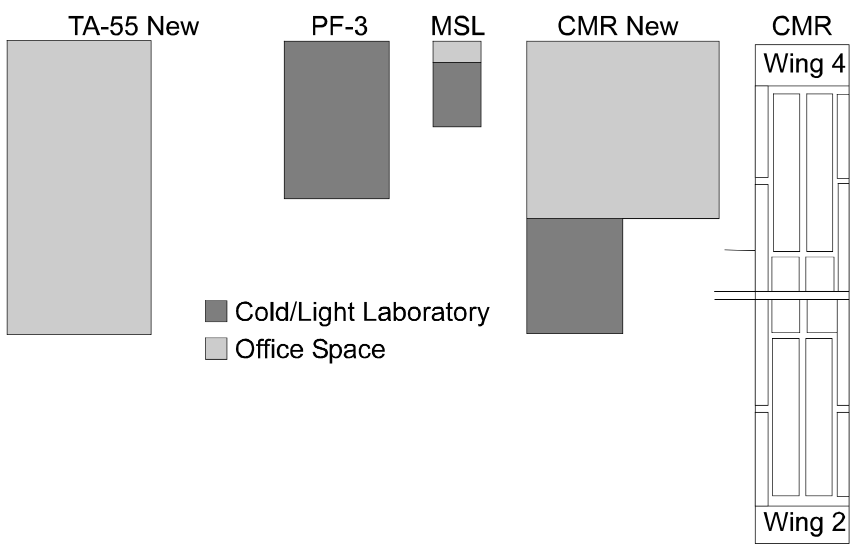
| Group | Current People Requirements At CMR | Additional People Requirements from Consolidation | Required Area (sq. ft.) |
|---|---|---|---|
| CST-3 | 11 | 25 | 3,924 |
| CST-8 | 42 | 7 | 4,484 |
| CST-9 | 13 | 3 | 1,464 |
| CST-12 | 22 | | 2,013 |
| CST-26 | 3 | | 275 |
| Other CST | 10 | | 915 |
| MST-5 | 35 | | 3,203 |
| Other Divisions | 9 | | 824 |
| From TA-55 | 59.5 | | 5,024 |
| **Total** | 211 | 35 | **22,043** |

## Appendix D - Office and Cold/Light Laboratory Options Schematic Drawings

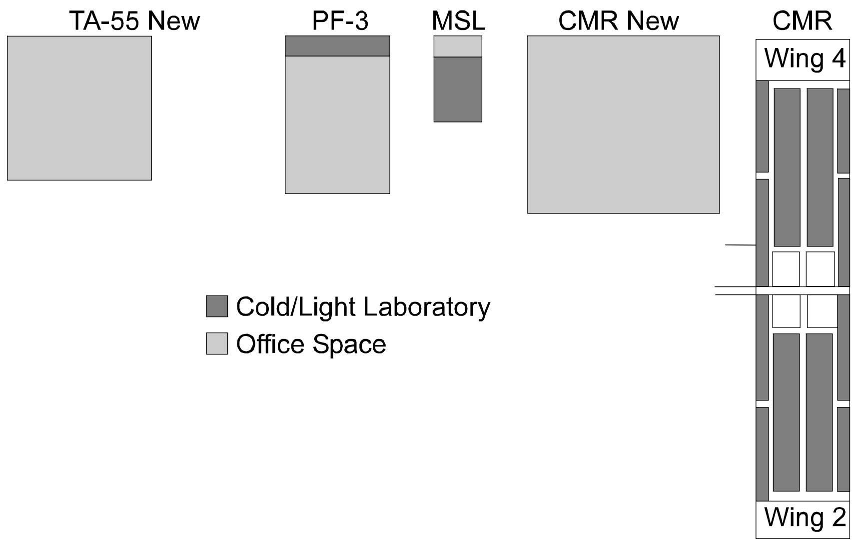
Option 1 - Place 2,000 sq. ft. of cold laboratory in PF-3, build new cold laboratory and office at TA-55 and CMR to fulfill requirements. Total cost = $35.6 M. Applies to Alternative A only.



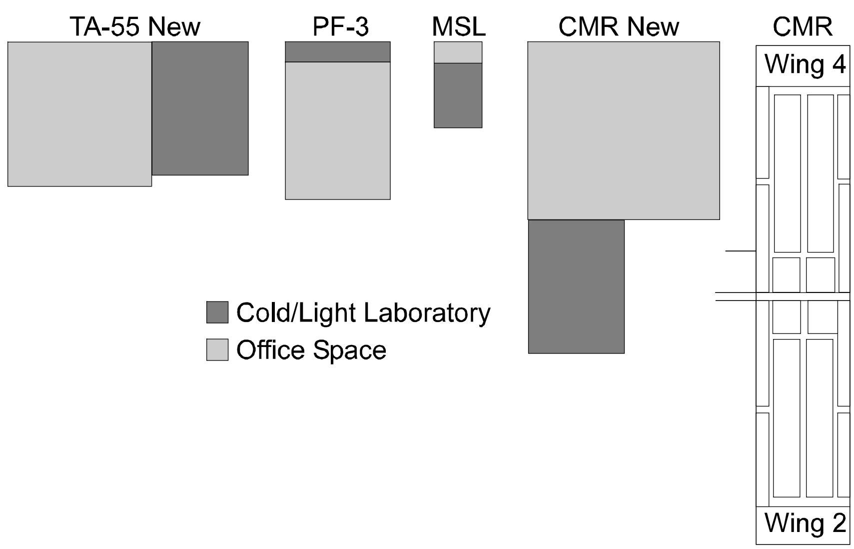

Option 2 - Fill PF-3 with cold laboratory, build new office at TA-55 and new cold laboratory and office at CMR to fulfill requirements. Total cost = $39.1 M. Applies to Alternative A only.



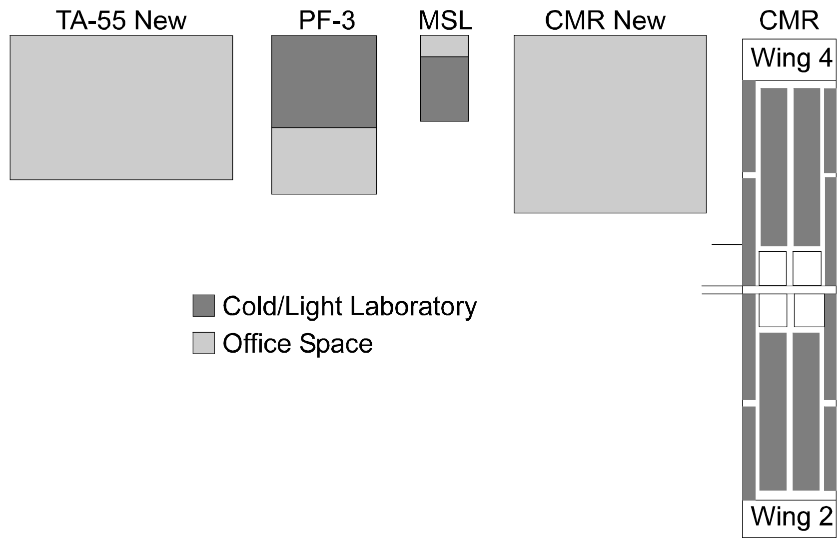
Option 3 - Use Wings 2 and 4 for light laboratory, place 2,000 sq. ft. of cold laboratory in PF-3, build new office at TA-55 and CMR to fulfill requirements. Total cost = $48.0 M. Applies to Alternatives B and D.



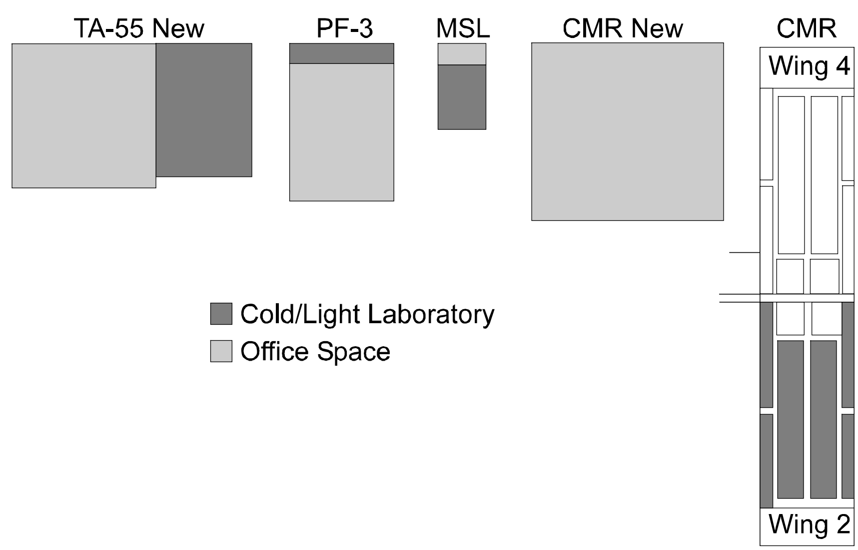

Option 4 - D&D Wings 2 and 4, Place 2,000 sq. ft. of cold laboratory in PF-3, build new office and cold laboratory at TA-55 and CMR to fulfill requirements. Total cost = $75.6 M. Applies to Alternatives B and D.



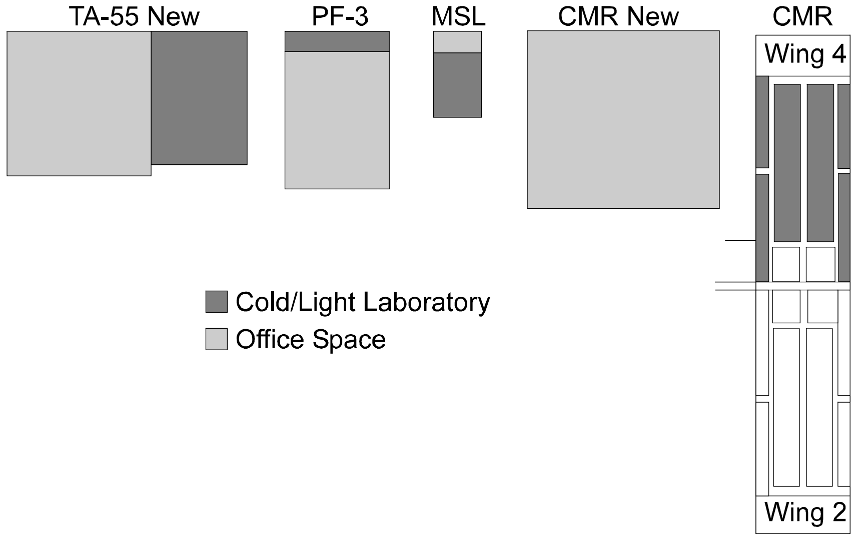
Option 5 - Use Wings 2 and 4 for light laboratory, maintain the current configuration of cold laboratory and office in PF-3, and build new office at TA-55 and CMR to fulfill requirements. Total cost = $55.3 M. Applies to Alternatives B and D.



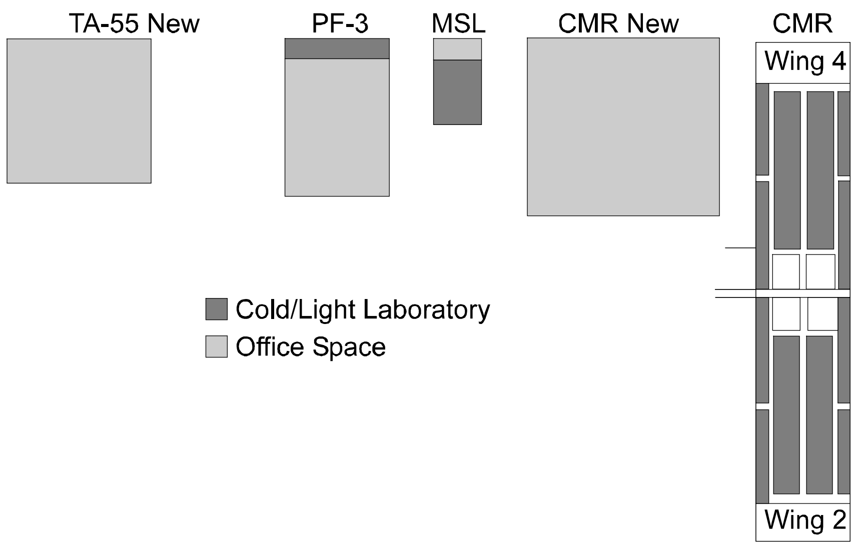

Option 6 - Use Wing 2 for light laboratory, D&D Wing 4, place 2,000 sq. ft. of cold laboratory in PF-3, build new cold laboratory and office at TA-55, and build new office at CMR. Total cost = $59.1 M. Applies to Alternatives B and D.



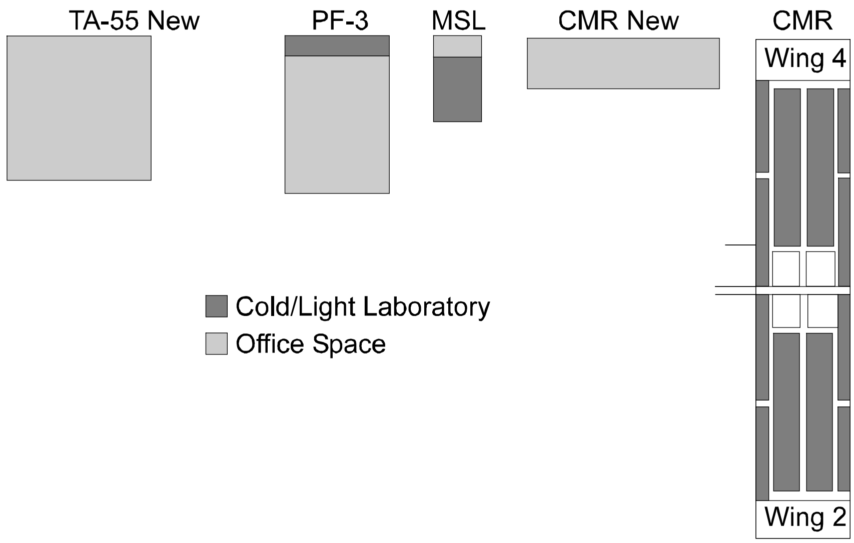
Option 7 - Use Wing 4 for light laboratory, place 2,000 sq. ft. of cold laboratory in PF-3, build new cold laboratory and office at TA-55, and build new office at CMR. Total cost = $44.1 M. Applies to Alternative C1 only.




Option 8 - Use Wings 2 and 4 for light laboratory, D&D Wing 5, place 2,000 sq. ft. of cold laboratory in PF-3, and build new office at TA-55 and CMR to fulfill requirements. Total cost = $68.0 M. Applies to Alternative C2 only.



Option 9 - Use Wings 2 and 4 for light laboratory, D&D Wing 5 and convert it to office space, place 2,000 sq. ft. of cold laboratory in PF-3, and build new office at TA-55 and CMR to fulfill requirements. Total cost = $64.2 M. Applies to Alternative C2 only.




Option 10 - D&D Wings 2, 4, and 5, place 2,000 sq. ft. of cold laboratory in PF-3, build new office and cold laboratory at TA-55 and CMR to fulfill requirements. Total cost = $95.6 M. Applies to Alternative C2 only.