Conceptual Design Report

NUCLEAR MATERIALS STORAGE FACILITY RENOVATION

Part I - Design Concept

Part II - Project Management

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CONCEPTUAL DESIGN REPORT
FOR
LINE ITEM PROJECT
NUCLEAR MATERIALS STORAGE FACILITY RENOVATION
AT THE

LA-UR96-1

LOS ALAMOS NATIONAL LABORATORY

Project Identification Number 11818
Technical Area 55
Building PF-41

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DESIGN/BUILD ACQUISITION STRATEGY

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I. DETAILED CONSTRUCTION ANALYSIS

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SUPPORTING INFORMATION

A. GENERAL DESCRIPTION OF PROJECT

1. OBJECTIVE

The Nuclear Materials Storage Facility (NMSF)* at the Los Alamos National Laboratory (LANL) was a Fiscal Year (FY) 1984 line-item project completed in 1987 that has never been operated because of major design and construction deficiencies. This renovation project, which will correct those deficiencies and allow operation of the facility, is proposed as an FY 97 line item. The mission of the project is to provide centralized intermediate and long-term storage of special nuclear materials (SNM) associated with defined LANL programmatic missions and to establish a centralized SNM shipping and receiving location for Technical Area (TA)-55 at LANL.

Based on current projections, existing storage space for SNM at other locations at LANL will be loaded to capacity by approximately 2002. This will adversely affect LANL's ability to meet its mission requirements in the future. The affected missions include LANL's weapons research, development, and testing (WRD&T) program; special materials recovery; stockpile surveillance/evaluation; advanced fuels and heat sources development and production; and safe, secure storage of existing nuclear materials inventories. The problem is further exacerbated by LANL's inability to ship any materials offsite because of the lack of receiver sites for material and regulatory issues.

Correction of the current deficiencies and enhancement of the facility will provide centralized storage close to a nuclear materials processing facility. The project will enable long-term, cost-effective storage in a secure environment with reduced radiation exposure to workers, and eliminate potential exposures to the public.

2. PHYSICAL DESCRIPTION OF PROJECT

The NMSF is composed of two distinct areas. The first is a two-level concrete structure approximately 36 ft tall, 55 ft wide, and 150 ft long, which is embedded in the subgrade and rests on volcanic tuff. The second area is a single-story concrete structure, about 85 ft wide by 150 ft long, supported by footings on engineered fill. The first floor of this structure contains a storage area and the shipping/receiving area. This level is continuous with the one-story building, which contains additional support functions (office space, mechanical rooms, etc.).

This project will make renovations to the facility required to support passive air-cooled storage of the SNM. Nuclear materials in the form of metals and oxides will be stored in an array of dedicated storage tubes, known as drywells, within the vault area. The drywells and the material containers within them will provide multiple confinement barriers between the stored materials and the environment, and the storage array

*Note: A list of acronyms and abbreviations used in this document appears in Part I, Section J.

will be housed within a robust vault-type structure. The drywells and their contents will be cooled by a passive, self-regulating, natural convection cooling system that induces buoyancy-driven ambient air to flow across the exterior of the drywells. There will be no contact between the cooling air and the stored SNM.

In the one-story portion of the building, a new mechanical penthouse will be constructed over the existing mechanical room to house non-critical heating, ventilation, and air conditioning (HVAC) equipment. The administrative support area will be reconfigured with new change rooms, a security station, a decontamination station, and a mechanical room. The existing structure will be stiffened to accommodate the new configuration by the addition of new structural elements (detailed in Section E 1.7). Additionally, new walls and other enhancements will be installed so that a Material Access Area (MAA) boundary is established.

A new, small utility building will be constructed south of the facility to support gas-fired boilers, water heaters, and chillers.

The functional areas in the renovated facility will include a secure temporary staging area; change rooms; a safe, secure transport (SST) vehicle garage and dock; a pack/unpack area; a nondestructive assay (NDA) laboratory; an intermediate storage area; and a storage vault (containing the storage array and the charge hall).

3. LOCATION

The proposed project will renovate Plutonium Facility (PF)-41, located in TA-55, south of Building PF-4. The project is located in a developed area at TA-55. PF-41 is connected to PF-4 through an underground tunnel. **(See Part IV - Conceptual Drawings.)**

4. NEED FOR RENOVATION

The NMSF was originally developed as the central intermediate and long-term SNM storage facility for LANL and is included in LANL's long-range plan. SNM is currently stored in PF-4, which cannot meet future storage capacity requirements. No other building at LANL has the potential storage capacity and protective devices that are available or planned in the NMSF.

Based upon U.S. Department of Energy (DOE) Albuquerque Operations (DOE/AL) Office and LANL projections, storage space limitations/restrictions will begin to affect LANL's ability to meet its missions between 1998 and 2002. LANL requires a facility with sufficient storage capability and capacity so that its missions can be achieved safely. Establishment of the NMSF as LANL's long-term storage facility will allow consolidation of long-term inventories from other LANL sites into one centralized facility. The NMSF site is appropriately located for this purpose because of its close proximity and connection (via tunnels) to the nuclear materials processing facilities at LANL. Also, the NMSF does not require establishment of a new Category I Protected Area, since the facility is located within the existing protected area at TA-55.

5. ORGANIZATION OF REPORT

This report is organized according to the sections and subsections outlined by Attachment III-2 of DOE Document AL 4700.1, Project Management System. It is organized into seven parts. **Part I - Design Concept** describes the selected solution. **Part II - Project Management** describes the management system organization, the elements that make up the system, and the control and reporting system. **Part III - Supplemental Information** contains calculations for the various disciplines as well as other supporting information and analyses. **Part IV - Conceptual Drawings** presents the project conceptual drawings.

Part V - Structural/Seismic Information provides a description of the seismic and structural analyses performed on the NMSF and their results. **Part VI - Alternatives Study** presents a study of the different storage/containment options considered for NMSF. **Part VII - Estimate Data** contains the project cost estimate information.

B. JUSTIFICATION

1. JUSTIFICATION

The NMSF is intended primarily for intermediate (less than two years) and long-term storage of LANL SNM that is not needed for near-term programmatic requirements. Currently, these inventories are stored in a working storage vault at PF-4. The storage configuration can contribute significantly to radiation exposures to personnel; also, the vault is needed to support other programs. Transfer of the SNM inventories to the NMSF will reduce exposures and provide additional space to support programmatic requirements.

DOE has recently assigned surveillance, laboratory testing of new materials for weapons, stockpile laboratory testing, and shelf-life program laboratory activities from its Rocky Flats (Colorado) plant to LANL. Each of these activities will be completed at LANL's PF-4 facility at TA-55 and will require a significant reduction in current PF-4 vault holdings. The NMSF, with its tunnel connection to PF-4, provides an ideal location for the PF-4 holdings. This action meets the original intent of the NMSF. In its current configuration, however, the facility is not usable and therefore needs to be renovated.

The NMSF, as the site receiving area, would receive and temporarily stage SNM pending shipment to a working vault or line for use in support of a programmatic mission. Small amounts of material from offsite conceivably could be brought to LANL for storage at the NMSF, but these will be rare. Most of the material brought to the NMSF will be packaged at the generating site per established NMSF acceptance criteria, as detailed in the **Functional and Operational Requirements Document** (June 1995). Existing capabilities at PF-4 will be used to support repackaging if the containers shipped to the NMSF become damaged during transport.

All material to be stored will be processed into stable metal and/or oxide form before placement in long-term storage. Material will be placed in sealed metal containers. Two container systems are currently identified: the metal and oxide container fabricated at LANL, and the DOE's AT400A capsule (the primary containment vessel for pits). Because of the emphasis on reduced radiation exposures and stability over long periods, the performance of future storage containers is expected to exceed that of current containers with regard to heat dissipation and surface radiation. Therefore, the NMSF conceptual design regarding these characteristics is being driven by today's containers rather than by future container design.

Engineering studies and this Conceptual Design Report (CDR) have determined the most cost-effective methodologies to bring the NMSF into compliance with DOE and federal requirements. The studies focused on process flow, radiation protection, heat generation, criticality, safeguards and security, HVAC design criteria, and hazards analysis. Additionally, operational requirements and storage criteria have been studied, and a comparison of DOE Order 6430.1A, General Design Criteria, with as-built conditions has been conducted. Combined with cost and schedule data, these criteria were used to compare a number of storage options. The concept described in this document represents the best balance of these criteria.

Additional justification for the NMSF renovation is as follows:

- The NMSF will provide a centralized, controlled area at which to receive and store SNM at LANL because of its proximity to PF-4, its large storage capacity, and its built-in security features. These factors should reduce operating costs over its 40- to 50-year life.
- The NMSF will provide enhanced safeguards and security for SNM operations. These safeguards include fewer personnel with access to intermediate/long-term storage material, remote handling of/access to stored material, an SST garage for enclosed loading/unloading activities, a tunnel for material transport to/from TA-55 processing areas, its location within an existing Category I protected area, and reduced road closures. The renovation will bring the facility into compliance with safeguards and security requirements.
- The NMSF will provide intermediate and long-term passive storage with a passive natural-convection cooling system. The cooling system will not require maintenance or incur significant operating costs.
- The NMSF will provide LANL with a facility to meet its projected programmatic missions, and to support its lead laboratory activities and interim storage options to address site facility/storage issues.
- Radiation exposures to personnel will be significantly reduced at other locations by consolidating long-term storage material from the LANL Category I storage sites into the NMSF. Certain automation features to enhance safety have been specified for material handling in the NDA laboratory and charge hall. As-low-as-reasonably-achievable (ALARA) radiation exposure concepts and requirements will be incorporated into the design.
- The renovation, with its passive cooling feature, provides the most economical, long-term solution of the available alternatives, based on a variety of cost-risk benefit analyses.

2. IMPACT IF NOT FUNDED

The impacts if the project is not funded are as follows:

- DOE will be unable to meet its continuing responsibilities regarding the nuclear stockpile as required by the Atomic Energy Act of 1954 (as amended), Presidential direction, and Congressional authorization and appropriation.
- LANL's support of nuclear nonproliferation policy will not be sustained because of the absence of safe, secure repositories at LANL.
- Surveillance of new nuclear material and existing stockpile, and shelf-life activities, will not be performed.
- Radiation exposure to facility workers will not be reduced, and impact on the environment will not be minimized.

- LANL will not be in compliance with applicable federal and state laws, regulations, and standards.
- Lack of a centralized facility will result in large inventories of inadequately controlled material throughout LANL.

C. RELATIONSHIP TO OTHER PROJECTS

1. CURRENT PROJECTS

The renovation of NMSF would not affect any other current construction projects on the site. Construction would minimally affect operations at TA-55 for a limited period. There would be temporary changes in site security, and changes in access would be required to segregate the NMSF from PF-4. The connecting tunnel will allow integral functions to be accomplished at PF-4 with minimized handling and shipping requirements.

The PF-4 Operations Center will be upgraded in the near future under another project. The design of the NMSF should take the (potential) revised configuration of the Operations Center into account.

2. FUTURE PROJECTS

The Radiographic Facility, currently proposed as an FY99 line-item project, will occupy a portion of the TA-55 site with a connection to PF-4 through an underground tunnel. This facility is a separate project and is not dependent on the NMSF building. Coordination between preliminary design of the proposed Radiographic Facility and the NMSF renovation will continue throughout the design and construction process.

D. ALTERNATIVES

A number of alternative renovation plans and project options were examined for this CDR as well as for previous efforts and studies. The obvious safety and operational deficiencies of the existing NMSF facility were considered, and a number of different storage technologies and concepts were examined. The storage technique selected will have the largest effect on the facility configuration; therefore, most of the effort was devoted to selecting the best storage technique. A detailed study of alternatives was performed and is presented as Part VI of this report. The alternatives and options are summarized below.

1. NO ACTION

As discussed in Section B, if a facility to provide a centralized intermediate and long-term SNM storage capability is not operational in the near future, LANL will not be able to fulfill its programmatic missions. Therefore, this alternative is not viable.

2. CONSTRUCTION OF NEW FACILITY AT TA-55

Under this option, a new facility would be built in the vicinity of the existing NMSF at TA-55. This alternative would allow for greater flexibility in the design and construction of the storage area to incorporate shielding, heat removal, and storage requirements in the most efficient, cost-effective solution. An Environmental Impact Statement (EIS) would be required for a new facility. The new facility probably could not be commissioned and operated before 2002, which would adversely affect PF-4 operations.

Based on the results in **Part VI - Alternatives Study**, a new building would have to be about 32,000 square feet in order to be effective. The estimated construction cost for the new building in that study was \$31,250,000, based on the estimated construction cost contained in the initial CDR of about \$12,900,000 and an estimated unit price of an additional \$300 per square foot for the structure, excavation, sitework, and site security, which are additional for a new structure. The study was based on the estimates contained in the initial CDR to ease comparisons of separate alternatives. However, in order to develop a more accurate cost for a new building, the cost data developed in this CDR should also be used. The estimated construction cost (building and equipment only) for the renovated facility (31,000 square feet) is about \$23,100,000, which results in a unit cost of about \$725 per square foot (including Special Facilities Equipment). The aggregate of these two unit prices is about \$1000 per square foot, thus yielding a total construction cost (with contingency) of about \$32,000,000. Design, management, and other project costs are estimated to be about \$42,000,000, based on the ratios for the renovation. Therefore, the total cost of a new facility at TA-55 would be approximately \$74,000,000. This cost is significantly higher than the total estimated project cost of \$56,652,673 for the renovated facility using a conventional acquisition strategy.

3. CONSTRUCTION OF A NEW FACILITY OUTSIDE TA-55

The construction of a new facility on LANL property but outside of TA-55 would allow for greater flexibility in design and construction, as discussed in alternative 2. However, on-site transport would be required,

with associated road closures, increased costs, and increased worker and public risk. Additionally, a new facility located outside TA-55 would unnecessarily duplicate site security, thus increasing costs. Finally, a new facility could not be commissioned before 2002, which would adversely affect PF-4 operations.

Based on **Part VI - Alternatives Study**, and the methodology contained in the description of Alternative 2 above, a new building outside TA-55 will cost about \$37,000,000 (building, site, security, and equipment). The cost is somewhat higher due to increased costs for site security. The estimated costs for design, management, and other project items is about \$42,000,000. The total project cost for a new building outside TA-55 would be approximately \$79,000,000.

4. USE THE EXISTING VAULT AT TA-41

The existing TA-41 vault could be used. Although the vault has been used in the past, no SNM is stored there currently for a variety of reasons. This location is undesirable because the vault is situated in a canyon sidewall directly under the Los Alamos townsite and its businesses. The site is inaccessible to SST vehicles; therefore, transfers of nuclear materials to smaller vehicles at a facility within LANL would be required. The TA-41 facility is labor-intensive to operate and requires closure of public roads to move material to and from the vault. The authorization basis (safety analysis documentation) and basis for operational safety requirements mean that this facility must be significantly upgraded to support start-up of long-term nuclear material storage in the vault. This facility could not be commissioned before 2002, which would adversely affect PF-4 operations. Cost for this option was not evaluated because it was believed that it was not a technically or operationally viable solution.

5. USE THE PF-4 DAY VAULT

The remaining available space in the TA-55 day vault could be used for intermediate and long-term storage. However, as stated earlier, PF-4 vault workers are required to enter the day vault; therefore, the use of the PF-4 vault storage space for this purpose would significantly increase radiation exposure for PF-4 operations/processing personnel. This alternative also will not meet future mission requirements at LANL for ALARA exposures.

The PF-4 vault currently supports the following missions: stockpile evaluation, WRD&T program, special recovery, advanced fuels and heat sources, and existing inventory. These existing mission assignments will lead to the accumulation of substantial SNM inventory in the foreseeable future. This projected accumulation cannot be accommodated in the existing vault capacity at PF-4. Cost for this option was not evaluated because it was believed that it was not a technically or operationally viable solution.

6. RENOVATE THE EXISTING FACILITY

A number of renovation plans that center around different storage concepts have been evaluated. These included modifying the existing stacker retriever/shelf storage warehouse system currently installed in the vault, water bath storage, solid-block storage array, and air-cooled, dry storage. These concepts are discussed in **Part VI - Alternatives Study**. Each technique was evaluated for passive and active cooling methods, as well as for modifications to the facility to meet current LANL and DOE health, safety, and

operational requirements. The passive thermal-convection cooling system, and storage of material containers in drywells, was found to be the most efficient, cost-effective, and safe option.

Two project alternatives have been evaluated. The first is a conventional acquisition strategy that allows LANL to take occupancy in November 2002; this strategy has an estimated total construction cost of \$45,291,574 and a total estimated project cost of \$56,652,673. The second strategy is a design-build approach that would allow occupancy in November 2001; the total estimated construction cost for this strategy is \$42,245,313 and the total estimated project cost is \$53,135,608. Both options are presented so the reader can consider alternative acquisition strategies. The decision of which strategy to use will be made after this CDR has been reviewed and the risks of each alternative evaluated by the funding organization.

E. DESIGN CONCEPT

1. PROJECT DESIGN DESCRIPTION

1.1 Introduction

This section presents the selected option and the systems required to support the renovated facility. A passive, natural-convection storage design was selected as the best alternative. The renovation will upgrade the facility to comply with current DOE and LANL health, safety, and operational requirements.

1.1.1 Basic Assumptions

Current Facility

The NMSF in its current configuration cannot be operated and used as a storage facility for SNM for the following reasons:

- The storage vault and related equipment are not functional and do not meet operational and radiological requirements.
- Heat generated by decaying SNM cannot be rejected by the facility, thus exceeding the heat limits set by the user's material certification standards.
- The operational and administrative areas (e.g., change rooms, mechanical rooms) do not meet current DOE Orders and requirements.

Design Philosophy

Modifications to the existing facility will be necessary to allow the storage concept to function properly and to comply with health, safety, and security requirements. The configuration of the storage array is the primary influence on how the rest of the facility is planned and designed. In addition to regulatory, safety, and security concerns, four basic criteria were used to establish the most effective renovation plan:

- Physical separation between storage, operations, and administrative areas
- A confinement system (ventilation or some other means) in the storage vault when accessing the material
- Adequate space for assay, accountability measurements, and material-handling functions
- A storage system with passive safe and secure shutdown capabilities

1.1.2 Project Assumptions

The following assumptions apply to this project:

Mission

- The concept will provide for the intermediate and long-term storage of SNM in support of LANL programmatic missions.
- Funding and project schedule are based on FY97 as the first year of new capital funding.
- The facility will be managed as a major DOE project.

Design

- A utility building that complies with DOE 6430.1A will be needed to support facility operations.
- The concept will allow for a nominal 6,000 storage locations and 6,600 kg of actinides, and dissipate 20 Kw of heat.
- The cooling system shall provide for passive safe shutdown.
- The design shall comply with the requirements of DOE Order 6430.1A and other applicable orders. Minimal exceptions to DOE orders are permitted, per DOE 4700.1A, based on a graded approach. All exceptions will have to be approved by LANL and DOE.
- All facility modifications will remain within the envelope of the building, if possible. Encroachments outside the structure must be limited.
- The facility will have a 40- to 50-year service life.
- Operations monitoring will occur from the PF-4 operations center, but NMSF will have a stand-alone capability.
- The renovated NMSF will be a Hazard Category 2 and a seismic performance Category 3 facility.
- The container dimensions identified in the **Functional and Operational Requirements Document** (June 1995) will remain fixed.
- Complex 21 containers are not available.
- Administrative controls of SNM will be minimized and engineering controls used where feasible.
- New NDA equipment will have to be purchased because existing equipment is not satisfactory.
- Walk-in HEPA filters are needed for ease of maintenance and operations.

Operation

- No materials in a pyrophoric state will be accepted and/or stored at this facility.
- A minimal amount of weapons components will be stored.
- The Resource Conservation and Recovery Act (RCRA) is not applicable to this project, since no mixed waste will be stored routinely, and only small amounts of potentially hazardous materials will be used (i.e., for cleaning and maintenance).
- Material will arrive at the facility already stabilized and packaged in approved containers.

Health and Safety

- The storage array shall be designed and configured to ensure that subcritical geometry is maintained.
- New safety analysis reports (SAR) and associated documentation will be developed.

1.2 Proposed Renovations

1.2.1 Present Building

The NMSF consists of a two-level concrete structure approximately 36 ft tall, 55 ft wide, and 150 ft long. Attached to this is a single-story concrete structure about 84 ft wide by 150 ft long. The first floor of this structure contains a storage area and the shipping/receiving area; it is continuous with the one-story building, which contains support functions (offices, mechanical rooms, etc.).

To support the new storage configuration, many changes will be made to the interior of the NMSF, most of which will affect the vault area.

1.2.2 Renovations

Structural and architectural modifications are required, as well as new and relocated mechanical, electrical, and instrumentation systems. In summary, the modifications are as follows:

Architectural

- Reconfigure the hardened structure to fully enclose the enlarged MAA, including roof reinforcement to meet security and seismic requirements.
- Reconfigure the support area to prevent commingling of operations within the MAA and administrative functions, and to establish radiological control points.
- Provide safeguards and security upgrades, including a hardened control point.

- Replace the peeling decontamination coating on interior surfaces of the MAA and the radiologically controlled area.

Civil/Structural

- Add a floor within the existing envelope to support NDA activities.
- Demolish and remove the existing storage/retrieval system.

Mechanical

- Provide a storage configuration with passive safe shutdown capabilities.
- Install a new high-efficiency particulate air (HEPA)-filtered HVAC system.
- Demolish existing fire protection system.
- Provide new fire suppression and fire alarm system.
- Construct a new mechanical utility building to supply hot and chilled water.

Electrical

- Install new and relocated mechanical and electrical equipment.
- Install a new grounding counterpoise system.

Radiological Protection

- Provide shielding to meet current ALARA radiological control standards.

See Part IV - Conceptual Drawings for further information.

1.3 Storage Concept

The following is a description of the passive air-cooled storage concept, which uses natural convection to dissipate heat from decaying SNM. This is meant as a general description only. A detailed thermal analysis is contained in Section 1.13 of this CDR. The concept and requirements of passive safe shutdown are also discussed.

Confinement Philosophy

The NMSF confinement philosophy is summarized in the following schematic. Per DOE Order 6430.1A (Section 1305-5), three layers of confinement are required for plutonium storage facilities. Three layers of confinement are provided through a combination of the container systems, drywells, and building systems. Primary and secondary confinement is provided by qualified and tested product/boundary containers. The product/boundary containers will always be handled and stored within the tertiary confinement system.

The tertiary confinement system consists of the building shell (including the HEPA filtering system), charge deck, and drywells. The drywells are welded to the charge deck and the charge deck is sealed to the building. The unfiltered cooling air will pass over the tertiary confinement boundary, which includes the exterior surface of the drywells.

1.3.1 Passive Air-Cooled Storage Concept

1.3.1.1 System Selection Basis

The passive air-cooled concept was selected because it provides a long-term storage solution with the following features:

- Indefinite storage terms. Once the containers are placed in the storage array, confinement and physical protection will be provided in a truly passive manner. Except for material control and accountability (MC&A) and security monitoring, no active electrical or mechanical systems will be needed.
- Physical separation between the operations and the storage vault.
- Meets the specific criteria and intent of the following sections of DOE 6430.1A:

1300-10	Physical Protection, Material Safeguards, and Storage of SNM
1305	Plutonium Storage Facilities
1306	Unirradiated Enriched Uranium Storage Facility
1320	Irradiated Fissile Storage Facilities
1324	Radioactive Solid Waste Facilities

Additional Codes and Standards may be found in Section 9.

In the dry storage concept, nuclear materials in the form of metals and oxides will be stored in an array of storage tubes, known as drywells, within the vault area. The drywells and their contents will be cooled by a passive, self-regulating, natural convection cooling system that induces buoyancy-driven ambient air flow across the exterior of the drywells. There will be no contact between this cooling air and the stored SNM.

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1.3.1.2 System Design Description

Storage Configuration

Containers. SNM will be stored in two types of containers. Metals and oxides will be stored in LANL-designed containers that consist of a carbon steel product-and-boundary-container system. Weapons components (pits) will be stored in the inner steel capsule of the AT400A system. These containers represent primary and secondary confinement and also provide a limited amount of physical protection.

See **Part IV - Conceptual Drawings** for representations of the container systems.

Baskets. The SNM containers will be placed in a "basket" to support them in the drywells and to aid with material handling. The basket will ensure that the containers remain in a subcritical storage geometry. The basket, with containers nested within, will be placed in the drywell, which is a permanent part of the facility. Each drywell can accommodate two baskets. The baskets will allow seven containers to be retrieved at one time, and 14 to be stored in a single drywell.

Storage Configuration. The drywells will be positioned in a storage array that promotes efficient cooling and maintains a subcritical geometry. They will be vertical and supported at their upper ends by a charge deck, which will also provide radiation shielding for workers performing material-handling operations.

The charge deck (a steel-and-concrete composite deck) will divide the storage vault into two separate areas. The area above the charge deck, known as the charge hall, will be used for material-handling operations. The area below the deck, in conjunction with the existing basement walls and floor, will form the major element of the cooling circuit. This area is known as the storage array. The remainder of the cooling circuit will consist of the entrance louver, the entrance shielding baffles, and the outlet vent.

Passive Cooling System

Cooling System. Cooling air will enter the facility through a secured and storm-proof louver fitted with a bird screen and located in the existing south wall of the facility. The air will then flow through a concrete labyrinth (designed to prevent radiation streaming) and into the lower section of the storage vault, where it will be drawn through the storage array. The air will be heated by the drywells, become buoyant, and rise relative to air of lower temperature. The heated air will rise through an outlet vent to the atmosphere. The outlet vent will be a vertical shaft extending from the charge deck through the existing roof at the northern end of the facility. The heated air rising through the outlet vent will induce additional ambient air into the inlet and through the array, thus creating a self-sustaining, natural thermal-siphon cooling flow.

Air Flow Calculations. To employ this cooling method, the buoyancy head pressure generated by the rising warm air must be sufficient to overcome the resistance to flow through the storage array, including entrance and exit losses. To determine whether this cooling concept will produce the desired effect, calculations were performed using local design data, the maximum temperature constraints of the stored material, the physical constraints of the existing facility envelope, and a heat output of 20 kW from the stored material. Some of the parameters used were an entrance-air temperature of 90°F (summer design temperature for Los Alamos, New Mexico), a maximum temperature of 138°F (based on a maximum stored-material temperature of 60°C or 149°F), and a minimum difference in height of approximately 49 ft from the center of the storage array entrance louver to the point of exit from the outlet vent. The results of these calculations were as follows:

- The temperature difference between entering and leaving air, and the 49-ft difference in height between the intake louver and the outlet vent point of exit, create a sufficient buoyant head pressure to remove the heated air from the array.
- A flow rate of approximately 16,000 cubic feet per minute (CFM) will be required to remove the heat.
- The available buoyant head pressure exceeds the resistance to air flow through the cooling circuit required to remove 20 Kw of heat released from the stored material. Therefore, natural convection will produce the desired cooling effect, allowing for flexibility and margin for safety.

A detailed thermal analysis has been completed, the results of which are more thoroughly discussed in Section 1.13; other information is contained in **Part III - Supplemental Information**. Additional heat transfer output analysis has been completed and is available for reference, but is not included in this CDR.

A higher air flow will result in a lower leaving-air temperature and thus a lower stored-material temperature as well as a reduction in the available buoyant head pressure. On the other hand, as the air flow through the storage array increases, the resistance to air flow will also increase exponentially. At a given point, the system will actually operate at a state where the resistance to air flow exactly equals the available head pressure. The actual leaving-air temperature, stored-material temperature, cooling-air flow rate, available buoyant head pressure, and resistance to air flow through the cooling circuit will be determined by an iterative process where all five functions are interrelated.

With proper design, wind effects on the building will also increase the vault flow rate by inducing a negative pressure at the outlet-vent exit point, thereby increasing the available buoyant head pressure and in turn increasing the flow of ambient air through the cooling circuit. This flow enhancement will reduce the temperature of the drywells and the stored material relative to their calm day values (which are dependent on wind direction and velocity). No credit has been taken for the effect of vault air flow enhancement by the wind in prediction of temperature for this study.

Conclusions. The thermal analysis (Section 1.13) details the determination of actual operating points and resultant stored-material temperatures for different material-loading levels and different entering-air temperatures. A review of the calculations shows that, even with the project constraints, sufficient excess capacity apparently exists in this concept to provide some contingency for overcoming higher ambient temperatures than the design summer day, as well as partial blockage of the entrance or exit louver.

1.3.2 Passive-Safe Shutdown

1.3.2.1 Background

DOE Order 6430.1A stipulates that a nuclear facility must be designed to achieve a safe response to unusual conditions, including all postulated design basis accidents (DBAs). The ultimate response is the safe shutdown of the facility, which will occur if normal power is lost. A facility in the passive safe-shutdown mode can remain in that mode indefinitely without unacceptable exposure to the public or environment, as defined by Paragraph 1300-1.4 of DOE Order 6430.1A. Those confinement structures, systems, and components (SSC) required to achieve safe shutdown are designated as "safety class." These SSC will be designed with redundancy, special qualification, and extra safety factors to ensure that they will function safely.

1.3.2.2 System Design Requirements

Methods

Passive safe shutdown can be achieved by either of two methods. The first is to shut down operations while maintaining some systems in an active state; this requires an emergency power system. The second is to shut down in a passive state, which does not require emergency power. DOE 6430.1A does not state a preference for either shutdown mode. Whichever mode is selected must be justified by safety analysis.

The active versus passive shutdown design decision is based on an assessment of the processes within the facility. The active-safe shutdown mode must be selected if the facility contains processes that could release radioactive material if they do not remain powered. The active shutdown mode must also be selected if the radioactive material that could be released within the facility cannot be contained by the facility structure. Passive shutdown can be selected where a facility employs no active processes requiring control after loss of power, and where the material that could be released can be contained with a facility structure.

When it can be justified, passive shutdown should always be considered preferable for the following reasons:

- It is demonstrated to be safe under the worst conditions.
- It is the simplest method because it does not require a complex safety-class power system and is most economical to maintain (lowest life-cycle cost).
- It minimizes spread of contamination within the facility.

Justification at NMSF

The processes within the NMSF are contained within the facility structure and will not cause an unacceptable release to the environment as a result of loss of power. Therefore, passive shutdown has been selected.

The following considerations justify this selection:

- The NMSF structure and drywells will be safety-class to support plutonium storage missions.
- All SNM in the NMSF will be stored within nested, sealed containers. These containers are very robust: the container system can operate at an internal pressure of 300 psig, with adequate safety margins. Drop and pressure tests have been performed. No processes in the NMSF will remove the SNM from the all-welded inner container.
- All SNM areas are served with HEPA-filtered ventilation.
- The containers will be stored within drywells supported by a charge deck, which will be in turn surrounded by a concrete vault. The charge hall will be HEPA-filtered and therefore substantially sealed from the environment, even if the HVAC system becomes inoperative. Portable air monitors will be employed at the intake in the event of a power failure. Additionally, the drywells will be sealed and the containers will not be exposed to the environment. The combination of these systems

provides all the physical and confinement protection necessary while still meeting the requirements of DOE 6430.1A.

- The forms of SNM being stored (metals and oxides) are not easily releasable. There will be no available source of energy to spread the materials. Should a container rupture occur when a material container is not within a shipping container or a drywell, contamination could slowly spread in the area of the spill, but there would be insufficient force to cause a significant transport of contamination around the HEPA filters and through the facility confinement structure.
- Structural basis analysis indicates that the NMSF structure will function during and after a design basis earthquake (DBE). Openings (doors and pipe/conduit penetrations) in the confinement structure can be adequately sealed to ensure that facility leakage is low enough that a release resulting in a significant site boundary exposure cannot occur.
- Thermal analysis indicates that the temperature rise due to decay heat of the storage array, stored material, and structure would not reach specified temperature limits for at least 30 days following complete loss of natural convection air flow through the array.
- The storage array will be designed and configured to preclude criticality accidents, even in the event of upsets resulting from accidents.
- The ventilation systems will be designed to breathe through both inlet and outlet HEPA filters to remain at equilibrium with the ambient conditions.
- The storage/retrieval mechanisms (bridge crane and container handling machine) will be designed to require power to release a basket; therefore, loss of power while the machines are holding a basket will not result in a dropped basket. Manual override will allow manipulation during a loss of power.

In the event that the NMSF shuts down, the following will occur:

- All systems will fail to a CLOSED position, meaning to a status that ensures continuation of safe conditions.
- All powered equipment will stop. This includes the material-handling equipment, the NDA equipment, and the ventilation systems.
- Security systems, alarms (fire, stack monitoring, criticality), SNM portal monitors, and emergency lights will remain functional with temporary back-up power from an uninterruptible power supply (UPS) (see Section 1.10 for specifics).
- Personnel will evacuate the facility through emergency exits with SNM monitors. Once the facility is evacuated, the doors will be secured and the door seals inflated.
- The only significant paths of effluent from the facility will be through the intake and exhaust HEPA filters.

1.4 Proposed Process Flow

The materials storage process flow will be as follows:

- Containers of SNM will arrive in an SST vehicle, which will park in the truck loading area.
- The truck will be unloaded, and containers will enter the airlock located adjacent to the truck loading area. The containers will then be within the MAA.
- From the airlock, items to be unpacked and assayed first will be transferred into the cargo restraint transport (CRT) staging area on the first floor. Items to be unpacked later may be placed in the vault-type room off the staging area, or taken to the basement via the elevator and placed in intermediate storage. Some items will be moved directly to PF-4, since NMSF is the primary receiving point for TA-55.
- Once in the pack/unpack area, the inner containers will be removed from the shipping containers and transferred via the elevator to the NDA laboratory. As shipping containers are emptied and material containers move through the NDA laboratory, more shipping containers will be retrieved from the vault-type room or the basement and brought to the CRT staging area. The empty shipping containers will be tested for contamination and, if clean, will be relocated to the garage through the airlock for transport offsite. If contaminated, they will be decontaminated first.
- In the second-floor NDA laboratory, the material containers will be assayed. Containers may also arrive here directly from the PF-4 tunnel. After being assayed, the containers will be loaded into a basket in the basket loading area. A basket will be loaded vertically, using a hoist provided in the ceiling.
- After the basket is loaded, it will be lowered into a permanent transfer cask that will be horizontally moved by a piston or other suitable mechanism. This cask will be located within a secure airlock between the vault and the NDA laboratory. The airlock doors will close, and the transfer cask will be moved into the vault area.
- The container handling machine, with internal shield valve, will then retrieve the basket from the transfer cask and place it in the desired drywell location.

Also refer to the **Functional and Operational Requirements Document** (June 1995), and to **Part III - Supplemental Information**.

1.5 Civil

1.5.1 System Function and Site Description

The civil portion of this project will provide the necessary utilities, landscaping, drainage, site improvements, and construction access necessary to facilitate renovations and operations.

The existing site is located within a secured area of TA-55, along the north side of Pajarito Road and west of TA-50. The NMSF is located about 75 ft south of PF-4. Building PF-142 abuts the NMSF at the northwest corner. The site is well-developed, with existing utilities, security fences and systems, and access roads in place. See **Part IV - Conceptual Drawings** for proposed bid work.

The landscape on the south and west portions of the site consists of native grass and juniper and piñon trees. An unpaved service road runs through the southwest corner of the site. North and east of the existing buildings, the site is paved and landscaped with grass and shrubs. The western and southern portions of the site slope from 5% to 30%; the paved areas are relatively flat.

The renovation of the NMSF will remain within the footprint of the existing building, but some modifications and additions to the building's exterior will be required. A utility building to house gas-fired boilers and other mechanical equipment will be constructed to the south of the existing building to comply with DOE 6430.1A. Portions of the site will have to be regraded to accommodate the selected renovation plan, but the overall drainage of the site will not change.

1.5.2 System Design Basis

Section 9 contains the applicable codes and standards used to develop the conceptual design.

1.5.3 System Design Description

Utilities

The existing site contains all the utilities necessary to service the renovated building. The current gas and water services are also sufficient to serve the new utility building, which will house the gas-fired boilers, chillers, and associated pumps and equipment. The gas service, which is currently connected to the NMSF, will be disconnected and rerouted to the new utility building to comply with DOE 6430.1A, which precludes natural gas service to a nuclear facility.

The existing domestic water service, a 3-in. line, will be used, but a tee will be added and the line extended to serve the utility building. New chilled- and hot-water supply and return lines will be installed between the utility building and PF-41.

The existing 1-in. steel gas line, with an operating pressure of approximately 90 psi, will be extended to the utility building. At the utility building, the pressure will be reduced to supply low-pressure gas to the boilers and hot-water heaters.

The existing radioactive liquid waste (RLW) line at the northern end of PF-41 will be modified within the existing footprint of the building to serve the renovated space. This line will serve only the decontamination showers, janitor's sink, and any sumps required within the controlled area.

The existing 13.2 kV power feeder serving PF-41 requires no increase in capacity to meet project requirements, but does require modifications for upgrading and refurbishing.

The existing underground communications require new conduit extensions between two existing manholes and buildings PF-41 and PF-142.

Foundations and Geotechnical Conditions

Sergeant, Hauskins, and Beckwith prepared an April 1984 geotechnical investigation report that was used in the design of the original facility. Because relatively minor modifications are planned for the site, another soil investigation was not deemed necessary for the preparation of this CDR, but one will be required to evaluate seismic performance during detailed design.

The 1984 soil report indicates that the soils underlying the site are alluvial deposits consisting of clayey and silty sands as well as sandy clays with lesser deposits of sandy silts. These deposits extend anywhere from 2 to 7 ft below existing grade and were not disturbed by construction of the original facility. Volcanic tuff comprises the material below these soft deposits. The site was regraded and compacted for construction of the NMSF in 1986; crushed volcanic tuff was used as backfill. The existing foundations bear on the tuff, which provides an excellent bearing strata, with bearing capacities on the order of 5000

psf. New foundations for the utility building should extend at least 36 in. below grade and bear on compacted tuff.

Clearing

Minor clearing will be required, primarily for the excavation and regrading necessitated by installation of the intake vent on the south side of the building, and for the utility building.

Landscaping

The site will be revegetated per LANL standards.

Construction Access

Access to the site will be provided through the original TA-55 construction access gate in the west fence. Temporary fences and security measures to separate PF-41 from the remainder of TA-55 will have to be installed. Construction access and required security measures are shown on the civil drawings. NMSF renovation crews will not require clearances or escorts. After construction is complete, the site will be turned back to the TA-55 perimeter intrusion detection and assessment system (PIDAS).

Site Improvements

The improvements required for this project include the following:

- Soil will be removed from the south and west portions of the site adjacent to the south wall of the existing building to accommodate construction of the storage array air intake vent.
- The existing soil cover on the vault roof will be removed.
- A utility building (approximately 32 ft by 42 ft in plan) will be constructed south of PF-41. This building has no nuclear mission and will house boilers and chillers. This building is proposed as a Performance Category 2 structure.

Drainage

Existing Conditions. The westerly and southwest portions of PF-41 and PF-142 are bermed with fill material, which is protected by a blanket for erosion control. The ground cover consists of native vegetation to the west and south of the existing buildings beyond the berm. There are asphalt paving and concrete walks to the east and north side of the existing buildings. The grade slopes from 5% to 30% to the west and south of the existing buildings. The northern and eastern paved areas of the site slope toward an existing storm drain located north of PF-41. The NMSF has an existing roof-drain system that collects storm runoff and discharges it into a storm sewer on the north side of the site. The southern and western portion of the site drains to a storm drain inlet at the site's southeast corner.

Proposed Conditions. The design storm used for NMSF is a 100-year, 15-min duration storm, per DOE-STD-1020-94. The construction will affect 1.7 acres. The buildings and parking area drainage will not be affected and will not be modified. The area adjacent to the southern wall of the building will be regraded to accommodate the new intake; however, the runoff will drain along the same path. Slope stabilization will be provided if conditions warrant.

1.6 Architecture

The existing NMSF was completed in 1987. The building is a two-level concrete structure. The first floor includes a security entrance and exit, a security station, a truck loading area, a shipping and receiving area, a packing/unpacking area, a telephone room, a vault storage area, an air sampling room, a mechanical equipment room, an airlock, and restrooms. The basement consists of an SNM storage vault and a number of smaller designated storage rooms. A tunnel connects the NMSF to the adjacent PF-4 north of the existing facility. A freight elevator and two stairwells connect the basement and first floor.

1.6.1 System Function

The architectural systems will promote effective use of the facility by providing spaces, egress, and flow for personnel and equipment. Layout and finishes will enable efficient maintenance and life safety enhancement.

1.6.2 System Design Basis

The renovated facility will provide intermediate and long-term storage for SNM. The architectural design basis for NMSF was developed through a programming process, a standard procedure which includes input from the architect-engineer (AE) and the user group to establish criteria essential in the development of this design. The design basis was selected according to the following criteria:

- The facility will provide physical separation between SNM storage, operations, and administrative areas.
- The facility will eliminate the need for mechanical ventilation in the SNM storage area.
- The facility will provide additional space for assay and material-handling functions.
- The facility's floor plan will incorporate operations process flow.
- Material can also be transferred to and from PF-4 via a tunnel.

1.6.3 System Design Description

The proposed design of the NMSF was dictated by the sequential requirements of the personnel and material storage flow. Regulatory, safety, and security requirements were also incorporated into the proposed design. All operations, storage, and administrative activities were required to be housed within the envelope of the existing building. Elements of the proposed design will be as follows:

- The MAA will be reconfigured and increased per architectural programming criteria to include the temporary staging and packing/unpacking areas; decontamination; controlled janitorial, mechanical, facility monitoring, and change rooms; NDA laboratory; intermediate storage vault; and the storage array (drywells). All spaces within the MAA will be located according to their operational flow and programmatic requirements.
- The security station, the truck loading/unloading area, the unisex restroom, and the uncontrolled janitor/storage closet will reside outside the MAA.

- The NDA laboratory will exist on the mezzanine level between the basement and the first floor, with a flexible floor plan to allow for future modifications based on technology requirements.
- The risk of contamination of the confinement ventilation system has been reduced by physical separation between operations and storage areas, application of airlocks, and alarmed vault doors.
- A transfer airlock will be constructed between the storage array and the NDA laboratory to improve material process flow and reduce the risk of contamination.

1.6.4 Access for the Physically Disabled

The nature and extent of operations expected at this facility discourage allowing the physically disabled to access hazardous areas where emergency evacuation may be required. The MAA is such an area.

1.6.5 Demolition and New Construction

The following modifications are proposed:

- The majority of the partitions on the first floor will be demolished. The entire space will be reconfigured to accommodate change rooms, a security station, decontamination stations, a revised material entry airlock near the garage, and a mechanical room. New areas will be formed with reinforced concrete and 8' concrete masonry unit (CMU) walls, which will require saw cutting of the existing slab; new footings will be poured. Existing doors, restroom facilities, ramps, and acoustical ceilings will be removed to accommodate the proposed spaces. Part of the first-floor slab will be removed to create the new vault storage area.
- The existing basement walls on the east and west sides of the storage array will be reinforced and thickened to support the charge deck.
- A transfer airlock will be constructed between the storage array and the NDA laboratory.
- A reinforced intake opening no less than 240 gross ft² in size will be cut in the south wall of the storage vault. Concrete shielding baffles will be constructed in the basement north of the intake to

provide radiological protection and promote adequate air flow. The air intake shall be designed to prevent unauthorized personnel access.

- An outlet vent will be constructed at the north end of the building. An opening, no less than 28 ft, 4 in. long by 4 ft wide, will be cut into the existing roof slab. A short vent structure, constructed of reinforced concrete walls with a rain cap and louvers, will be installed. The roof slab around the vent will be reinforced.
- All interior walls in the building will be repaired, sealed, then sandblasted and painted with a special protective coating (SPC) to meet decontamination requirements.
- Both existing interior stairways will be reconfigured and/or relocated to allow access to the new mezzanine. Additionally, a new stop will be added to the elevator for the same purpose. A new landing for the elevator and stairs will be constructed.

1.6.6 Code Analysis

Background

The specialized characteristics and security needs within the MAA are outside of the Uniform Building Code's (UBC) applicability. Therefore, the UBC will be used as the applicable code for design of the area outside the MAA. The area within the MAA will be analyzed based on DOE orders 5632.1C and 6430.1A and National Fire Protection Association (NFPA) 101, Safety to Life from Fire in Buildings and Structures ("Life Safety Code").

Outside MAA

The area outside the MAA will be designed to comply with the following UBC sections:

Occupancy Classification

- Net floor area 3,667 ft²
- Occupant load 50 (Table 10-A)
- Occupant load factor 15 (Table 10-A)
- Occupancy B-2 (Chapter 3)

Type of Construction

Type II (Table 6-A, Section 603.1)

Location on Property

- Openings are not permitted less than 5 ft, protected less than 10 ft (Table 5-A)
- Fire resistance of exterior walls = 1 hour less than 20 ft (Table 5-A)

Allowable Floor Area

- Allowable floor area = 3,600 ft² (Table 5-B). Area may be doubled in buildings of more than one story if the building is provided with an approved automatic sprinkler system throughout (Section 505.3) (No sprinklers will be installed in the charge hall and storage array.)

Height and Number of Stories

Height = 65 ft, 4 stories allowed (Table 5-B)

Minimum Egress Requirements

Minimum of two exits other than elevator are required where number of occupants is at least 50 (Table 10-A)

Inside MAA

The area inside the MAA will be designed in accordance with DOE Orders 5632.1C and 6430.1A. (See **Part III - Supplemental Information** for additional guidance criteria relevant to the design of this project.)

NFPA 101 - Life Safety Code

A thorough life safety analysis will be conducted for this facility during detailed design. However, preliminary analysis indicates that the proposed renovation can be performed in compliance with NFPA 101. Alternatives shall not diminish the level of life safety below that which exists prior to the alteration. A summary of the preliminary analysis follows. (See **Part III - Supplemental Information** for additional life safety guidance criteria relevant to the design of this project).

Hazard Classification

The project has been assigned a Low Hazard classification in accordance with NFPA 101. Emergency egress paths and exits will be provided from normally occupied areas of operation. Emergency egress will be arranged so that a single fire or incident will not block egress from the facility. However, the charge deck will have a single exit door. (See **Preliminary Fire Hazards Analysis**.)

Occupant Load

The design of the NMSF assumes an anticipated occupant load of 40, double the projected actual occupant load of 20.

Means of Egress

Doors - Fire-rated doors and assembly will be provided to appropriately separate and prevent the spread of fire and smoke throughout the facility. Doors will be equipped with approved emergency panic hardware and self-closing devices as required, permitting unobstructed egress from the facility.

Stairs - Stair assemblies shall comply with all requirements of NFPA 101 for construction, sizing, incorporation of handrails, etc., for this facility.

Corridors - Corridors to be used as means of egress in this facility shall be of one-hour construction and include fire-rated door assemblies in compliance with Section 5-1.3.4 of NFPA 101.

Capacity of Means of Egress

Design shall be sized per occupant load in accordance with NFPA 101, including the arrangement of exits.

Travel Distance

The maximum travel distance has been restricted to 200 ft in most cases.

Exception for Number of Means of Egress

Actual occupancy and security may limit the actual number of exits in a few cases in compliance with 28-2.4.1 requirements.

Illumination

Means of egress shall be illuminated as per the requirements of Section 5-8.

Emergency Lighting

This facility shall be equipped with emergency lighting as per Section 5-9.

Signage

Signage shall be provided at each door in compliance with ANSI 117.1, continually illuminated as per Section 5-10 of NFPA 101.

Protection

Handrails at landing and truck docks, stairwells, basket loading area, and drywell tubes shall be emplaced in accordance with section 28-3. Fire alarms and emergency call boxes shall be emplaced in accordance with 28-3.4.1.

Elevators - (28-5.3)

Modifications to the existing elevator must be in accordance with 7-4.3 requirements and tested in accordance with 7-4.8.

During construction, adequate escape facilities will be maintained according to 31-1.1.

1.7 Structural and Seismic

1.7.1 System Function

The structural systems will provide the facility with a safe, secure, and hardened envelope for the vault and other areas within the MAA. They will also provide for safe occupancy and operations outside the MAA. The structure will support the storage array, special storage equipment, and other required systems; enable the facility to maintain its integrity during a design basis accident (earthquake or thermal event); and facilitate ease of maintenance and operations. These systems will also impede unauthorized access to the material storage areas.

Detailed seismic and structural analyses have been performed to determine the adequacy of the existing structure and the modifications required to support the renovation concept. A complete set of original design and construction documents was not available from the agency responsible for construction of the facility. However, the as-built drawings were available and were used in the investigation.

A report of the seismic investigation is in **Part V - Seismic/Structural Investigation**, which contains calculations on the behavior of the existing structure as well as the postulated behavior of the modified structure. The entire computer output is bound separately and is available at LANL for inspection, but is not included in this report. The report and data are preliminary and will be refined during detailed design. However, the report and the analyses indicate that the proposed renovation is feasible.

1.7.2 System Design Basis

Codes and references used as a basis for the analyses are listed in Section 9 and in **Part V - Seismic/Structural Investigation**.

1.7.3 System Design Description

1.7.3.1 Modifications

The following structural modifications for the NMSF renovation are required (**See Part IV - Conceptual Drawings**):

Remove

- The first floor slab in the vault area (column lines 1 and 2) will be removed.
- Soil cover on the existing storage area roof will be removed.
- The existing mezzanine slab between column lines B and C will be removed.
- The north/south wall on column line 1.5 in the basement will be removed.

Add

- A mezzanine floor slab will be added at 10 ft above the basement slab between column lines 2 and 3.
- New concrete and CMU walls will be introduced in the administrative area. The calculations in **Part V** address these walls. Care should be exercised in the detailing of these walls: The new walls should be restrained laterally at top and bottom. The lateral restraint at the top should allow for relative vertical displacement between the top of the walls or partitions and the roof and supporting precast beams.
- A lightweight mechanical penthouse will be constructed on the roof over the southeast corner of the facility.

- Steel grating will be added to protect the intake vent and the stack outlet vent (26 kips each). These vents will be structurally non-critical and must be supported to maintain the structural integrity of the NMSF facility.
- Buttresses will be installed along the west wall of the building. The buttresses will be attached to the wall with dowels. The buttresses are required to strengthen the wall for crane loads as well as for thermal stresses.

1.7.3.2 Analysis and Models

Background

These proposed modifications will satisfy the upgraded functional and operational requirements for the NMSF.

Models Used

The existing structure and the modified structure were evaluated using simplified conservative methods as detailed in **Part V - Structural-Seismic Investigation**. Input loads will be consistent with those specified for Moderate Hazard facilities with Performance Category 3 classification per DOE-STD-1020-94.

The scope of the seismic evaluation performed is in accordance with the guidelines of the LANL Structural Standard, DOE-STD-1020-94, and other required industry standards including UBC and ASCE-7. The current evaluation considers accidental torsion loads, soil-structure interaction, lateral soil pressure, and thermal stresses (for the modified structure only). The magnitude of the loads and the considerations for their combined effects are described in Section 3.0 of **Part V**. Also, a preliminary structural evaluation of the existing buried access tunnel and its interaction with the NMSF was performed.

The structural performance goals for this Category 3 facility, during and after occurrence of a postulated earthquake event, include occupant safety, continued operation, and confinement of hazardous material. The PC-3 basis was determined using DOE-STD-1020-94 and an assumed accident probability of the PHA (yet to be completed). Quantitatively, this performance requirement corresponds to exceeding the postulated earthquake event with an annual probability of 0.30g ($5 \times 10^{-4}/\text{yr}$).

Computer Programs Used

The analysis was performed using "A Series of Computer Programs for Static and Dynamic Finite Element Analysis of Structures," SAP90 User's Manual, Computers and Structures, Inc., Berkeley, California. The evaluation procedure and results of the analysis are presented in Section 6.0. This evaluation shows that the conceptual structural modifications envisioned for the NMSF are feasible. Furthermore, the modifications could be implemented so that the resulting structure adequately meets DOE requirements for Performance Category 3 structures. Most of the structural strengthening required is in the west wall of the structure and the roof over the administrative area.

Results

The results of this preliminary evaluation indicate that the as-built NMSF structure is adequate to withstand the loads specified by current DOE standards for Category 3 structures.

Future Work

The simplified conservative methods used in the preliminary structural seismic evaluation are consistent with the conceptual design stage of the structural modifications to the existing NMSF. A significantly more detailed and complete analysis and evaluation is required for full compliance with current DOE requirements. Detailed analysis is expected to take place at the Title Design stage for the NMSF facility.

1.8 Mechanical

The existing mechanical systems will be replaced because current equipment is insufficient and cannot be maintained cost-effectively. All existing HVAC equipment will be removed. This includes fans, ductwork, boilers, air-cooled condensing units, centrifugal exhaust fans, rooftop exhaust fans, HEPA filter plenums, hot water piping, refrigerant insulation and piping and associated valves and fittings, fume hoods, diffusers, sidewall registers, exhaust registers, return-air registers, two electric unit heaters, expansion tanks, hot-water and chilled-water circulating pumps, boiler flues, and water heater flue.

All existing potable and non-potable water piping, plumbing fixtures, sanitary sewer, radioactive liquid waste, vent piping, water heater, natural gas piping, vacuum piping, compressed-air piping and pressure-reducing valves, associated valves, piping, and fittings will also be removed.

Section 9 contains a list of applicable codes and requirements. Substantial guidance can be found in the "LANL Facilities Engineering Standards - Mechanical."

Separate HVAC systems will be provided for the MAA (a radiologically controlled area), the support area outside the MAA, and the utility building.

1.8.1 MAA HVAC System

1.8.1.1 System Function

The primary system function is to maintain controlled, continuous airflow from the outside environment into the MAA, in order to prevent the spread of contamination within the facility during normal operation and to minimize the spread of contamination during abnormal conditions.

The existing mechanical equipment cannot adequately support the renovated facility and therefore will not be reused. The existing HEPA filter housings do not allow for ready access and maintenance because of interferences and clearance problems with other equipment. The operations and maintenance (O&M) organizations require walk-in/walk-out housings, whereas the current configurations are bag in/bag out. Also, many of the fans, pumps, and other items could not be reused due to differing requirements and capacities.

The MAA HVAC system primarily will provide ventilation for the charge hall and working areas as well as tertiary confinement for the MAA. The secondary function of the MAA HVAC system is to condition the ventilation air and maintain a specified temperature for equipment and occupant comfort in the working areas.

1.8.1.2 System Description

The HVAC system for the MAA will provide supply and return air for all occupied areas within the MAA. Ventilation is determined by the thermal requirements of the building, and is approximately five air changes per hour. Exhaust air will pass through three stages of HEPA filters before being exhausted to the environment. Return air will be passed through three stages of HEPA filters before being mixed with outside air. The cooling and heating load will be set by outside-air requirements, building-shell loads, and internal gains. Recirculation of room air with a 15% outside-air purge will be used.

The outside-air and exhaust-air filter trains (FF-1, FF-2, FF-5, FF-6) consist of bag in/bag out-type filter housings with test sections upstream and downstream of each filter. An airlock is attached between filter trains for isolation filter change-out to prevent contaminating the hot mechanical room.

The recirculation air filter trains (FF-3, FF-4) consist of walk-in plenums at each HEPA filter bank. Each filter bank has a dioctyl phthalate (DOP) test probe upstream and downstream of each 24" x 24" filter. An airlock is attached to the filter trains to protect against contaminating the hot mechanical room.

The change rooms will have a separate exhaust system with its own single-stage HEPA filter and fan located in the pack/unpack area. An access door will be provided in the ceiling for filter changeouts. The pack/unpack area will have an exhaust hood with an integral HEPA filter connected to the main exhaust system. Room-air temperature will be maintained by modulation of hot-water coil valves.

The storage array will not be maintained at a controlled temperature. Instead, it will be ventilated as a function of the convective thermal-siphon effect driven by SNM heat generation, and allowed to thermally stabilize at a temperature consistent with the outside-air temperature.

The ventilation system will allow the building to breathe through HEPA filters and maintain the tertiary-confinement design concept should a loss of power or a shutdown occur.

Supply air for the MAA will be delivered by a constant-volume return-air fan and outside-air fan, with identical return-air and outside-air fans for standby use in the event of a primary-unit failure. The units will be wired for duty cycling and to prevent the standby units from operating simultaneously with the normal operating units. The units will share one outside-air intake louver, prefilter, and preheat coil, per NFPA 90A. The preheat coil will have face-and-bypass dampers, an in-line circulating pump, and a thermostat and freezestat. Terminal heating coils will be located outside the MAA to eliminate water leak potential and to provide better access for maintenance. The return-air and outside-air systems will have three-stage HEPA filters.

The return air and outside air will be mixed and will flow through a split chilled-water cooling coil. The supply-air duct system will distribute the air to the individual zones, each of which will be equipped with a terminal heating coil controlled by a thermostat located in its zone. Drip pans will be provided underneath each terminal heating coil. Each janitor closet will be exhausted.

The supply air will enter each room through non-aspirating diffusers to minimize turbulence within the MAA. Supply air will be distributed to each room (see **Part IV - Conceptual Drawings**). Air to the tunnel will be supplied near PF-4 and returned near PF-41. Room air will then be drawn into the return/exhaust-air duct system through return-air grilles located near the floor. Normally, 85% of the air will be recirculated, and 15% will be exhausted through a monitored stack. Both the return and the exhaust air will be filtered with three stages of HEPA filters. The 15% outside air is based on LANL standards.

The HEPA walk-in filter housings will be fabricated of welded stainless steel sheet metal and stainless steel channel. HEPA walk-in plenums will be constructed in accordance with ASME N509-1989 and N510-1989, and tested in accordance with ASME N510-1989. The airlock between HEPA filter trains will be fabricated of welded 10-gauge cold-rolled steel. There is 100% redundancy for the HEPA filters for the purpose of filter changes, maintenance, and failures during operating hours.

All fans will be sized to minimize noise economically.

The Facility Monitoring System (FMS) will be used to provide programmable logic control (PLC) of the HVAC system. The control system will operate in the following sequence:

- The exhaust fan will start and, upon verification of exhaust flow, the supply-air fan will be started by the PLC. This constant-volume system with variable-speed drives is designed for 85% recirculation and 15% outside air to maintain the proper temperature, differential pressure, and air-change rate within the space. Air recirculation is permitted by use of a three-stage HEPA filtration system located upstream from the return air and exhaust air fan. An air flow station sends a signal to the variable speed drives to maintain a constant air flow.
- The exhaust fan and supply-air system will be programmed so that, if the exhaust fan shuts down, the supply fan system will shut down to prevent an over-pressurization of the space.
- A differential pressure switch will indicate fan-running status; a pressure differential alarm (PDAL) will sound at the FMS in the event that the fan is not running or belts are broken. The spare fan (100% standby fan) will be interlocked with the main fan and start automatically to maintain the required air flow if the main fan fails. Each fan plenum system will include a supply- and discharge-air damper that closes when the associated fan is inoperative. Also, the fail-safe position for the supply-air fan supply and discharge dampers will normally open on loss of control-air pressure to provide a ventilation air path for the exhaust fans.
- The supply-air fan will be interlocked with an outdoor-air damper, smoke damper, exhaust isolation damper, and exhaust-air fan. All the dampers must be open, as indicated by damper-end switches, for the supply-air fan to start and run. The supply-air, return-air, and exhaust-air fans will be shut down and the smoke damper closed when smoke is detected in the supply air stream. Smoke detectors will be located upstream of the cooling coil, upstream of the supply-air HEPA filter plenums, upstream of the return-air HEPA filter plenums, upstream of the pack/unpack area supply-air plenum, upstream of the pack/unpack area exhaust-air filter plenum, upstream of the change area exhaust-air filter plenum, and upstream of the building exhaust HEPA filter plenum, per NFPA 90A. All standby equipment is programmed for duty cycling to prevent the two units from operating simultaneously, and to rotate use of the units periodically for preventive maintenance.
- The supply-air intake and exhaust dampers will be automatically controlled for 15% minimum outside air, while the return-air damper will be controlled for 85% maximum return-air flow. The dampers are also provided with end switches and interlocked with each supply-air, return-air, and exhaust-air fan motor starter.
- In the face-and-bypass preheat coil, the discharge air temperature is controlled by proportioning the entering air through the multiple face (heating) and bypass channels. The thermostat, located 3 ft downstream of the preheat coil, responds by adjusting the position of the dampers to maintain the correct proportion of air necessary to keep the discharge-air temperature constant at 55°F set point. A circulating hot water pump is programmed to be activated by the thermostat to allow the water to flow continuously through the coil.

- An in-line circulation pump provides constant water flow through the coil.
- The chilled-water cooling coil CC-1 is controlled through modulation of a three-way control valve for each coil. The three-way valve is controlled by a thermostat mounted downstream of the cooling coil to maintain an air temperature of 55°F leaving the cooling coil.
- All air filters, such as the supply-, return-, and exhaust-air filters, will be locally and remotely monitored for the pressure differential across the filter. This indicates the amount of filter loading and acts as an indicator for filter changeout.
- The room temperatures will be maintained at 75°F during the cooling season and 72°F during the heating season. A room-located thermostat will modulate the control valve of a duct-mounted terminal hot-water heating coil to maintain the room design temperature. A drip pan is provided underneath each terminal heating coil. The drip pan will drain to the janitor's sink in the MAA.
- A differential pressure sensor will measure each zone pressure in reference to atmospheric pressure and modulate the zone inlet-air damper to maintain the zone pressure. The reference control air lines will be connected to the atmospheric reference header located in PF-4. The pressure differentials between zones are necessary to ensure air flow in the proper direction.
- In the event of fire, a heat detector is provided in each of the three-stage HEPA filter trains to isolate each filter train by closing the pneumatically operated dampers and to provide a fire alarm. The HEPA filter trains will be locally and remotely monitored for the pressure differential across the filter. This indicates the amount of filter loading and acts as an indicator for filter changeout. The FMS issues an alarm if the delta pressure across the filter train rises to 4.0 in. w.g., per LANL request.
- The exhaust-air fan is activated through the PLC. The exhaust system is a constant-volume system that compensates for filter loading by exhausting the same amount of air from the zones at all times. This is accomplished by maintaining a constant exhaust air flow with a variable-frequency drive control on the fans. The controls will be set for a slow response time to prevent interference with the zone pressure controls and to prevent control hunting. Each exhaust fan is interlocked with its inlet and outlet dampers, both of which must be fully open, as indicated by damper-end switches, for the fan to be started and run.
- The supply fan is interlocked with the exhaust fan to prevent it from operating if the exhaust fans are not operating. In normal operation, one exhaust fan will be running continuously, and one fan will be in standby mode. If the running fan fails, the system will automatically start the standby fan through the interlocks and sound an alarm at the FMS. A stack monitor provided by instrumentation and control will sense the exhaust-air flow; in the event of radiation detection, it will send an alarm to the FMS, and an administrative decision will be made whether or not to shut down the HVAC system. The change-room exhaust fan will be interlocked with the main exhaust fans to start when any one of them starts.
- All control devices are pneumatically actuated in response to control signals from the PLC located in P-41. The PLC monitors the HVAC system and controls its performance. This PLC communicates with the PLC of the FMS located in PF-4. The FMS may be used to reset the HVAC control set points and, in the case of failure of the PLC in P-41, bypass it and act as a backup, providing direct control of the HVAC system.

1.8.1.3 System Specification and Equipment Data

Table 1.8-1 shows the equipment specified for the MAA HVAC system.

TABLE 1.8-1 MAA HVAC EQUIPMENT

Tag	Description	Size	Specification	Electric Power Requirements
CC-1	Cooling Coil	572,774 BtuH	Water Flow: 115 GPM; EWT: 45°F Air Flow: 22,782 CFM; LWT: 55°F EAT: 84°F; LAT: 55°F	N/A
PHC-1	Preheat Coil	140,268 BtuH	Water Flow: 14 GPM; EWT: 180°F Air Flow: 3,417 CFM; LWT: 160°F EAT: 5°F; LAT: 55°F	N/A
Varies	Terminal Heating Coils (approximately 19 units of 38 ft ² of coil each)	392,785 BtuH	Water Flow: 93 GPM Air Flow: 22,782 CFM EWT: 180°F; EAT: 55°F LWT: 100°F; LAT: 90°F	N/A
FS-1 FS-2	Outside-Air Fan	Buffalo BL-300 3,451 RPM 5.95 BHP	3,456 CFM, 9.5 in. w.g. sp. at 7,500 ft. elevation	460V 3-phase 60Hz 7-1/2 HP
FR-1 FR-2	Recirculation Fan	Buffalo BL-600 1806 RPM 30.2 BHP	19,365 CPM, 9.0 in. w.g. sp. at 7,500 ft. elevation	460V 3-phase 60 Hz 40 HP
FE-1 FE-2	Exhaust Fans	Buffalo BL-300 3358 RPM 5.8 BHP	3,417 CFM, 8.75 in. w.g. sp. at 7,500 ft. elevation	460V 3-phase 60 Hz 5 HP
FS-3	Pack/Unpack Supply-Air Fan	Greenheck ORB Size 9 2,640 RPM 2.1 BHP	1,994 CFM, 2.82 in. w.g. sp. at 7,500 ft. elevation	460V 3-phase 60 Hz 3 HP
FE-4	Fume Hood Exhaust Fan	Greenheck ORB Size 7 2,208 RPM 0.51 BHP	590 CFM, 3.42 in. w.g. sp. at 7,500 ft. elevation	460V 3-phase 60 Hz 3/4 HP
FE-5	Pack/Unpack Exhaust Fan	Greenheck ORB Size 9 1,746 RPM 1.1 BHP	1,404 CFM, 2.92 sp. at 7,500 ft. elevation	460V 3-phase 60 Hz 1-1/2 HP
FE-3	Change Room Exhaust Fan	Greenheck ORB Size 5 3,265 RPM 0.418 BHP	480 CFM, 3.0 in. w.g. sp. at 7,500 ft. elevation	460V 3-phase 60 Hz 1/2 HP
FF-1 FF-2	Three-Stage Outside-Air HEPA Filtration System	2 X 2 Bank 12 HEPA filters	Each of two trains capable of handling 3,417 CFM	N/A

Tag	Description	Size	Specification	Electric Power Requirements
FF-3 FF-4	Three-Stage Recirculation-Air HEPA Filtration System	5 X 4 Bank 60 HEPA filters	Each of two trains capable of handling 19,365 CFM	N/A
FF-5 FF-6	Three Stage Exhaust Air HEPA Filtration System	2 X 2 Bank 12 HEPA filters	Each of two trains capable of handling 2,937 CFM	N/A
FF-7	Single-Stage Exhaust Air HEPA with Prefilter	1 x 1 1 HEPA filter	Bag in/bag out filter housing 480 cfm	N/A
FF-8	Single-Stage Exhaust Air HEPA with Prefilter	1 x 2 2 HEPA filters	Standard side load housing 1,404 cfm	N/A
FF-9	Single-Stage Supply Air HEPA	1 x 2 2 HEPA filters	Standard side load housing 1,994 cfm	N/A

1.8.2 Support-Area HVAC System

1.8.2.1 System Function

The function of the HVAC system for the support area is to provide ventilation and to condition the ventilation air to maintain a specified temperature for occupant comfort. The HVAC system will also maintain room air cleanliness and quality.

1.8.2.2 System Description

Supply air for the support area will be delivered by a constant-volume air-handling unit. The unit will have an air blender, prefilter, preheat coil, fan, and cooling coil. The preheat coil will be a face-and- bypass type with an in-line circulation pump and a thermostat mounted 3 ft downstream of the preheat coil. The supply air fan will be provided with inlet vanes to "trim" air flow.

Outside air will be drawn into the system through a wall-mounted fixed louver and mixed with return air through an air blender. The air will then be filtered by a 60% cartridge filter, and a hot-water preheat coil will be used to heat the mixture of outside/return air. A chilled-water cooling coil will be used to cool the supplied air to 55° F. The air will then be drawn through the air-handler fan and discharged into a supply-air duct system that will distribute the air to the individual zones. Each zone will be equipped with a terminal heating coil to maintain space temperature.

The air will enter each room through aspirating diffusers to mix the supply air with room air. Room air will then be drawn into the return/relief air duct system so that 15% outside air and 85% return air will mix.

The support-area HVAC system will operate in the following sequence:

- The supply-air fan will be started through the activation of the fan's HOA switch.
- A differential pressure switch will indicate fan-running status; an alarm will sound at the FMS when the fan stops.
- The supply-air fan will be interlocked with an outdoor-air intake damper and an exhaust-air damper; the dampers must be open for the supply-air fan to operate. The outdoor-air intake damper and exhaust-air damper will close when the supply-air fan is not operating.

- The sequence of operation for the support-area HVAC system integral face-and-bypass hot-water preheat coil control, chilled-water cooling coil control, supply-air filter monitoring and alarm, and room temperature control are identical to the MAA HVAC system. For a description of the control system, see Section 1.12.
- A dry-bulb temperature control will modulate the return-air damper, exhaust/relief-air damper, and outside-air damper (integral to the air-handling unit) to maintain the supply-air temperature when the dry-bulb temperature of the outside air is suitable for cooling by the economizer. A thermostat located at the intake damper and another at the return-air damper will provide an input signal to the economizer control, which in turn will compare the two input signals with the set point and modulate the three dampers to achieve the desired temperature.

1.8.2.3 System Specification and Equipment Data

Supply and return ductwork will be standard-gauge galvanized sheet metal. Table 1.8-2 shows the equipment listing for the support-area HVAC system.

TABLE 1.8-2 SUPPORT-AREA HVAC EQUIPMENT

Tag	Description	Size	Specification	Electric Power Requirements
HVA-1	Supply Air Handler	Trane Size 6 7,109 RPM 1.1 BHP	2,502 CFM, 1.7 in. w.g. sp. at 7,500 ft elevation	460V 3-phase 60 Hz 1-1/2 HP
N/A	Preheat Coil for HVA-1	15,394 BtuH	Water Flow: 1.0 GPM Air Flow: 2,502 CFM EWT: 180° F; EAT: 5° F LWT: 160° F; LAT: 55° F	N/A
N/A	Cooling Coil for HVA-1	51,656 BtuH	Water Flow: 11 GPM Air Flow: 2,502 CFM EWT: 45° F; EAT: 77.4° F LWT: 55° F; LAT: 52.2° F	N/A
N/A	Terminal Heating Coils - approximately 9 units consisting of 4.2 sq ft of coil	42,110 BtuH	Water Flow: 6.0 GPM Air Flow: 2,502 CFM EWT: 180°F; EAT: 55°F LWT: 160°F; LAT: 90°F	N/A
FE-6	Unisex Bathroom Exhauster	Greenheck GR80-4 87 RPM 1/4 HP	250 CFM, 0.25 sp. at 7,500 ft elevation	120V 1-phase 60 Hz 1/4 HP

1.8.3 Chilled-Water and Hot-Water Systems

1.8.3.1 System Function

The chilled-water and hot-water systems will provide conditioned water to the facility's HVAC systems to maintain the required space temperature conditions for personnel comfort and equipment operations. The chilled-water system provides chilled water to the facility's HVAC cooling coils for space cooling. The hot-water heating system provides hot water to both the HVAC preheat coils and the zone-terminal heating coils.

1.8.3.2 System Description

The stand-alone chilled-water and hot-water systems will provide and distribute chilled and hot water to the facility's HVAC system. The chilled-water system will provide supply water at 45°F, with a designed 10°F rise through the chilled-water circuit. The building's cooling load will be satisfied through two 100% capacity air-cooled water chillers piped in parallel. Under design conditions, one of the two chillers will operate; the second chiller will remain in a standby mode to serve as a backup. The chilled water will be circulated through three pumps piped in parallel. Under design conditions, two of the three pumps will operate, while the third pump will remain in a standby mode.

The hot-water heating system will provide 180°F water with an outside temperature control and a design temperature drop of 20°F through the hot-water heating circuit. The water will be heated by an atmospheric-vented boiler. The second boiler is a 100% capacity backup boiler in standby mode. There will be two separate circuits. The preheat coil and the terminal heating coils for the support area will be on one circuit connected directly to the boilers. The preheat coils and terminal heating coils for the MAA will be on another circuit.

All standby equipment in both chilled-water and hot-water systems will be programmed to prevent both normal and standby units from operating simultaneously, and to rotate use of the units on a periodic basis for preventive maintenance. The chillers will be located on a slab outside and adjacent to the utility building. The boilers, boiler pumps, and chiller pumps will be located inside the utility building.

A tie-in to the existing chilled- and heating-water systems at PF-4 was considered. However, these systems do not have sufficient capacity to serve the requirements of both facilities.

1.8.3.3 System Specification and Equipment Data

Chiller: Two air-cooled chillers (CWAC-1, CWAC-2) will cool 126 GPM of chilled water to a leaving temperature of 45°F and a 10°F temperature rise. The chillers will be piped in parallel and the second chiller (100% backup capacity) will remain in standby mode. Air-cooled chillers with multiple compressors were chosen for their high reliability and efficiency under both full and partial load; they will also eliminate the need for cooling towers. Chillers are derated for 40% propylene glycol to prevent freezing.

Boiler: Two 900 MBH input/720 MBH output at sea level, atmospheric-vented boilers will be used to produce the heating hot water to a temperature of 180°F at a rate of 64 GPM. The heating hot-water system is designed on a 20°F temperature drop. The second boiler (100% backup capacity) will remain in standby mode.

Pumps: The chilled-water system will use three circulation pumps (two in operation and one on standby). The pumps (3HP) are sized to satisfy 50% of the full design load. Three (1.5HP) heating hot-water circulation pumps (two in operation and one on standby) are each sized to satisfy 50% of the full design load.

Expansion Tank: The expansion tank will be a bladder-type, American Society of Mechanical Engineers (ASME) code pressure vessel rated for 150 psig maximum working pressure for each of the chilled-water and hot-water heating systems.

Table 1.8-3 presents the equipment list for the chilled- and hot-water systems.

TABLE 1.8-3 EQUIPMENT FOR CHILLED/HOT WATER SYSTEMS

Tag	Description	Size	Specification/Model No.	Electric Power Requirements
CWAC-1 CWAC-2	Water Chiller, Air-Cooled	70 ton at 7,500 ft. elevation	Trane RTAA 070	460V 3-phase 60 Hz
PCW-1 PCW-2 PCW-3	Chilled-Water Circulation Pump	63 GPM, 65.8 ft. 3 HP, 1,750 RPM	Bell and Gossett Model 1 1/4" BC	460V 3-phase 60 Hz 3 HP
BHW-1 BHW-2	Hot Water Boiler	502,088 BtuH output at 7,500 ft. elevation	AJAX Mode WG-900 900 MBH Input/720 MBH Output at Sea Level	120V 1-phase 60 Hz
PHW-1 PHW-2 PHW-3	Heating-Water Circulation Pump	47 GPM, 47 ft. 1.5HP	Bell and Gossett Model 1-1/4" AC	460V 3-phase 60 Hz 1.5 HP
PHW-4	MAA Preheat Coil Pump	14 GPM, 40 ft. 0.5HP	Bell and Gossett Series 60	460V 3-phase 60 Hz 1/2 HP
PHW-5	Support Area Preheat Coil Pump	1.6 GPM, 40 ft. 0.25HP	Bell and Gossett Series 60	120V 1-phase 60 Hz 1/4 HP

1.8.4 Breathing Air

1.8.4.1 System Function

The function of the breathing-air system is to provide clean, dry air to technicians wearing supplied-air respirators and suits while conducting decontamination and maintenance within the MAA.

1.8.4.2 System Description

The system will be designed for use by three technicians working in supplied-air suits and will have the capacity to support a fourth person in the event of an emergency. An air flow of 8 CFM will be supplied to each suit for a duration of 2 hours.

1.8.4.3 System Specification and Equipment Data

Purified breathing air that meets the Compressed Gas Association Grade D breathing-air specifications will be supplied from tanks on a flatbed located outside PF-41. Breathing air will be supplied to specific user breathing-air stations in PF-41 using Type K copper tubing, factory-cleaned, capped, and labeled for breathing-air systems. Pressure regulators and filters with four user connections will be provided with each breathing-air station. Connections will be unique so that there is no mistake connecting to other than breathing air.

A tie-in to the existing breathing-air systems at PF-4 was considered; however, the distance between PF-4 and the NMSF resulted in excessive pressure drop. A dedicated system for the NMSF has been determined to be more cost-effective.

1.8.5 Compressed Air

1.8.5.1 System Function

The function of the compressed-air system is to provide clean compressed air to controls and air-operated tools within the facility. Compressed air will also be used to inflate door seals. Since door seals may provide a barrier to potential release in some loss of power scenarios, the compressed air system may have to be safety-class. This will be refined in the PHA, but is not developed in depth here.

1.8.5.2 System Description

The compressed-air system will be designed to provide 100 standard CFM of oil-free and moisture-free 100 psig air at -40°F dew point to controls and air-powered tools within the MAA facility. The exact quantity of air required will be determined during the detailed design phase.

1.8.5.3 System Specification and Equipment Data

Compressed air will be provided by two compressors, one on-line and the other on standby. The compressed air distribution system will consist of two receivers and two regenerative desiccant air dryers with afterfilters, one dryer on-line and the other on standby.

The most common regenerative desiccant dryer uses two symmetrical towers, each containing a bed of adsorbent desiccant. The offline desiccant dryer tower is regenerated by dry compressed air passing through it. A timed four-way valve switches drying and regeneration cycles between towers, making the drying process continuous and automatic. One compressed-air train will operate at design load, while

the other compressed-air train will be on standby. The tanks will be separated by valves to prevent both tanks from draining if one develops a leak. The piping will be copper.

1.8.6 Potable and Non-Potable Water

1.8.6.1 System Function

The potable and non-potable water systems will be of Type L copper. These systems will be designed in accordance with all federal, state, and local codes and standards.

1.8.6.2 System Description

The existing water supply will be replaced and adapted to supply the decontamination showers, restrooms, janitor's sinks, hose bibs, and make-up water for the hydronic systems. The potable hot water for the facility will be supplied by a gas-fired water heater located in the utility building. The system will be complete with block valves, backflow preventers, pressure control valves, flow rate indicators, flow totalizers, water hammer arresters, and a hot-water circulating pump. The piping will be Type L copper.

1.8.6.3 System Specification and Equipment Data

Table 1.8-4 presents the equipment list for the potable water systems.

TABLE 1.8-4 EQUIPMENT FOR POTABLE WATER SYSTEMS

Tag	Description	Size	Specification	Electric Power Requirements
HUW-1	Hot Water Heater	300,000 input at sea level	A.O. Smith BL-300 303 GPH	N/A
PDH-1	Hot Water Circulation Pump	N/A	7 GPM, 12 ft Bell and Gossett LR-15B	1/12 HP 120/1/60

1.8.7 Sanitary Waste System

1.8.7.1 System Function

The function of the sanitary waste system is to collect liquid wastes from the uncontrolled areas of the NMSF and the controlled change rooms, such as the showers, lavatories, janitor's sinks, urinals, water closets, and floor drains. Sanitary waste systems will also collect liquid waste from fixtures in the controlled area such as urinals and water closets. The sanitary waste system will be designed following current design codes and regulations. A minimum flow velocity of 2 ft/sec. will be used for all sanitary waste lines. No drains in controlled areas of the MAA will connect to the sanitary waste system.

1.8.7.2 System Description

The existing sanitary waste system will be replaced. The sanitary waste stream will be gravity-fed and will drain into the existing sanitary sewer at the site. Floor drains will be provided in the cold mechanical room and the utility building. The piping will be hub-and-spigot standard-weight cast iron.

1.8.8 Radioactive Liquid Waste System

1.8.8.1 System Function

The function of the RLW system is to collect liquid waste from controlled areas of the MAA such as janitor's sinks and floor drains. The RLW system will use double-containment piping and will incorporate a leak-detection monitoring system with control panel. A minimum-flow velocity of 2 ft/sec. will be used for all RLW lines. The piping will be polyethylene double-containment piping. The RLW collection system will have monitoring and automated control on the transferring system to prevent the transfer of radioactive solutions or materials from the MAA that are above the authorized limit.

1.8.8.2 System Description

The existing RLW system main is 2 in. in diameter inside the building. A 4-in. diameter main is required to accommodate waste requirements. Therefore, the existing system will be removed to the point at which it becomes 4 in. outside the building. A new 4-in. system will be installed in the facility and connected to this existing 4-in. line outside the building. All buried RLW piping will be double-contained and constructed according to the requirements set forth in the LANL Civil and Mechanical Standards Manual.

The RLW system will collect liquid waste from all sources within the controlled area of the MAA, except sanitary waste in the change rooms, and run the liquid to the treatment plant located east of the site at TA-50. Floor drains will be provided in the MAA mechanical room.

1.8.9 Deionized Water System

1.8.9.1 System Function

The function of the deionized water system is to supply deionized water to the NDA laboratory for equipment maintenance and operation.

1.8.9.2 System Description

A new deionized water system will be provided to a central location in the NDA laboratory. Additionally, a stainless steel sump drain system will be provided to dispose of excess water resulting from equipment maintenance and operation. This system will discharge to the RLW drain serving the main floor of the NMSF.

1.9 Fire Protection

1.9.1 System Function and Existing Conditions

The fire protection and prevention features of the NMSF are designed to minimize the potential for the occurrence of fire and to ensure that fire does not cause an onsite or offsite release of radiological material that is a threat to public health and safety. The fire protection systems will keep the hazards to the public from fire and its effects at the lowest reasonable level. These systems will ensure that process

control and safety systems are not damaged by fire or related perils and that this facility will not suffer unacceptable delays as a result of fire and its effects. Property damage from fire and related perils will not exceed the level established in DOE 5480.7A.

Currently, PF-41 is provided with automatic sprinkler protection in all areas except for the storage rack areas in the basement vault. The TA-55 looped mains will provide water for fire protection systems and fire hydrants.

New fire protection features will be designed and installed in accordance with the requirements of DOE Orders 6430.1A and 5480.7A, and other applicable codes and standards (see Section 9 for a complete list).

1.9.2 System Design Basis

The preliminary fire hazards analysis, which is included in **Part III - Supplemental Information**, establishes the basis for the modifications and additions to the fire protection system.

1.9.3 System Design Description

The NMSF has two fire areas that are to be separated by a 2-hour fire-rated fire wall. New and existing penetrations will be provided with 2-hour fire-rated seals. Door openings will be provided with 1-1/2-hour fire-rated doors. Fire Area One will consist of the drywell storage array, the charge deck, materials receiving and handling, the first floor support area, the mezzanine, and the basement support area. Fire Area Two will have two zones: the first-floor loading area, and the building office and support equipment not related to the nuclear materials storage area. A new utilities building will be constructed south of the NMSF.

Separations between transformers and the building and any fire protection features will be in accordance with FM Loss Prevention Data Sheet 5-4, October 1994.

General Description of Fire Protection

Automatic sprinklers are installed in most areas of the building, but they are not provided in the storage vault. These systems and fire hydrants are fed from a single 10-in. main from the TA-55 yard loop. The sprinkler systems were hydraulic calculated systems when they were installed. Fire hydrants are to be located at least 50 feet from the building. An appropriate number and type of fire extinguishers will be located throughout the facility buildings in accordance with NFPA 10 and site requirements.

Water Supply to Fire Suppression System

The yard water loop in TA-55 will provide for alternate flow paths. However, the 10-in. main that supplies the fire hydrants and sprinkler systems in the NMSF is not provided with alternate flow paths. The sprinkler systems are supplied through a manifold feed arrangement, which does not allow individual control of each riser with an outside control valve. The water supply demand for hydraulic designs will include a minimum 500 gpm hose stream allowance and other water demands as required.

New sprinkler systems will be supplied from minimum 6-in. connections. A new 10-in. main will be looped around the NMSF and connected to the TA-55 fire main loop to provide an alternate flow path. A post indicator control valve located a minimum of 40 feet from the exterior wall of the building will be provided to control the water supply to the new sprinkler systems. Hydrants will be located at least 50 feet from the building walls, and spaced so that the hose lays from the hydrants are within 300 feet of all portions

of the exterior walls of the building. Underground fire water supply mains will be designed and installed in accordance with DOE Orders (see Section 9 and PFHA) and NFPA 13 and 24. Bollards will be provided for new fire hydrants and post indicator valves.

Automatic Sprinkler Systems

Automatic fire sprinkler systems are currently installed throughout most of the facility. These systems provide fire protection for the building, equipment, and HVAC systems. New or reworked sprinkler systems will be designed in accordance with NFPA 13. The minimum sprinkler system water demand will be based upon criteria for Ordinary Hazard Group 2. Pre-action systems will be provided throughout Fire Area One, except for the storage array and the charge deck. The HEPA filter unit will be provided with a deluge system; the remaining areas will be provided with wet sprinklers. Wet pipe sprinkler systems will be provided in Fire Area Two and in the Utilities Building. The sprinkler system to be reused will be reviewed during the design process to ensure that adequate protection will be provided.

HEPA filters and filter plenums will have the following fire protection features:

- Automatic and manual water deluge spray systems will be provided inside all HEPA filter plenums for protection where plenum filters have a leading filter surface cross-sectional area greater than 1.5 m^2 (16 ft^2).
- Automatic water deluge spray systems will be provided inside all HEPA filter plenums having a leading filter surface area of 0.5 m^2 (6 ft^2) or less when the filter plenum is not separated from the room by fire-rated construction.
- Metal demisters will be installed downstream of the water deluge spray sprinkler heads and upstream of the first series HEPA filter. Demisters will have a nearly 100 wt% efficiency for water drops $50 \mu\text{m}$ and larger, and an efficiency greater than 99 wt% for water drops 1 to $10 \mu\text{m}$; airflow velocities will be 2.5 to 3 m/sec (500 to 600 ft/min), or operated airflow velocities with an operated water flow deluge spray delivery rate.
- Demisters will be located as far away as possible from the HEPA filters, but not less than 91 cm (36 in.). The demisters will be approximately 15 cm (6 in.) from the deluge spray sprinkler heads.

Deluge spray systems will be designed in accordance with NFPA 13 and 15, with the following modifications:

- The density of the automatic deluge system will be $0.049 \text{ l/sec per m}^2$ ($0.25 \text{ gal/min per ft}^2$) over the entire filter area, or $0.063 \text{ l/sec per } .236 \text{ m}^3/\text{sec}$ ($1 \text{ gal/min per } 500 \text{ ft}^3/\text{min}$) airflow, whichever is greater, using deluge sprinkler heads. The spray pattern will be a downward vertical water curtain approximately 15 cm (6 in.) in front of the pre-filter or demister. Each sprinkler head will not exceed 4 linear ft of curtain coverage.
- Automatic-activated heat detectors will be located in the final ducting or filter plenum housing. Density of the manual system will be $0.049 \text{ l/sec per m}^2$ ($0.25 \text{ gal/min per ft}^2$) over the entire filter area using deluge spray nozzles that form a full-circle, solid-cone discharge. Nozzles will be horizontally directed at the face of the first series of HEPA filters so that all areas of the first stage filters and framing support system will be wetted.

Containment for fire protection water discharges will be provided. The containment will be sized for the anticipated sprinkler flow for a duration of 20 minutes. Splash blocks to prevent erosion will be provided for drains from sprinkler systems.

Fire Alarm System

A local energy fire alarm system exists at this facility. Additions to the system required by this project will be performed in accordance with NFPA 72. The fire alarm system will be reviewed during the design process and updated to the requirements of NFPA 72. The fire alarm system will transmit alarms to the TA-55 Operations Center and the Fire Alarm Center and provide notification to building occupants. Standby battery power will be provided. The automatic sprinkler and deluge system will be individually annunciated on the control panel. Manual fire alarm pull stations will be provided adjacent to each exit. Smoke and fire dampers and duct smoke detectors will be installed as needed in accordance with NFPA 90A. Additional audible and visual fire alarm annunciating devices may be required. Fire alarm devices will be located in accordance with NFPA 72 and 101.

Architectural Standards

The design of attachments for hangers, supports, and sway braces, and the seismic restraints to the building structure for the sprinklers and the fire alarm systems, will meet the requirements of UBC Zone 2B. Earthquake loads will be calculated in accordance with UCRL 15910, Section 4, for important or low-hazard-use facilities.

Fire Department Response

The Los Alamos Fire Department will respond to PF-41 from Fire Station West, which is located about two miles away. The building has a fire alarm system that provides notification of alarms and troubles with the sprinkler systems and the manual pull stations. Alarms are sent to the TA-55 Operations Center and to the Fire Alarm Center, which notifies the Fire Department. The Operations Center and the Fire Alarm Center are constantly attended.

Exterior Fire Exposure

Exterior fire exposures are limited to natural cover fire. Other buildings are well separated from the facility. The building separation meets the distances noted in NFPA 80A, "Exterior Exposure Protection," and Factory Mutual (FM) Loss Prevention Data Sheet 1-20. PF-4 and PF-85 are more than 150 ft away from PF-41. PF-142 is less than 100 ft away; however, an earthen berm is located between the two buildings.

Interior Fire Exposure

Fire Area One will have concrete walls, floor, and roof. A 2-hour fire-rated barrier will separate this area from the rest of the building. The barriers will include some new walls and floors. Penetrations in the walls or floors will be sealed with 2-hour fire-rated seals. Door openings will be provided with 1-1/2-hour fire-rated doors.

Fire zones in Fire Area One are not to be separated by fire-rated barriers. However, they will be provided with concrete walls to form compartments which will limit fire spread and provide containment. The storage array and the charge deck fire zones will be separated from the rest of the fire zones by concrete shield walls with sealed penetrations, and as a result will be isolated. The construction, while not fire-rated, will provide adequate fire separation between Zones 1 and 2 and the rest of Fire Area One.

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1.10 Electrical

With the exception of the grounding and communications systems, most of the equipment comprising the existing electrical systems will be retained and relocated to suit the physical reconfiguration of the building. Installation of new materials and equipment will be required to replace the existing grounding and communications systems so that the inherent deficiencies identified in those systems may be eliminated.

1.10.1 Power Distribution

1.10.1.1 System Function

The function of this system is to distribute reliable power to all mechanical and electrical systems in the safest and most cost-effective manner while meeting all required codes and standards. Major systems within the NMSF requiring power include mechanical equipment, lighting, instrumentation and controls, radiological and stack monitoring, criticality alarms, security, and communications.

1.10.1.2 Design Basis

All applicable codes and standards which constitute the basis for the conceptual design are listed in Section 9.

1.10.1.3 Existing System Description and Deficiencies

The NMSF is served from the TA-3 substation through 13.2 kV feeder S9. NMSF is one of several loads connected to this feeder. Feeder S9 is tapped on both sides of an outdoor double-ended substation located at the southeast corner of PF-41 through switch numbers 1340 and 1345.

The substation serving PF-41 is comprised of two transformers in non-parallel configuration, each rated at 750/862.5 kVA—13.2 kV—480 Y/277 V. The main bus breaker is set at 1200 A and rated to carry a transformer continuous current of 1037A at 862.5 kVA and 480 V; the maximum main bus setting is 1600 A, with an available interrupting current (AIC) rating of 25,000 A. The substation serves two 600 A motor control centers (MCCs) and one 600 A switchboard at 480 V, 3-phase, each located within PF-41. Most loads associated with the mechanical systems are served from the MCCs; all other loads, including a few from the mechanical systems, are served from more than a dozen lighting and power panelboards at 480/277 V and 208/120 V.

The revised NMSF load requirements have been conservatively estimated not to exceed a peak demand of 760 kVA over a 15-min interval (refer to electrical load calculations in Part III, Section B4), which is well within the present capacity of the existing substation transformers. Therefore, no capacity increase in the existing substation serving PF-41 is required.

The notable deficiencies of the existing power distribution system relate to the physical condition and possible under-protection of feeder S9 and to the absence of suitable uninterruptible power supplies (UPS) to serve critical loads, including the stack monitoring system.

1.10.1.4 Proposed Modifications

The proposed modifications will provide a reliable and efficient power distribution system for the NMSF. These modifications include upgrading the condition of feeder S9, relocating and refurbishing service equipment to minimize feeder and branch circuit lengths, increasing the battery capacity of the existing

UPS to meet DOE design criteria for emergency power to critical systems, and installing a separate, dedicated UPS to provide emergency power to the stack monitoring system.

Feeder S9 Upgrade

Table 1.10-1 shows the recorded historical type and duration of interruptions on feeder S9 over the preceding 8-year period. The data reveal that interruptions from maintenance and new construction have decreased significantly since 1986, and that lightning has been the major cause of most recent interruptions on feeder S9. The frequency of all interruptions is one or two per year.

The interruptions of longest duration recorded in the table are in the 5- to 8-hour range. All loads on feeder S9 did not experience an outage of this duration, however, since feeder S9 has alternate source ties to feeder EA-1 at switch G1094 and to feeder S20 at switch G1769 (refer to Johnson Controls drawing no. ES-10 in Part III, Section B4 for a one-line diagram of the overall 13.2 kV distribution system). The majority of S9 feeder loads, including the NMSF, experience outage durations limited to the time it takes a lineman to drive the line, find the fault, and operate the required tie switch(es) to restore temporary service to the feeder. The actual outage duration for the NMSF is, from historical operating experience, less than one hour in daytime and less than two hours at night.

TABLE 1.10-1 TYPE AND DURATION OF INTERRUPTIONS
 Feeder S9, 1986-1993

Date	Duration (hrs:min)	Effect	Cause
05/93	7:35	S9 opened & locked out	Lightning strike on pole-mounted insulator
09/92	0:38	S9 tripped (accidental)	Operation of gang-operated switch on adjacent circuit
06/92	0:42	S9 opened and locked out; pole-mounted arrester destroyed	Lightning strike on pole-mounted arrester
11/91	5:37	S9 opened and locked out	Broken middle phase on 3-phase riser assembly
08/91	0:35	TA-3 #2 power transformer tripped out	Lightning
06/91	No record	S9 opened and reclosed	Lightning
04/90	No record	S9 opened and locked out	Faulted primary on transformer
05/89	No record	S9 opened and reclosed	Lightning
08/88	No record	S9 shorted/tripped	Lineman error
07/88	No record	S9 tripped	Wrong size stirrup installed, causing loose connection
01/87	No record	S9 tripped	Outage scheduled error
11/86	No record	S9 tripped	Jumper burnout on pole

The performance of feeder S9 is adequate to serve the load requirements of NMSF. Typical outages of two hours or less can easily be sustained according to the material storage methodology, which indicates that outages of up to four hours are acceptable. NMSF load requirements are non-process-related and can be categorized as static-type operations typical of storage facilities such as warehouses.

The reliability of the existing S9 feeder can be improved at minimal cost by upgrading the present condition of the line and enhancing its protective features. As a minimum, the following improvements will be enacted during the Title II design and construction phases of this project:

- Review existing arrester ratings on feeder S9; install additional arresters for better coverage of the exposed portions of the line.
- Field-verify that every other pole is grounded through a ground rod in accordance with current practice; add grounding as required.
- In Title II design, perform a protective coordination study on all protective devices on feeder S9, including fuses, devices, and reclosures; confirm proper and more effective selective coordination of protective devices.
- Closely examine all wood structure assemblies on feeder S9, including tangent, angle, deadend, and riser poles; check for bad connections, cracks on insulators, and other discrepancies, and repair or correct.
- Check for proper balance of 3-phase loading on feeder S9 and the tie feeders used for primary backup.

Relocation and Refurbishment of Existing Service Equipment

The reliability and efficiency of the existing NMSF power distribution system may be improved by locating service equipment closer to the loads it serves. An enhanced building layout, with more efficient use of space, operational safety, and consolidation of similar processes, also generally results in better equipment placement with minimized distances between sources and loads. Such a layout also allows a greater level of redundancy to be achieved at little or no additional cost. In addition, this report recommends refurbishing some of the equipment with new parts where such refurbishment will significantly improve operation, enhance safety, or extend the life of the equipment.

- The existing motor control centers MCC-A and MCC-B will be refurbished and relocated to the mechanical room, adjacent to the variable frequency drives. The MCC refurbishment will consist of complete replacement of all starter units with new, smaller, modular-type technology. The new MCC locations will result in short underground feeder runs from the substation and straight feeder runs to the motor loads in the utility building. As indicated by the load calculations in Part III, Section B4, no additional MCCs or expansions of existing ones will be required to serve the revised NMSF loads.
- Load calculations verify that existing switchboard SWB-A will adequately serve the revised NMSF general power and lighting loads. New building configurations will likewise not require any additional capacity or breaker spaces to serve power and lighting panelboards. Also, since future expansion or load modifications are not planned for the NMSF, providing additional switchboard capacity is not justified. A spare conduit(s), which will allow cables to be installed from the substation to a location near SWB-A, will permit installation of an additional switchboard at minimal cost, if required.

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subject to section 148 of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2168).

Approval by the Department of Energy prior to release is required.

- All but two of the existing panelboards will be relocated to the electrical room in the renovated NMSF facility. Calculations of the revised NMSF loads show that these existing panelboards will not require additional breaker spaces.
- The dry-type transformers serving existing panelboards will be relocated to the loading dock north of the electrical room. The vibration isolators will be replaced for each of these transformers.

Computer and Instrument Power Distribution

New isolation transformers and panelboards will be provided to serve only computers, instruments, and other sensitive electronic equipment. An isolated grounding system derived from the secondary windings of the isolation transformers will be specified in accordance with LANL Facility Engineering Standards (see Section 9), with loads served from isolated grounding-type receptacles. Isolation transformers shall be K-factor rated as K-13 minimum.

Existing UPS Upgrade

The existing UPS is rated to serve a total load of 15 kVA. Calculations indicate that the existing UPS will adequately serve the following non-safety-class systems: criticality alarms, radiological monitors, and critical instrumentation and controls. Batteries will be added to the existing UPS so that it will serve the full load for 4 hours.

New UPS

A new UPS with a nominal rating of 10 kVA is required to serve the stack monitoring instrumentation for NMSF. A dedicated UPS which meets the emergency power requirements of DOE Order 6430.1A is required to serve this system in order to be conservative. The UPS should meet the redundancy and separation criteria invoked by DOE Order 6430.1A, Section 1660-99.0.1. Significant criteria for this UPS include a battery time of 24 hours at full load, certification by the manufacturer that the unit will survive certain drop tests, and system redundancy achievable through a combination of alternate sources, duplication of critical components, and parallel switching for maintenance and normal operation.

Convenience Receptacles

Duplex outlets will be provided in all areas as required by the user. All outlets installed in the kitchen and vending areas shall be equipped with ground-fault circuit-interrupters (GFCI). For custodial use, 20-amp dedicated outlets will be provided in all corridors at 20-foot centers. Isolated grounding-type receptacles will be provided for computers, instruments, and other sensitive electronic equipment.

1.10.2 Building Lighting

Existing interior lighting fixtures will be relocated where possible to suit the building reconfiguration. New lighting will be installed indoors to meet NFPA emergency lighting and project requirements. No modifications are required to the existing exterior lighting system.

1.10.2.1 System Function

The function of this system is to ensure operational safety of the facility during normal and emergency conditions.

1.10.2.2 Design Basis

All applicable codes and standards which constitute the basis for the conceptual design are listed in Section 9. Only those products designed for high-efficiency operation shall be specified. In addition, the design shall be based on providing the following illumination levels in accordance with DOE 6430.1A and the Illumination Engineering Society of North America (IESNA) recommendations:

- Office and inspection areas — 50 footcandles
- Storage and general areas — 30 footcandles

1.10.2.3 Existing System Description

The existing interior lighting fixtures should be evaluated for maximum reuse. All fixtures will require either permanent removal, removal for relocation to suit the modified building layout, or removal and reinstallation in the same space following architectural modifications.

1.10.2.4 Proposed Modifications

General

All existing lighting fixtures that require removal to accommodate the new building configuration shall be evaluated for reuse in the new areas. This evaluation will include lens and reflector retrofit options in addition to space footcandle-level compliance. All new lamps shall be energy-saving type, and all new ballasts shall be electronic type.

Normal Interior Lighting

- Lighting in large areas with ceilings higher than 18 feet will be served from high-pressure sodium high-bay industrial luminaires with at least 15% uplighting to provide a more uniformly lighted environment. Approximately 50% of the luminaires will contain a quartz incandescent lamp to provide lighting while the main lamp is warming up or restriking. Luminaires will operate at 277 volts. Lighting equipment containing tritium will not be used.
- Lighting in large areas with ceilings from 10 to 18 feet will be provided by high-pressure sodium, low-bay industrial luminaires with at least 40% uplighting to provide a more uniformly lighted environment. Approximately 50% of the luminaires will contain a quartz incandescent lamp to provide lighting while the main lamp is warming up or restriking. Luminaires will operate at 277 volts.
- Lighting in shop or mechanical spaces with ceilings lower than 10 ft, or where lights are needed for only short periods of time, will be supplied by mounted industrial fluorescent fixtures providing at least 15% uplight using energy-saving lamps and ballasts. Ballasts will operate at 277 volts.
- Lighting in office areas will be served from lay-in type fluorescent troffers with prismatic acrylic lenses and energy-saving lamps and ballasts. Ballasts will operate at 277 volts. Premium-quality parabolic fixtures will be specified for installation in spaces that contain computer screens and other types of monitors to eliminate screen reflections and minimize eyestrain.
- Existing vault lighting will be revised for remote ballast mounting. The existing high-intensity discharge fixtures have their ballasts mounted as an integral part of the fixture; this configuration has

caused the ballasts to overheat and fail. Ballasts will be located remotely from the fixture to minimize failures from overheating and to facilitate scheduled maintenance.

Emergency Lighting

Emergency lighting fixtures will be furnished by the government. The fixtures will be self-contained and battery-operated, and meet the requirements of NFPA 101 and NFPA 70. Dedicated single-receptacle outlets shall be provided within 2 ft of each fixture.

Illuminated Exit Signs

Exit signs will be government-furnished, self-illuminating, and require no power.

1.10.3 Lightning Protection and Grounding

Portions of the lightning protection and grounding system that can be visually inspected will be reused where possible, and deficiencies will be corrected.

1.10.3.1 System Function

The function of this system is to ensure that all electrical systems operate safely, efficiently, and as intended, and to protect the building's structure, contents, and personnel from lightning.

1.10.3.2 Design Basis

All applicable codes and standards which constitute the basis for the conceptual design are listed in Section 9. In addition, the lightning protection system shall be installed in accordance with NFPA 780 and UL96A.

1.10.3.3 Existing System Description and Deficiencies

The existing lightning protection system was recently tested and found deficient in many areas. High grounding-system impedance readings in the 65 ohm range, and the discovery of open conductors and missing bonding jumpers (water pipe to counterpoise) are some of the more serious deficiencies noted.

There is also evidence that the existing computer grounding system is completely isolated from the building's grounding system, without any connection between the two systems. To meet the requirements of NFPA 70, IEEE 142 recommends that the computer grounding system be isolated from the building or power equipment grounding system, except where the two grounding systems are connected *at only one point*.

1.10.3.4 Proposed Modifications

To correct these deficiencies in the existing lightning protection and grounding system, a new grounding counterpoise will be installed around the perimeter of the building. The counterpoise will consist of a #4/0 bare copper conductor buried between 2 to 5 feet from the outside edge of the building foundation. New downcomers (lightning protection conductors) will be installed to connect the roof-mounted lightning protection to the grounding counterpoise. The downcomers will be located on the outside of the building to facilitate system inspection. The lightning protection system shall be certified to receive a master label in accordance with UL95A. The existing roof-mounted lightning protection system shall be refurbished as recommended by the results of this certification.

An isolated grounding system will be provided for computers, instruments, and other sensitive electronic equipment as described above. In accordance with IEEE 142 recommendations, the isolated grounding system will be connected to the building grounding system at a single point, preferably at the service entrance ground bus.

Correcting these deficiencies in the building's lightning protection and grounding system, together with upgrading feeder S9 as described, should result in a marked reduction in the frequency and duration of interruptions to the building's electrical service.

1.11 Communications

The communications systems required for NMSF include telephone and data distribution, paging/intercom, and fire alarm.

1.11.1 Telephone and Data Distribution

1.11.1.1 System Function

The function of this system is to distribute telephone and data communications services to all parts of the building through a system of raceways.

1.11.1.2 Design Basis

All applicable codes and standards which constitute the basis for the conceptual design are listed in Section 9. In addition, the telephone and data communications system shall meet criteria established by the Electronics Industries Association/Telephone Industries Association (EIA/TIA) and the Building Industry Consulting Service International (BICSI).

1.11.1.3 Existing System Description and Deficiencies

The existing telephone room will be demolished as part of the building reconfiguration. The existing telephone room does not meet the requirements of LANL Division CIC-4 for dedicated and separate closets for telephone and data communications, including minimum space provisions for each closet.

1.11.1.4 Proposed Modifications

Space will be allocated in the electrical room for separate telephone and data communications closets. The following descriptions are based on recent LANL standards for telephone and data communications facilities within buildings.

Feeder Conduit

Two 4-inch PVC conduits will be installed from manhole 55-231 to PF-142, and from manhole 55-162 to PF-41. One conduit will be terminated in the telephone closet in the electrical room of PF-41 and the other conduit will be terminated in the data closet. A pull tape will be pulled into each feeder conduit and tied off at each end to facilitate installation of cabling by others.

Equipment Closets

Separate equipment closets will be provided for telephone and data, each with a minimum inside dimension of 3 ft by 6 ft, with a common wall between. Each closet shall have a lockable double door

which opens into the hallway. Door locks will be provided by others. The walls of each closet are to be completely covered with 3/4-in. plywood painted with fire-retardant paint. Two circuits for convenience power served from the UPS shall be provided at each backboard, plus an additional duplex receptacle in the telephone closet for paging equipment. Two 4-in. conduits with bushed sleeves are to be installed between the telephone and data closets for interconnecting cabling by others.

Grounding

A copper grounding bus at least 12 inches long will be installed at the backboards in each equipment closet. The busses will each be bonded to the building's grounding counterpoise at a single point, with a #4/0 bare copper protector grounding conductor.

Distribution

A raceway system consisting of conduits and ladder-type cable trays will be provided for installation of all telephone and data cables. Government-furnished telephone and data cables will be shielded and labeled for use in return-air plenums.

Telephone outlets and cable circuits will be revised to meet the new building configuration requirements. One telephone and one data outlet will be placed side-by-side at each workstation, with a minimum of two outlets of each type in each office. A 3/4-in. conduit will be extended from each outlet to a cable tray or equipment closet, whichever is the more direct route, for each homerun to the backboard. One government-furnished cable will be provided to each telephone outlet, and two cables to each data outlet. No cable run should exceed 300 ft in total length from the equipment closet. All telephone and data cables will be identified in accordance with LANL engineering standards and CIC-4 requirements. All cable terminations will be by others.

1.11.2 Paging/Intercom

A paging/intercom system will be provided throughout the building. A separate conduit system will be installed for intercom wiring. The paging/intercom system will be tied into the Operations Control Center in PF-4.

1.11.3 Fire Alarm

A fire alarm system shall be provided in accordance with NFPA 72. The existing fire-alarm control panel will be relocated to the electrical room. Manual pull stations will be provided at all fire exits, and heat detectors will be installed in the HVAC HEPA-filter trains for local alarming of the fire alarm control panel. (Refer to Section 1.9, and to the Preliminary Fire Hazards Analysis [PFHA] contained in Part III of this CDR, for further descriptions of the fire protection and alarm system requirements, and to Section 1.12 for description of the reporting of NMSF-initiated fire alarms through the proposed facility monitoring system [FMS].)

1.12 Instrumentation and Process Controls

1.12.1 Facility Monitoring System

1.12.1.1 System Function

This section describes the structural and functional requirements for a geographically distributed, electronic FMS, which will monitor and control the NMSF systems.

The material storage requirements and methodology are still being developed for the NMSF. As this process continues, the control system requirements may change as well. The system defined herein establishes an umbrella to cover all reasonably foreseeable requirements and a budgetary number for further evaluation of the project. Each component of the system will be reviewed for its cost/benefit and safety considerations in conjunction with the next phase of the project.

For the purposes of this CDR, an enhanced FMS is being described. In addition to the conventional facility controls, this FMS includes various information-processing and material-tracking capabilities. These enhanced features are suggested as a complement to the LANL Material Accountability and Safeguards System (MASS) as well as a contribution to overall improved control.

The following assumptions are used in presenting this system design:

- Integrating automation into the current design is more cost-effective than adding it later.
- Better information equates to better control.
- Automatic data acquisition is preferred over manually input information.
- Reliable electronic tracking of material can reduce the frequency of material inspection.
- Increased levels of automation provide safer, more efficient operation. Automation provides tangible benefits, including
 - minimizing personnel contact and handling of material;
 - eliminating erroneous material-handling occurrences;
 - increasing safety through material handling and access interlocking;
 - providing accurate and reliable electronic data transfer to the LANL MASS; and
 - providing the storage array database showing location of containers.

1.12.1.2 System Design Basis

The FMS will provide real-time monitoring, alarm handling, reporting, and control functions for the facility process, mechanical, environmental, and safety systems. The system will also handle information for electronic material tracking, electronic data exchange with the LANL MASS, and any operational reports that may be needed. The FMS will be a client/server-based system using a local area network (LAN) for data communications. The system will be geographically distributed to provide maximum reliability and data throughput. The FMS must address the physical/virtual separation of facility control functions (real-time process control) and material tracking or other secure information functions (MASS or ESH computer interfaces) necessary to meet LANL requirements. This separation may take the form of multi-levels of software or hardware-segregated systems. Regardless of methodology, all safety system communication links will meet LANL secure communications requirements, in accordance with DOE Orders 6430.1A and 5639.6A. The combining of control and information systems, to the point of upgrading the control system to a safety system, will not be allowed.

The FMS is functionally a two-part system. One part is the real-time process control system, which will be programmable logic controller (PLC)-based. The PLC will interface with the facility process and safety systems via geographically distributed input/output (I/O) modules, or via a data highway or LAN for sophisticated control subsystems (e.g., continuous air monitors [CAM]). The second part is the information system portion, which will be microcomputer (PC)-based. The information system will interface with the PLC via a data highway or LAN. (See Section 9 for a list of applicable human factors standards.)

The FMS will monitor and control the sequential and modulating process variables associated with the NMSF. The user will interface with the FMS using color graphic display terminals or operator stations. The operator stations will provide for either or both real-time, process-control, man-machine interface (MMI),

as well as the information system functions, depending on the level of the station (see the System Block Diagram in **Part IV - Conceptual Drawings**).

The FMS will have two operator stations in the NMSF control room. Additional stations will be located in the pack/unpack and staging areas, the NDA laboratory work area, the RCT work area, and the PF-4 Operations Center, which will be reviewed/upgraded as part of a FY96 General Plant Project. There will also be an engineering/configuration station. The PF-4 stations will also provide off-hour monitoring of the NMSF.

Note: If possible, the MMI of both the PF-4 facility and the NMSF should be the same, or at least compatible. If this is the case, the NMSF display screens could be viewed on the PF-4 display terminals, and the two NMSF operator stations would not be needed in PF-4.

Operator Stations

Each real-time operator station will be capable of displaying all control screens, information screens, and alarms as required. The MMI will provide for user interaction with equipment status; proportional, integral, and derivative control; data trending; reports; event logs (including sequence of events); and alarms. The information stations will provide the user with an interface to the electronic material-tracking and LANL MASS electronic data-exchange functions. Alarms will be provided for, but not necessarily limited to, the following types of abnormal or upset conditions:

- Remote system failure
- Criticality alarms
- Radiological stack monitoring
- Breathing-air quality alarms
- CAM alarm conditions
- High or low pressure and flow in ducts
- Exhaust fan motor failure
- HVAC dampers failing to achieve completely OPEN or completely CLOSED position
- High or low differential pressure between vaults, accessways, and office areas, and across pre-filters and HEPA filters
- High differential pressure between building and atmosphere
- Fire detection and fire suppression alarm system
- RLW detection
- Helium detection in a drywell

PLC System

The FMS will be a PLC-based system. The system will have redundant processors with the capability to transfer automatically between units without loss of control or data. If more than one set of PLC processors is required, the sets will be interconnected by redundant data highways. If the PLC supplier cannot provide a redundant LAN interface, a single interface to a LAN-resident data collection machine with redundant LAN interfaces to the operator stations could be considered.

Note: The PLC-based system should be configured to match the planned controls upgrade for PF-4 as closely as possible to reduce training and maintenance costs.

The PLC system will communicate with the operator stations and information system functions via either a network (e.g., Ethernet, Token-Ring) or a PLC supplier data highway and interface-card communication link. Serial data communication between the PLCs and operator stations will not be allowed. (Serial

communication between instrument subsystems such as the CAM and the PLC will be acceptable, provided it is at a speed sufficient for good control and data exchange.)

The actual process control algorithms and other control functions will be calculated within the PLC processor and not at the operator stations. The PLC system I/O or other communication link interfaces will also serve as the data-acquisition front end for the information system portion of the FMS.

The PLC system will be fault-tolerant to ensure maximum availability. The system should have on-line diagnostic capabilities to assist the user in identifying a fault, as well as being modular-component-based to allow rapid replacement of failed parts in minimum time.

I/O Points

The FMS will be designed for a minimum of 1000 I/O points. However, the PLC hardware and MMI software should be able to support an additional 1000 points in the future without system or hardware redesign (not including new racks, communication cards, or other add-ons). The I/O racks should include 25% free module space to support this future expansion. The I/O modules will support voltage, milliamperage, millivolt, thermocouple, and resistance thermal device input signals; 120 VAC and 24 VDC digital input and output signals; and 4-20 mA_{dc} analog output signals.

Hardware

The operator-station MMI will run on standard PCs. The interface software will be user-configurable in terms of I/O point tags, addresses, engineering units, alarm values, ranges, set points, and other factors. The MMI will provide for dynamic graphic display screens with interactive data display. The software will also include a graphic editor/drawing feature that will allow user development, graphic display screen editing, and linking of the display/objects to the dynamic I/O points.

The operator stations will provide the user with the following functions:

- Dynamic graphic display screens that depict the process or equipment being used
- Process control or monitoring information in a "panel faceplate"-type screen format on a per-I/O point basis
- Alarm annunciation and acknowledgement, including alarm record keeping
- Real-time and historical process-data trend recording, including data archiving and retrieval
- Report generation, including scheduled print-outs
- Real-time event recording for sequence-of-event analysis
- Process and event data acquisition and storage on a user-configurable basis in 15-sec., 30-sec., 1-min, and 5-min increments
- Electronic verbal alarm and/or message capabilities.

Interfaces

The FMS will provide for interfacing with the various instruments, analyzer subsystems, fire protection systems, material tracking systems, security systems, and HVAC system controls. The system will also support verbal announcement of alarms and/or warning messages via the NMSF public address system. The security system interface will include various permissives or interlocks to control access to areas during upset alarm conditions.

The FMS should provide capabilities for electronic data exchange between the NMSF information system and the LANL MASS data system, if required. The actual interface requirements will be defined in cooperation with LANL personnel.

Security

The FMS will have provisions for many levels of password protection to prevent unauthorized changes in system configuration, control constants, or recorded data. The password protection requirements will be appropriate for the type of station (e.g., real-time control station or secure information station).

Tracking System

The FMS will include bar-code reader/wand stations at each material-handling station and transfer/transition point. This will include, but will not necessarily be limited to the truck dock, staging area, pack/unpack area, NDA laboratory (at both accessways), and the container handling machine. The bar-code reader stations will be connected to the FMS via the LAN. The material-tracking system will maintain a record of the time and location of each transfer or transition the material container makes. A bar-code printer located in the pack/unpack area will generate code labels for new containers. The bar-code data reference/record will include all pertinent data regarding the container (e.g., package date, material, weight). The tracking system will be capable of receiving the record file and identifier of other facilities that may send coded material to the NMSF.

1.12.1.3 System Description

The FMS will be an interactive, geographically distributed, PLC-based control system with multiple operator control stations. The PLC system will have redundant processors with automatic standby switchover between units. The PLC and operator stations will communicate via redundant LAN. A generic system configuration is shown in the system block diagram (**Part IV- Conceptual Drawings**).

The operator stations will be industrial-grade PCs with high-resolution graphic display monitor, hard drive, trackball/mouse pointing device, keyboard, and LAN interface cards. The stations should be 486s or better, with sufficient memory to meet MMI and information system application requirements.

Each operator station will be capable of performing all station requirements, including system, configuration, and administration functions appropriate for the type of station. However, to avoid interference with operations personnel, a dedicated engineering/configuration station will be provided. This engineering station will also be able to configure and maintain the PLC and ladder logic functions. Each operator station will be a stand-alone unit. The loss of one or more stations will not affect system control or the remaining operator stations.

Each operator station will have MMI software with the following features or functions:

Interactive Graphic Display will provide the operator with a graphic overview of the process and equipment status as well as of user interaction with control elements, including starting and stopping control equipment.

Alarm Annunciation will provide an overview of all active alarms, including acknowledged and unacknowledged alarms. It also provides a way to prioritize alarms and to annunciate and clearly differentiate higher priority alarms. It will be able to generate an alarm print-out, including tag name, alarm type, process variable value, and time of occurrence. When the alarm is acknowledged by the operator,

this data (including time of acknowledgement) will be printed; the data will again be printed with the time when the alarm condition clears.

The MMI will also provide an alarm summary log, which will include the last 1000 alarms and 3 years of data. Each alarm record will include the above-noted data. This summary will be printable upon demand.

The MMI should support assignment of enhanced alarms, including the display of additional text or verbal alarm messages to assist the operator in responding to these key upset situations.

Sequence of Events will provide time-and-date stamping of operator-identified events. The system should maintain an event log of the last 1000 events containing the action, time, and date of occurrence, the user whose password was used to initiate the action, if appropriate, and the sequence of events associated with the occurrence. This log will be printable upon demand.

Data Trending will provide for real-time and historical trending of process variables. Points to be trended will be operator-selectable. The time span will be selectable in sample intervals from 15 sec. to 5 min and in 5-min, 30-min, 1-hour, 8-hour, 24-hour, 5-day, and 30-day trend displays. If long-term trend data is needed, the operator will be able to select the trend for archiving. The system will then automatically save the trend data in time-stamped files for later retrieval. The MMI will provide utilities to facilitate transfer of historical trend files to removable magnetic tape or disk media for long-term archiving without overwriting any trend data.

Operational Reports will provide the means to create and generate various operational reports (e.g., shift, daily, weekly) from any data available to the FMS. The operator will be able to schedule reports to print at defined times or time periods before or after a shift change.

The FMS will include redundant servers with databases and files for fault-tolerant handling of the facility's information requirements. The servers, PLC, and operator stations will communicate via a redundant LAN.

The PLC, I/O, communication cards, power supplies, and other hardware associated with real-time process control and data acquisition will be housed in free-standing National Electric Manufacturers Association (NEMA)-12 steel enclosures. Loss of communication to the servers or operator stations will not affect the monitoring and control functions of the PLC system.

1.12.2 Automated Material Storage/Retrieval System

1.12.2.1 System Function

The material storage/retrieval system defined herein establishes a automated approach to minimize personnel contact and material handling, and to maximize data acquisition and remote monitoring of the containers. This level of automation will also put the maximum demand on the FMS. The actual material-handling approach and level of automation will be defined by LANL operations personnel following safety and cost-benefit analyses.

The material storage/retrieval system will have two main components. The first part is the container handling machine in the charge hall. This unit will place and retract the basket and its containers from the drywell. The container handling machine will have position encoders and interlocks to track its position and record all material-handling operations in the storage vault as part of the material-tracking system. The container handling machine will use bar-code readers to verify container identification and material-tracking requirements, as well as video monitoring to visually verify the condition of the exterior container. This approach assumes that containers will be stored in open baskets inside the drywells. The

container handling machine will also have safety interlocks to ensure personnel, material, and equipment safety during retraction and insertion operations.

The second component of the system will consist of a transfer cask that will move the baskets from the vault to the NDA laboratory via a transfer airlock. The airlock will be seismically designed to serve as the pressure boundary for the MAA. Once inside the NDA laboratory, a second retraction device will extract the basket from the transfer cask. The basket container will be raised to the NDA laboratory level; then the operator will open the desired compartment door and remove the container. The process will be reversed for reinsertion of a container into a drywell or addition of a new container.

1.12.2.2 System Design Basis

Container Handling Machine

The container handling machine will be operator controlled (via pendant- or base-mounted controls) and will be able to be controlled remotely for positioning and initiation of retraction/insertion functions. The unit will use optical encoders, vision systems, or other spotting devices to determine x and y position within the storage vault. Electrically driven retraction arms will mechanically grab the basket and withdraw it from the drywell. The container handling machine will communicate with the FMS via umbilical cord.

The container handling machine should have permissives and/or interlocks to protect the operators and prevent damage to the machine or the baskets. These permissives and interlocks will include, but will not necessarily be limited to, the following:

- Retraction device must be in full UP position prior to machine travel.
- Retraction device cannot activate without outriggers in position.
- Retraction unit cannot initiate a retraction sequence over a drywell unless there is a valid pending container removal or insertion order for that drywell, the drywell pressurization status is normal, and the drywell tracer gas analysis reading is normal.
- Retraction unit cannot initiate a transfer sequence unless the transfer cask is in the RECEIVE position.

Transfer Cask

The transfer cask system will move the storage basket between the storage array and the NDA laboratory via an airlock. The transfer cask will be moved by either a trolley mechanism or hydraulic "arms." The travel mechanism will be interlocked with the airlock doors to maintain safe operation. The airlock will be seismically designed to serve as the pressure boundary for the MAA.

Once the basket is transferred to the NDA laboratory side, it will be lifted to the NDA laboratory floor level by a hoist. The operator will then open the basket compartment and remove the container (using robotics or manual devices). The procedures for return or insertion of a container into a drywell will be the same actions in reverse.

Scanning System

As the containers are extracted from the drywell, bar-code readers located in the container handling machine will scan the container bar codes. At the same time, a video camera located in the machine will transmit a digital image of the containers to the FMS. The FMS will be able to display, pan, zoom, and replay this digital image. The FMS should have a transfer operation screen that will display

- the container identification number and position within the array as last verified;
- container identification numbers and array position for current extraction;
- a subwindow digital display of each container; and
- a means for the operator to select a container and scroll the picture up and down and from left to right to view the front of the container.

The system should alarm any abnormalities in container numbers or locations. The system should automatically save the video image of each container. The material-tracking record will be automatically updated on each material event. The video digital file updates, and the previous file, will be deleted upon completion of the retraction or insertion operation (or saved to long-term storage).

1.12.2.3 System Description

Refer to the Material Handling (1.14), Process Flow (1.4), and Special Facilities Equipment (1.18) design descriptions for further information.

1.12.3 Automated Material Tracking System

1.12.3.1 System Function

The information system portion of the FMS will provide for comprehensive material-handling and movement data acquisition. This will include assigning and tracking material via bar codes and bar-code readers. This information will be used to locate material within the storage array as well as to exchange data electronically with the LANL MASS. The actual tracking and transfer requirements will be developed in cooperation with LANL personnel.

Bar-code readers will be located at each handling or transition point in the NMSF to record material movement within the facility as well as into or out of the facility. The material-tracking system will be able to generate needed production handling and storage reports. The system will also support NMSF personnel in container surveillance. The frequency, selection methodology, and initiation means of container surveillance will be developed in cooperation with LANL personnel during detailed design.

1.12.3.2 System Design Basis

The material-tracking system will include a number of data input stations located throughout the facility. The data stations will include a small data processor, LAN interface port, four-line text display screen, and hand-held bar-code reader. The data stations will be located at material transition/transfer points, temporary storage areas, and process work stations. These points will include, but will not necessarily be limited to, the truck docking area, the staging area, the pack/unpack area, the NDA laboratory entry and exit, and the PF-4 transfer tunnel. Additional bar-code readers will be located in the container handling machine located in the storage vault.

The material-tracking program will maintain a database record of each container. The information will include, at a minimum, the container identification number, contents, weight, container type, packaged date, each container-handling location (including time and date), as well as any additional process information required by LANL. The program will maintain a minimum of five years of record data on the redundant-server hard drives. The program will also provide necessary utilities to periodically transfer data to an optical disk for mass data storage and permanent archiving of the material-handling data. Provisions will be made so that no material-handling/tracking data is lost by data overwriting.

The tracking program will be able to create and generate various material storage and handling reports, as well as material inspection/confirmation reports defined by LANL. The program will also support NMSF personnel in determining periodic inspection requirements and their frequency. A component of this system element will be to collect and present supporting data regarding the integrity of the containers, and to document any extensions in the frequency of visual material inspection and confirmation. The specifics of this requirement will be developed in close cooperation with LANL personnel.

The program will support the creation of new container identification records. A bar-code label printer will be located in the NDA laboratory. As an alternative to paper codes, ink-jet printing of bar codes directly onto the container surface may be considered.

All aspects of material-handling data access, record creation, and other database tasks will be properly password-protected. The record database should also support SQL-type data queries to allow the user to access the data in any way necessary to meet the NMSF's requirements.

The system should be designed to produce International Atomic Energy Agency (IAEA) reports, if required, and to integrate with the LANL MASS system and the DOE Nuclear Materials Management and Safeguards System. Other reports will be defined later in the design process.

1.12.4 Breathing-Air System Monitoring

1.12.4.1 System Function

The breathing-air system is critical to the facility for decontamination procedures and equipment maintenance operations. The instrumentation and monitoring required to provide continuous clean air for breathing consists of pressure, flow, purity, and compressor status indication locally, at the FMS, and remotely at the points of use.

1.12.4.2 System Design Basis

A tank trailer will be the primary source of the continuous breathing-air supply. Pressure, flow, and operating status will be monitored. This data will also be monitored at the FMS and the RCT/Health and Safety office alarm consoles. Indications of system supply failure or high carbon monoxide levels will activate a local intermittent evacuation alarm at the breathing-air stations and to any personnel inside the vault. The intermittent alarm will last for 10 min (minimum reserve supply time), then change to a continuous alarm. The alarm will go to continuous immediately upon a low-pressure alarm from the backup system.

Should the tank trailer fail, a new bottled-air backup system will provide sufficient air for evacuation from the vault. The pressure and flow rate will be monitored separately from the tank trailer system. Low pressure or presence of flow from the backup system will be configured to provide alarms while allowing approximately 30-min reserve capacity. The switchover to the bottle backup system is automatic when the pressure falls below the set point of the backup bottle system supply regulator.

1.12.4.3 System Description

The breathing air will conform to Compressed Gas Association grade D, requiring monitoring for carbon monoxide. Furthermore, temperature, pressure, flow, and carbon monoxide will be monitored and alarmed locally and remotely through the FMS as follows:

Monitored Component Alarms

CO ₂	High CO ₂ concentration
Carbon monoxide	High and High High levels
Temperature	High
Pressure	High and Low
Flow	High and Low rates

Local alarms will consist of a fault or trouble light and audible evacuation speakers. Individual breathing apparatus will also be provided with audible low-pressure alarms. Each user will be required to have a two-way intercell communication device that must be monitored by someone directly outside the cell.

1.12.5 HVAC System Monitoring

1.12.5.1 System Function

The HVAC system provides environmental conditioning for the facility and ventilation for the vaults and other confined areas. Section 1.8 describes the HVAC mechanical systems, including instrumentation and control system descriptions and interfaces. The instrumentation required to monitor and control the HVAC system consists of pressure, flow, and temperature elements, and equipment status indication locally and at the FMS, as indicated in the specific system instrument list and the FMS I/O section (see **Part IV - Conceptual Drawings**).

1.12.5.2 System Design Requirements and Description

See Section 1.8.

1.12.6 Remote Area Monitors

1.12.6.1 System Function

If approved by LANL, digital pocket dosimeters will be used in place of permanently installed remote-area monitors (RAM). The NMSF will be considered an extension of PF-4, which uses digital pocket dosimeters. The digital pocket dosimeters provide individual monitoring and indication of direct-radiation levels resulting from gamma radiation exposure. The dosimeters provide a real-time readout to the individual and an indication if radiation levels exceed a specified set point. Type and quantities of digital pocket dosimeters will be coordinated by the LANL Environment, Safety, and Health (ESH) division.

1.12.7 Continuous Air Monitors

1.12.7.1 System Function

This section describes the requirements for a system that will provide continuous monitoring of airborne radiation resulting from alpha contamination. The system will provide sufficient information to maintain ALARA exposure limits to protect personnel and the environment from inadvertent radioactive releases.

1.12.7.2 System Design Basis

The CAM system will monitor airborne radioactivity levels (higher than normal background) of work areas, air ventilation systems, and radioactive storage areas. Each CAM will be capable of providing the following electronic information to the FMS:

- Contamination spectra
- Contamination concentration
- Alarm status
- Hazardous release verification
- Monitor fault/failure
- Data time and date stamping
- Detector identification/location

Each CAM will provide an audible and visible high-radiation alarm locally. Each CAM will also provide an audio and visual alarm to an operator interface unit (OIU) located outside the entrance of the monitor area, to the FMS, and to the health physics computer monitor located in NMSF. Alarm information to the FMS will include an access portal interlock to prevent inadvertent access to contaminated areas.

The CAM system will be designed in accordance with DOE 6430.1 A, DOE 5480.11, and LANL and industry standards. Design requirements, such as quantity and locations of CAMs, will be coordinated with the LANL ESH Division.

1.12.7.3 System Description

The CAM system will consist of radiological-monitoring instrumentation to detect and record chronological and historical data of airborne contamination from alpha-emitting radionuclides.

The Canberra Alpha Sentry, the LANL standard CAM, will be used as the standard unit for the facility. The system is comprised of alpha-radiation detection instrumentation that provides local and remote monitoring and alarm capability. Current data, trending, and historical information will be monitored and maintained by the FMS and by the ESH computer system via a shared data-highway network. Local CAM operational status and normal background radiation levels will also be monitored at the HS office.

The system will provide for normal-operating-condition monitoring of airborne contaminants. The system will also provide permissive and interlock functions for control of ventilation systems and access to radiation areas, and local alarming for occupied, controlled areas. Each CAM will be configured to meet ALARA limits, DOE 5480.11 guidelines, DOE and LANL RadCon Manuals, and 10 CFR 835. Alarm levels will be set at one-tenth the derived air concentration averaged over an 8-hour period, based on the maximum permissible concentration for Pu-239 of $2 \times 10^{-12} \mu\text{Ci/cc}$. Data obtained from radiation monitoring will be used for evaluation of personnel protection, preventive maintenance, and standard operating procedures.

Redundant components will include vacuum pumps and FMS interfaces such as data highway cables and computer data channels, which will be physically and electronically isolated. This will ensure the integrity of the data and provide continuous monitoring during computer system maintenance or communication failure. Minimum design features will include the following:

- Radiation detection, primarily alpha
- Local audible alarm (a pulsating solar alarm)
- Local and remote fault alarms
- Spectra, background, and limited isotope resolution
- Concentration
- Alarm status
- Hazardous release verification
- Monitor fault/failure
- Data time and date stamping

- Unit identification/location

CAMs will be provided to continuously monitor airborne radioactivity levels and higher-than-normal background in general air movement paths for full-time access areas and air ventilation systems. Detector locations are based on a qualitative analysis of the exhaust air paths or contamination points. Determination of these locations will be coordinated with ESH Division. Each detector will provide audible and visible high-radiation alarm indication via OIUs locally, at the FMS, and outside the entrances to the monitored areas. The FMS will provide access-portal interlock capability to prevent inadvertent access to possibly contaminated rooms. These interlocks should not impede egress from the area.

The existing vacuum exhausters will be reused for the CAM's vacuum requirements. The existing vacuum exhauster system is to be relocated to a new pump room, along with new vacuum exhausters for the fixed air samplers (FAS). The existing vacuum exhausters run at a noise level of more than 100 dB; therefore, hearing protection for personnel inside the pump room will be required.

Portable monitors provided by the HS office will be used for monitoring special activities, such as decontamination operations, and for monitoring the vaults prior to personnel access. Radiation control technicians (RCTs) will provide individual ESH monitoring of exposure. Therefore, the system will not be classified as safety-class. Redundant monitors, standby power, and UPS backup will not be required.

1.12.8 Fixed-Air Samplers (FAS's)

1.12.8.1 System Function

This section covers the requirements for FASs, which will provide general housekeeping and engineering controls of airborne radiation resulting from alpha contamination over a prescribed time period.

1.12.8.2 System Design Basis

The FAS system consists of a sampling vacuum system and filter hoods (fixed heads) that hold removable filter paper. The FASs will be installed in work areas where radioactive materials are stored or handled and where radioactive airborne particles or vapors may be present. Air within these areas is pulled through the FASs. After a prescribed sampling interval, which is dependent on the area and probability of contamination as determined by ESH personnel, the sample filter paper is removed, identified, and counted using a scintillation alpha counter. The FAS system will be designed in accordance with DOE Order 6430.1 A and Order 5480.11. Quantities, types, and locations of the FASs will be coordinated with LANL ESH Division.

1.12.8.3 System Description

The FAS system provides for general housekeeping and engineering controls of airborne radiation resulting from alpha contamination over a prescribed period of time. The system is composed of a sampling vacuum system and filter hoods (fixed heads) that hold removable filter paper. FASs are installed within areas where radioactive airborne particles or vapors may be present. They sample air within these areas, providing a representative sample of potential airborne radioactive materials.

FASs will be capable of accepting sample filter paper 75 mm in diameter. Each fixed head will have a 3/8-in., National Pipe Thread (NPT)-threaded female inlet and a male quick-disconnect fitting. The sampling filter papers will be compatible for use with in-line-operated low- and high-volume air sampling pumps and will be approved for particulate sampling in the nuclear industry. The filter will be chosen in coordination with ESH Division.

The sampling vacuum system will be comprised of two high-velocity, low-pressure/volume air-sampling pumps. One pump will run continuously and the other will serve as backup. These exhausters will be controlled so that primary and backup pumps automatically switch approximately once a month to maintain equal running time on each unit. The exhauster will be positive displacement or centrifugal-type, capable of providing an air flow rate of 2 scfm through each fixed head.

Air flow/engineering studies to determine the total capacity of the sampling vacuum system must be performed based on the quantities, locations, and types of FASs. In determining the type of sampling vacuum system used, the following factors will be considered: exhauster noise level, installation cost, annual electric cost, and life-cycle cost. Quantities, locations, and types of fixed heads will be coordinated with LANL ESH Division.

1.12.9 Personnel Monitors

1.12.9.1 System Function

This section covers the requirements for personnel monitoring in contamination-controlled areas. Personnel monitors will be provided to prevent the inadvertent spread of contamination beyond controlled areas. Contamination alarms will require notification of an RCT for confirmation by portable survey meters.

1.12.9.2 System Design Basis

Personnel monitors will be provided for personnel monitoring and contamination control. Contamination control areas for the facility are defined as any guarded-access area requiring a dosimeter badge for entry where radioactive materials or elevated radiation fields may be present. Personnel movement from areas of potentially higher contamination levels to areas of lower levels will be monitored and administratively controlled through the use of personnel monitors. Activation of local alarms will require the alarm initiator to call for assistance from the facility RCT.

Personnel monitors will consist of the following:

- Full-body personnel monitors will be provided at major MAA entrances for personnel monitoring, contamination control, and also for unauthorized movement of SNM.

Each monitor will be capable of providing the FMS with radiation level, alarm status, monitor fault/failure, and detector location. The actual data collected will depend on location and the individual monitor function. The alarm system will be managed on a "report by exception" basis; that is, data will be sent to the FMS only upon activation of an alarm or fault condition. Each monitor will also be able to respond and provide data upon a request from the FMS. Alarm levels and monitoring will be in accordance with DOE 5480.11. Quantity, exact type, and proposed locations of personnel monitors will be coordinated with ESH Division.

- Automatic hand/foot monitors will be provided at locations within controlled areas for personnel monitoring and contamination control. These units will be designed for one-step monitoring of hands and feet. Quantity, type, and proposed locations of hand/foot monitors will be coordinated with ESH Division.
- Air-proportional hand/foot monitors will be provided at locations within controlled areas for personnel monitoring and contamination control. These units will be designed for manually self-monitoring hands and feet. Quantity, type, and proposed locations of hand/foot monitors will be coordinated with ESH Division.

1.12.9.3 System Description

The personnel monitors will consist of radiological monitoring instrumentation to detect contamination from beta-, gamma-, or alpha-emitting radionuclides. Each personnel monitor will be configured to meet LANL ALARA limits and DOE 5480.11 guidelines. Alarm levels will be set at 0.5 mrem, one-tenth the allowable dose equivalent for a radiation area averaged over a one-hour period. Portable monitors provided by ESH will be used for confirmation and to determine decontamination action.

Personnel monitors will include three different kinds of monitors:

- Full-body personnel monitors are comprised of large-area detectors with controlled geometry and timing that provide local and remote monitoring and alarm capability. The full-body monitors will monitor surfaces that include, but are not limited to, hands, bottom of shoes, and clothing. Current data, trending, and historical information will be monitored and maintained by the FMS and by the ESH computer system via a shared-data highway network. Local instrument operational status and normal background radiation levels will also be monitored at the ESH office. The detector will be a P-10 gas-flow-proportional, large-area (full-body) detector.

The full-body monitoring system will provide monitoring for normal and abnormal radiation levels of personnel entering or leaving radiological control areas. These monitors will provide local alarms and remote sequence-of-events data acquisition. Minimum design features will include alpha and beta/gamma radiation detection, local audible alarm (a long beep), local and remote fault alarms, historical data, and detector location.

- Automatic hand/foot monitors will be provided at four locations within controlled areas for personnel monitoring and contamination control as shown on the radiation detection location drawing. These instruments will be dual air-proportional, large-area alpha scintillation probes connected to a single local ratemeter. These units are designed for one-step monitoring of hands and feet. Type and proposed locations will be coordinated with ESH Division.
- Air-proportional hand/foot monitors will be provided at six locations within controlled areas for personnel monitoring and contamination control when leaving a room, as shown on the radiation detection location drawing. These units are designed for manually self-monitoring hands and feet. Type and proposed locations of hand/foot monitors will be coordinated with ESH Division.

1.12.10 Neutron Monitors

1.12.10.1 System Function

Individual bubble dosimeters will be used instead of permanently installed neutron monitors. The NMSF will be considered an extension of PF-4, which uses bubble dosimeters. Type and quantities of bubble dosimeters will be coordinated by ESH Division, but they are not considered part of this project.

1.12.11 Criticality Monitoring and Alarm System

1.12.11.1 System Function

The requirements for a criticality monitoring and alarm system (CMAS) are based on monitoring a high-intensity gamma burst resulting from a criticality accident. The system will provide sufficient information to actuate local and area alarms, and to alert personnel to evacuate the facility in the event of a criticality

accident. The requirement of CMAS for this facility has not been determined. This section is included in the event that the system is required.

1.12.11.2 System Design Basis

The CMAS is required to monitor the facility for a criticality accident and will be positioned to detect gamma dose levels above normal background. The CMAS will initiate an evacuation signal when any two detectors exceed the alarm set point. A triangular arrangement will be used to maximize coverage, with a network of three detectors providing separate signals to a local coincidence counter and alarm controller (the third detector provides redundancy). The detector locations will be arranged so that the maximum detection distance will be 50 m from the most likely sources of fissionable materials.

The controller will initiate an alarm if any two of the three signals exceed set point. A set point of approximately 50mR/hour is recommended. Local and remote FMS alarm output, including facility-wide audible alarms, will be generated. The CMAS will be capable of providing alarm status, count rate, detector/channel status, fail detector/channel status, data time and date stamp, and alarm location.

As with the CAMs, the CMAS will be managed on a "report by exception" alarm basis, able to respond to FMS polling. Alarm levels, locations, and monitoring will be in accordance with American Nuclear Society (ANS) 8.3 and DOE 5480.24. The types, locations, quantities, and other logistics will be coordinated with ESH Division.

1.12.11.3 System Description

The CMAS will consist of three gamma-sensitive radiation detectors, a data acquisition module (DAM), and a control terminal. Each gamma detector exceeding its set point will activate a local alarm to the DAM. If two or more detector set points are exceeded, the general alarm will be initiated, activating evacuation signals located throughout the facility. The control terminal will poll the detectors for current status, maintain historical data, and command the activation of a built-in calibration check source on the detectors. The control terminal will interface with the FMS and the ESH computer. In the event of a general alarm, the current data, criticality gamma-flux count rates, trends, and historical information will be monitored and maintained by the FMS computer system.

The CMAS will provide for alarm monitoring of a high gamma field resulting from a criticality accident in the facility. The alarm will continue until it is manually reset at the control terminal. Detectors will be capable of detecting the minimum accident that will deliver the equivalent of an absorbed dose in free air of 20 rad at a distance of 2 m from the reacting material within 60 sec., responding to transients of 1 ms and providing alarm trip points of 10 mR/hour above normal or operational background at the monitoring point. Based on triple area coverage and a 50 m radius, the maximum alarm set point will be 400 mr/hr. Redundant components will also include control terminal interfaces, such as data highway cables and computer data channels, which will be physically and electronically isolated.

Minimum design features will include the following:

- Geiger-Muller (GM) tube to detect gamma flux
- A standard LANL audible evacuation alarm when two or more detectors are tripped
- An audible and visible local alarm when only one detector is tripped
- Local and remote fault alarms
- Alarm status indication
- Detector fault/failure indication
- Historical data storage for the past 30 days in 1-min time periods

- Built-in check source on detectors
- Service detector will interrupt and perform count rate calculations based on elapsed time
- Nonvolatile battery backup of historical data

Criticality detectors will be provided to monitor the facility for a sudden gamma flux that would be the result of a criticality accident. The LANL standard and/or preferred model is the Eberline RMS-11. Detector locations are based on a pattern of triple overlapping coverage so that a minimum of two detectors would detect a criticality. Detector locations will be coordinated with ESH Division. Detectors will be ceiling-mounted with power supply from the DAM. The DAM and control terminal will be rack-mounted within the facility in a NEMA-4 enclosure, complete with light and bell for single-detector warning alarm.

1.12.12 Stack Monitoring System

1.12.12.1 System Function

This section describes the requirements for a stack monitoring system, which consists of instrumentation and/or sampling to monitor normal emissions from the facility. This system is required to ensure that radiation doses to the public are maintained to ALARA. The HVAC exhaust from possibly contaminated areas will be monitored to ensure filtration integrity as well as to document any abnormal releases.

1.12.12.2 System Design Basis

The level of radioactive effluent material in confinement exhaust systems will be continuously monitored. All exhaust systems will have monitors that provide an alarm if the concentration of hazardous material in the exhaust exceeds specified limits. Appropriate features that prevent an uncontrolled release of radioactive material to the environment or workplace will be provided and are described throughout the CDR. Instrumentation will sense abnormal conditions affecting safety and subsequently provide an alarm. Effluent monitoring systems will provide audible and visible alarms to the operator, enabling timely corrective actions to ensure the safety of operating personnel and the public. Airborne effluent monitoring of the HVAC exhaust stacks will include measuring for alpha and beta/gamma in gaseous or particulate form. Monitoring of airborne effluent will include continuous, representative sampling from each stack, complete with flow control, alpha CAM, and beta/gamma CAM. Lower limits of detection are based on using 10% of the guidelines established by applicable DOE Orders guidelines. Types, locations, and other logistics of the stack monitoring equipment will be coordinated with ESH Division.

1.12.12.3 System Description

The stack monitoring system will consist of isokinetic sampling systems complete with multi-probe samplers, skid assemblies with vacuum sampling pumps, flow control, UPS, and radiological monitoring instrumentation. The system, along with the FMS, will detect and record chronological and historical data of airborne contamination, both particulate and gaseous. The detectors, monitors, flow control valves, vacuum pump, associated piping, UPS, instruments, and control wiring will be assembled and skid-mounted. The local control system will include an annunciator panel that provides local and remote monitoring and alarm capability. Current data, trending, and historical information will be monitored and maintained by the FMS and by the HS computer system via a shared data highway network.

The system will provide for isokinetic sampling of particulate, radionuclide, and gaseous contaminants, at stack flows from 20% to 125% of design capacity. Representative samples are extracted from the stack via isokinetic probes, and pass through the vacuum sample piping to the inlet of the sampling skid. The sample passes through an alpha CAM particulate filter rated at 5 microns and then through an ion

chamber-type beta/gamma detector to the skid-mounted vacuum pump suction. The exhaust from the pump is then piped to a port on the exhaust stack.

The isokinetic probe assembly consists of multiple sample ports and thermal sensor-type velocity measurement elements with radiation-resistant wiring, mounted on an aluminum manifold attached to a 5-in. ASA flanged adapter. Isokinetic sampling is based on controlling the velocity of the sample proportional to the average velocity in the stack. In this system, a thermal mass flow sensor provides the input to the velocity controller, which sends a control signal to an electric motor-operated velocity control valve. The thermal mass flow sensor also provides flow data used in determining the concentration of contaminants.

The in-line alpha CAM detector head will be the LANL-standard Canberra Alpha Sentry unit designed for stack monitoring. It consists of a filter-based detector with a cutpoint of approximately 1 micron. This filter can be used to detect continuous on-line alpha radiation released from the facility, as well as provide an off-line analysis of particulates. Analysis of particulate quantity and size distribution can then be used to determine the HEPA filter replacement and testing schedule.

The remainder of radiation contamination can be determined by an ion chamber detector calibrated to measure ^{241}Am , ^{233}U , ^{235}U , ^{236}Pu , ^{239}Pu , ^{240}Pu , and ^{237}Np .

Each vacuum sampling line will have a vacuum pump rated at 4 scfm at 19 in. Hg vacuum at sea level. The pump will be an oilless, carbon-vane, regulated vacuum pump.

A redundant skid will be provided, and vacuum sampling piping will be stainless steel welded vacuum tubing.

The control system will be supplied with UPS backup for data acquisition, data storage, alarm, and data transmission. It will have the following features:

- Local audible alarm (a pulsating sonar alarm)
- Local and remote fault alarms
- High radiation alarm
- Alarm status
- Monitor fault/failure
- Historical data
- Pump fault/failure
- Low/high flow alarms

The probe assemblies will be installed in the stack at a distance based on the largest diameter of the stack, eight diameters downstream of the last obstruction and two diameters upstream from the exhaust point. The redundant probe will be mounted at a 90° angle from the others. Locations of all stack monitors will be coordinated with ESH Division.

1.13 Thermal

1.13.1 System Design

The **Functional and Operational Requirements Document** (June 1995) establishes the following requirements for heat removal for the NMSF:

- Up to 20 kW will be removed from the storage area during normal operation.
- Up to 15 W will be removed from any storage location in the storage area during normal operation.
- The temperature of nuclear material stored in Nuclear Materials Technology (NMT) containers will not exceed 176°F (80°C) during normal operation.
- The temperature of nuclear material stored in NMT containers will not exceed 212°F (100°C) during a DBA.
- The surface temperature of pits stored in AT400A capsules will not exceed 149°F (65°C) during normal operation.
- The surface temperature of pits stored in AT400A capsules will not exceed 212°F (100°C) during a DBA.
- Storage equipment and structure are not to exceed their temperature design conditions.

These requirements must be met by the NMSF design for the bounding operating conditions and DBA. The bounding operating condition for the NMSF is the passive, air-cooled heat removal mode with a typical 24-hour temperature cycle for the ambient air having a peak temperature equal to the maximum historical temperature at the NMSF location. Based on meteorological data for LANL, the bounding ambient air conditions should be adequately represented by a sinusoidal temperature curve with a maximum of 95°F (35°C), a minimum of 75°F (23.9°C), over a period of 24 hours. The bounding DBA should be adequately represented by a complete loss of air flow through the storage area for up to one week (the assumption being that lack of air flow would be detected and corrective actions taken within a one-week time period).

1.13.2 Analysis Approach

The analysis approach was to subdivide the heat-removal assessment into its component parts, to parametrically analyze each part to obtain the effects of boundary-condition variations and modeling uncertainties, and to assemble a bounding assessment. A report has been prepared detailing the results, which is included in **Part III - Supplemental Information**. Further documentation has been prepared, which is not included in the CDR, but is available upon request.

1.13.2.1 Analysis Approach for Normal Operation

The analysis of heat removal from stored materials in the NMSF during normal operations was split into four parts:

- Heat transport from the storage arrays by natural convection air flow through the facility
- Conduction, convection, and radiation heat transfer from the heat-generating nuclear material in the NMT containers to the air outside the drywell
- Conduction, convection, and radiation heat transfer from the heat-generating nuclear material in pits stored in AT400A capsules to the air outside the drywell
- Transient response of the stored material to the ambient-air temperature diurnal cycles

Facility Heat Transport

The steady-state transport of heat from the facility by natural convection was analyzed with a three-dimensional model of the NMSF storage system using the AEA Technology - Computational Fluid Dynamics Services, Inc., FLOW3D code. The model included the three parallel storage bays, the inlet downcomer and flow baffle, and the exhaust vent. The storage array was modeled as heat-generating, porous media with flow resistances representative of flow across rows of cylindrical tubes. The air flow and its associated heating-up were calculated in accordance with the buoyancy pressure head developed between the ambient air in the inlet downcomer and the heated air in the exhaust vent and in accordance with the flow resistances of the flow paths. For the reference calculation, a uniform and equal heat generation in each of the three bays was assumed. A steady-state inlet air temperature of 70°F (21.1°C) was assumed. From this model, air temperature distributions throughout the storage arrays, including maximum local air temperature, were obtained as functions of inlet air temperature, material loading distributions, and modeling uncertainties. The details of the model can be found in **Part III - Supplemental Information**.

Steady-State Heat Transfer from Material in NMT Containers

The steady-state heat transfer from the nuclear material in the NMT containers to the air flowing around a drywell was analyzed with a detailed two-dimensional, lumped-parameter model that evaluated conduction, convection, and radiation. For the reference calculation, the containers were assumed to be supported on carbon-steel circular shelves spaced 12 in. apart vertically and attached to a cylindrical-cage storage unit. From this model, the temperatures of the stored materials and associated storage components were obtained as functions of design details, temperature, and flow rate of the air surrounding the drywell, and of material and model uncertainties. The details of the model can be found in **Part III - Supplemental Information**.

Steady-State Heat Transfer from Pits in AT400A Capsules

The steady-state heat transfer from the nuclear material in typical pits in AT400A capsules to the air flowing around a drywell was assessed by combining two pieces of information. The first part is the calculated temperature rise from the air to the capsule outer surface. The second part is the measured temperature rise from the capsule outer surface to the pit surface for the highest powered pit. A one-dimensional lumped-parameter model evaluated conduction, convection, and radiation heat transfer. The measured temperatures were based on prototypical experiments. Best-estimate average and worst-case temperature increases were determined. The details of the model are given in **Part III - Supplemental Information**.

Transient Heat Transfer from Material in NMT Containers

The transient heat transfer from the nuclear material in the NMT containers to the air flowing around the drywell was analyzed with the detailed two-dimensional, lumped-parameter model described above. A sinusoidally varying air temperature was used as a boundary condition to determine the transient response of the stored material to 24-hour air temperature cycles. A step change in air temperature also was analyzed to determine basic response time constants. The details of the model are given in **Part III - Supplemental Information**.

1.13.2.2 Analysis Approach for Accidents

The assumed abrupt loss of all air flow through the NMSF storage array to the environment, with the accompanying transient heating-up of the facility components and structures, was selected as the

bounding accident for thermal challenges. The facility heating-up was analyzed with a detailed two-dimensional, lumped-parameter model that treated conduction, convection, and radiation within and from the facility through its perimeter structures to the surrounding soil and air. For the reference calculation, it was assumed that heat transfer to the ends of the storage bays was minimal and was conservatively neglected. It was assumed that the facility had been operating normally with the stored material generating 20 kW of power, and that an effective steady state had been established in the drywell assemblies, the facility's structures, and the surrounding soil at the time the accident occurred. From this model, the temperature transients for the stored materials, associated drywell components, and structures were obtained as functions of design details and material and model uncertainties. The details of the model are given in **Part III - Supplemental Information**.

1.13.3 Analysis Results

The results of the reference analyses are summarized in this section. From these results, a composite, conservative temperature response for the stored material in the NMSF was formulated to compare with temperature limit requirements. This formulation is presented in Section 1.13.4.

1.13.3.1 Analysis Results for Normal Operations

Facility Heat Transport

The temperature distribution in a vertical plane along the center of the middle storage bay is shown in Figure 1 (see **Part III - Supplemental Information** for figures and tables referenced). The temperature increases along the bay and reaches a maximum near the exit. With inlet air at 70°F (21°C), the maximum air temperature is 80.6°F (27.0°C) and is located in the region where the air exits the bay, resulting in a maximum increase in air temperature of 11.0°F (6.1°C). The velocity distribution in this same vertical plane is shown in Figure 2. The high velocities are calculated at the restricted inlet and exit regions. The flow distributes vertically over the height of the bay within a short distance from the inlet before encountering the drywells (the first row of drywells is 5.5 ft [1.68 m] downstream from the inlet baffle).

The differences in temperature distributions among the three bays are shown in Figure 3. In this model, the outer bays are wider than the middle bay and have an unrestricted flow space along the outer walls. The air is cooler in these regions because the flow is higher and the volumetric heat generation is less. For uniform loading, the results are relatively insensitive to changes in the hydraulic loss coefficient because of compensating effects of reduced velocity, higher air temperatures, and increased buoyancy head. Parametric results indicate that the calculated temperature rise through the bay may have an uncertainty of ~20%. Calculations with material loaded only in the center bay indicate that the bay separation walls need to be extended up the exhaust vent to prevent the heated and unheated air from mixing in the exhaust vent, thereby reducing the buoyancy head driving the flows. The detailed results are given in **Part III - Supplemental Information**.

Steady-State Heat Transfer from Material in NMT Containers

The calculated temperature distribution from the material (metal, although the container is intended also to store oxides or stabilized residues) stored in the NMT containers to the air surrounding the drywell is shown in Figure 4. The radial temperature profile shown is distorted because the basket structure is heated via conduction from the containers through the carbon-steel plates of the basket structure to the mesh of the basket. This conduction path results in the basket temperature shown in Figure 4 being higher than the calculated air temperatures on both sides. With a local air temperature of 80°F (26.7°C), the temperature of the stored material for average best-estimate conditions was calculated to be 145.8°F (63.2°C), which results in a temperature rise above the surrounding air of 65.8°F (36.6°C). Parametric

results indicate that, for the worst-case conditions and model uncertainties taken simultaneously, the calculated temperature rise from the air to the stored material has an upper bound value of 73.9°F (41.1°C). Because there are clear design aspects to be optimized that relate to material selection, surface finish, and support fixtures, and because the assumed power of 15 W is conservative by at least 10%, the calculated results are expected to be sufficiently bounding. The detailed results are given in References 6 and 7 (see **Part III - Supplemental Information**).

Steady-state Heat Transfer from Pits in AT400A Capsules

The temperature rise from the air surrounding the drywell to the highest powered pit in an AT400A capsule was estimated by combining the calculated temperature rise from the surrounding air to the side surface of the capsule with the measured temperature rise from the side surface of the capsule to the maximum temperature of the pit surface. With an air temperature of 80°F (26.7°C), the maximum temperature of the pit surface for average best-estimate conditions was estimated to be 111.8°F (44.3°C), which results in a temperature rise above the surrounding air of 31.8°F (17.7°C). The worst-case condition and model-uncertainty temperature rise has an upper bound value of 37.2°F (20.7°C) or a bounding pit-surface temperature of 117.2°F (47.3°C). For the same reasons listed above for NMT containers, the calculated results for the AT400A capsule are expected to be conservative. The detailed results are given in **Part III - Supplemental Information**.

Transient Heat Transfer from Material in NMT Containers

The transient response of the material stored in NMT containers in the NMSF drywells is shown in Figure 5. The air temperature transient was assumed to be sinusoidally varying about a nominal value of 80°F (26.7°C), with the maximum change being 9°F (5°C). The results indicate that the stored material does not respond immediately (because of thermal resistances and heat capacities) to changes in air temperature. The peak temperature of the stored material is delayed approximately 3.45 hours relative to that of the air and, as a result, does not incur the same magnitude of temperature variation. The stored material experiences an amplitude variation that is only 0.74 of that in the outside air. Thus, on a day in which the outside air varies 20°F (11.1°C) from minimum to maximum, the stored material would experience less than a 15°F (8.3°C) variation. The detailed results are given in **Part III - Supplemental Information**.

1.13.3.2 Analysis Results for Accidents

The transient temperature response of the central region of the NMSF storage bays is shown in Figure 6 (see **Part III - Supplemental Information** for figures and tables referenced). The rapid temperature rise in the first few days is the result of the large thermal resistances associated with rejecting heat from the drywells into and through the concrete structures surrounding the storage arrays. The net heat flows into various parts of the facility are shown in Figure 7. The net heat flow into the drywells decreases rapidly as the drywells heat up. The heat then begins to flow into the interior walls of the storage bay and into the perimeter walls. In the long term, the primary path for heat flow is upward through the loading floor and out through the roof of the loading bay. Results of parametric studies indicate that the bay separation walls play an important role in delaying the heating up of the stored material. The parametric studies also indicate that the results (increases in temperature) may be uncertain by on the order of 100% during the timeframe of interest (~10 days). The detailed results are given in **Part III - Supplemental Information**.

1.13.4 Facility Thermal Performance

To assess the thermal performance of the NMSF, a conservative assessment of the maximum temperatures of the stored material during normal operations and postulated accidents was made and then compared with the specified temperature limits.

1.13.4.1 Thermal Performance for Normal Operations

The conservative assessment of the temperature of material stored in NMT containers during normal operation was formulated as follows:

1. Use worst-case ambient air as specified in Section 1.12.1 (sinusoid with an average of 85°F [29.4°], a minimum of 75°F [23.9°C], a maximum of 95°F [35.0°C], and a period of 24 hours).
2. Add a conservative temperature increment associated with air heating-up as it flows through the storage bay (use 11.0°F [6.1°C]).
3. Add a bounding temperature increment associated with heat transfer from the stored material in the drywell to the local air (use 65.8°F [36.6°C]).
4. Apply the 0.74 amplitude reduction factor to the magnitude of the temperature-time variation.

The result of this formulation is shown in Figure 8 (see **Part III - Supplemental Information** for all figures and tables referenced), along with the temperature limit (176°F [80°C]). A residual margin of 6.8°F (3.8°C) exists between the peak predicted temperature and the limit. The result contains an additional conservatism in that the thermal mass of the bay will significantly damp out the daily temperature oscillation, and the full combined effects of items 2 and 4 will not be observed at any one location.

The conservative assessment of the temperature of pits stored in AT400A capsules during normal operation was formulated as for the NMT containers, except that the temperature increment used in item 3 was based on pit and AT400A considerations (31.8°F [17.7°C]). The result of this formulation is shown in Figure 9 along with the temperature limit (149°F [65°C]). A substantial residual margin of 13.8°F (7.7°C) exists between peak predicted temperature and the limit.

The margins to the temperature limits can be increased by optimizing the design of the fixtures holding the materials inside the drywells to reduce the ΔT between the drywell wall and the storage container. The selection of materials and surface finishes and the extent of the fixtures can significantly affect the conduction, convection, and radiation heat transfer processes and therefore increase the margins to the temperature limits.

1.13.4.2 Thermal Performance for Accidents

The conservative assessment of the temperature of material stored in NMT containers during the postulated bounding accident was formulated as follows:

1. Use the reference transient heating-up results as a basis.
2. Add an uncertainty factor of 100% (double the ΔT increase at 10 days).
3. Add a conservative temperature increment associated with heat transfer from the stored material in the drywell to the drywell wall (use 66°F [36.7°C]).

The result of this formulation is shown in Figure 10 (see **Part III - Supplemental Information** for all figures and tables referenced), along with the accident temperature limit for stored material (212°F [100°C]). The time interval before the temperature limit for the stored material is reached is 35 days, which is well in excess of the requirement of 7 days.

The conservative assessment of the temperature of pits stored in AT400A capsules during the postulated bounding accident was formulated in the same manner as for the NMT containers, except that the temperature increment used in item 3 was based on pit and AT400A considerations. The result of this formulation is shown in Figure 11, along with the accident temperature limit for pits. The time interval before the temperature limit for the stored material is reached is more than 45 days, which is well in excess of the requirement of 7 days.

1.13.5 Conclusions

Based on comparing the bounding temperatures predicted for the materials and pits to be stored in the NMSF against the respective temperature limits, the natural convection heat-removal capability for the reference NMSF concept is sufficient and acceptable. Margins exist in the heat-removal capability to permit design optimization during subsequent design phases and to consider "stretch" storage capacity in the facility if needed in the future.

However, the margin for the plutonium metal stored in the NMT containers is the most limiting from a heat-removal perspective. In subsequent design phases, both the temperature limit and the thermal analyses will need to be addressed further to ensure confidence in the margin and its adequacy. Furthermore, the margin to the limits can be increased through optimizing the design concepts for the holding fixtures. In particular, the choice of materials and surface finishes and the physical extent of the fixtures can significantly affect the conduction, convection, and radiation heat transfer processes and therefore increase the margins of the temperature limits.

1.14 Material Handling

1.14.1 System Design Basis

This section describes the major components of the storage system and the different areas to and from which the material will move while in the facility.

In general, remote material handling is necessary to meet ALARA requirements, although the selected system in the Charge Hall can be operated manually if desired. The NDA laboratory and other operational areas combine automation and manual features and assists. The storage system selected is based on the container systems specified in the **Functional and Operational Requirements Document** (June 1995). These systems include the metal and oxide container currently under development by NMT division and the metallic capsule of the AT400A container system. The storage system was designed around the size, weight, and physical number of containers and items expected to be stored.

The proposed material-handling system is based on a series of meetings and discussions held with the user, facility management, and LANL engineering personnel. It is also based on the process flow system which follows, in which cycle times between various stages of processing through the facility and areas involved are specified. Refer to the Process (P series) drawings in **Part IV - Conceptual Drawings** for a depiction of the material-handling steps. A diagram of the material-handling flow is presented in Figures 1, 2, and 3, which follow. A detailed process flow model is included in **Part III - Supplemental Information**.

NMSF Project

Material Handling Flow Diagram

Movement of Material from Truck Loading to NDA Laboratory

FIGURE 1

NMSF Project Material Handling Flow Diagram

Transfer Through NDA Laboratory

FIGURE 2

NMSF Project

Material Handling Flow Diagram

Transfer from NDA Laboratory or PF-4 to NMSF Storage Array

FIGURE 3

This material flow assumes that an incoming SST will be unloaded as the first step, since material arriving by SST will require the most effort to unload. Material arriving from PF-4 will not require as many steps.

1.14.2 System Design Description

Unloading Dock Area

Material coming from outside of TA-55 is packaged in cylindrical containers similar to 55-gal. steel drums. Each drum is secured on a pallet in groups of up to four. The weight of this palletized load dictates the use of a powered rolling device. Obstacles such as uneven trailer flooring, gaps between trailer and dock, and doorway thresholds prevent safe, manual operation by a single operator of an unpowered cart.

The pallets need to be moved from the loading dock through the airlock. The pallets to be unpacked first are taken into the adjacent temporary staging area, while those that can be unpacked later are moved by the elevator to the intermediate storage area in the basement.

The unloading equipment must perform limited stacking operations to conserve operations space in the dock area; it will also be required to perform similar functions in the temporary staging area, where the pallets will be queued for further processing. The selected equipment, known as a Walkie Straddle Stacker (WSS), has a 4000-lb load capacity and an 8-ft lifting mast. Operation is similar to that of an ordinary hand pallet-jack: a handle is steered in the desired direction of travel, and the operator walks along with the load. It is powered by a rechargeable electric battery capable of operating for an 8-hour shift.

The current design for the NMSF features a drive-through garage/dock area. The SST will enter through the west door and drive straight into the facility, crossing over a lowered, pit-mounted, variable-height loading dock. The truck will stop with the back of the truck in line with the edge of the lift. This kind of lift equipment can accommodate various truck bed heights, but all SSTs should have similar bed heights. The dock height must be designed to match the truck bed height so that the operator will not have to continually adjust the dock height. The dock dimensions are approximately 10 ft deep by 16 ft long, with a 6-ft raise/lower range. Standard lift units are available in this size range with a lift capacity of up to 20,000 lb.

Airlock

This area enables the introduction of shipments without upsetting the building pressure. Doors will be physically interlocked, and procedures will be required to prevent a "two door open" condition. Materials will be temporarily stored in this area while the SST is unloaded.

When a truck arrives, the RCT, dressed in precautionary clothing, will enter the airlock, open the door to the garage, and make sure that the other airlock door is closed. Security police officers will then supervise the opening of the vault door. The RCT will monitor the truck for contamination. NMT personnel will load drums into the airlock. After the airlock is filled or the truck is unloaded, the airlock doors and vault doors to the garage will shut. Personnel from inside the facility will then enter the airlock and move the material either to temporary staging or to intermediate storage.

Portal radiation monitoring for personnel access control will be required. Material-handling equipment will routinely cross the tertiary confinement threshold; access will be administratively controlled.

No material-handling activities other than those stated will be permitted in this area.

Temporary Staging Area

This staging area is intended for the short-term storage (less than a work shift) of palletized shipping containers and the breaking of pallets into individual container loads. This area will also serve as a queue for numerous manually operated four-wheel carts to transport individual storage containers.

The area is configured as an open-storage room, with marked locations for material-handling equipment and personnel. A dedicated area is reserved for a 1-ton jib crane/hoist and various drum-lifting tools, and room will be provided for pallet making and breaking tools. Empty, clean shipping containers and pallets will be moved to the garage as soon as possible through the airlock. If containers are contaminated, they will be decontaminated. A detailed procedure will be developed at the Title Design phase. This area is served by the loading dock WSS, which will be used for storage and retrieval of the pallets.

Additionally, this staging area can also function as a receiving point for materials to be transferred to PF-4. Unopened shipping containers may be separated from pallets and transported directly to PF-4 via the elevator and tunnel. (This is expected to occur infrequently.)

CRT Staging Area

The CRT staging area will store unopened shipping containers that could not be unpacked in the course of a normal work shift. Storage times will be limited to no more than 2 days. The room will be vault-type with alarmed doors.

Pack/Unpack Area

The pack/unpack area will be used to remove the SNM containers from the shipping containers for vault storage. It is located adjacent to the CRT staging area. The room layout will be a dedicated assembly-line arrangement consisting of an overhead hoist, an enclosed area for remote handling of the SNM containers into shielded carts, and a HEPA-filtered return-air space for uncapping the drum. The enclosed shielded area will be configured as a hooded space with a remote manipulator station and a closed-circuit TV monitor system.

The transport cart with the individual shipping container will be manually wheeled into the opening area. The drum lid will be removed next to the HEPA-filtered slot hood, and the hoist with a lifting tool lowered into the open drum. The tool will be fastened to the inner storage container, which will be lifted from the shipping drum. The product/boundary containers will then be removed from the inner vessel and placed in a shielded cart for transport to the NDA laboratory.

This area may serve as a branch in the material flow stream. Materials needing to be assayed will be transported by an operator to the NDA laboratory or to PF-4 via the elevator and tunnel.

Intermediate Storage Area/Miscellaneous

The intermediate storage area will be for storage of palletized or single drums for periods of up to 30 days. It will be a vault room into which shipping containers will be brought on dollies from the airlock via

the elevator. Shipping containers will be retrieved and taken to the CRT staging area as they need to be unpacked and the contents placed in storage.

Charge Hall and Storage Array

The storage array is intended for long-term placement of SNM in drywells of 18-in. diameter steel. The storage array will be cooled with natural draft convection. The drywells will be supported from above and welded to a composite steel-and-concrete charge deck, and the drywells will hang in the air stream below. The charge deck and the drywells will maintain the pressure boundary between the charge hall (which is HEPA-filtered) and the array (which is exposed to unfiltered air).

The charge hall will be physically separated from the operations area of the building by a concrete wall, while the array will be separated by a wall and baffles. All material-handling operations will take place in the charge hall.

The product/boundary storage containers will be placed in baskets (with up to seven containers per basket) and up to two baskets inserted into a drywell. The baskets will have hooks onto which the grapple on the container handling machine can fasten. The container handling machine is essentially a shielding bell with an automated grapple, capable of vertical insertion and extraction of baskets. The container handling machine will be moved about the charge hall by a bridge crane; the machine will also be provided with features that enable operations via a pendant control switch.

Basket Loading Area

In a vault area adjacent to the NDA laboratory, the containers will be loaded vertically into baskets in the basket loading area. Containers will be transferred from NDA Storage Array #2, or directly from PF-4. A hoist in the ceiling will then lower the basket into a permanent transfer cask that is hydraulically moved by a piston or other mechanism between the operations area and the storage vault, all within an airlock. Movement of the product/boundary containers within this area will occur within the airlock. A steel plate shroud will be welded to the underside of the charge deck and fastened and sealed to the floor. The area bounded by the shroud and the walls of the airlock will be subjected to the confinement ventilation system, and will be entirely within the tertiary confinement boundary of the building. Upsets within this area will not cause a release to the environment.

The container handling machine, with shield valve, will then retrieve the basket from the cask, move to the desired location, and place the basket in the drywell. The machine will be securely fastened to the deck during insertion and retrieval operations. The opposite process will be used to remove material from the storage array. In case of mechanical failure, the device can be operated with manual movement and control. Loss of power will not cause load drop or loss of control.

A summary, with approximate times, is included in Tables 1, 2, and 3, which follow. The times in Tables 1 and 2 are based on the assumption that the charge hall will be occupied. However, if the charge hall were not occupied, significant material-handling time reductions could be achieved (see Table 3). The crane and container handling machine could be operated remotely, and human occupancy during the insertion/extraction operation would not be necessary. Additionally, shield valves and shielded plug pullers would not be needed, significantly reducing the cost. The cost of those items is included to be conservative and maintain maximum flexibility.

1.14.3 Nondestructive Assay Area

The NDA laboratory area will be used for the measurement and safety examination of materials received from or shipped offsite in support of MC&A activities related to the NMSF. The NDA laboratory will perform accountability and confirmatory measurements on all containers received from off-site sources before they are transferred to the NMSF storage vault. Additionally, all containers removed from the NMSF storage vault will be reexamined to support MC&A plans or off-site shipment.

This area will contain the most complicated operation in the facility, and require a high degree of automation to meet ALARA requirements and maintain worker safety. For a description of the steps involved in this process, see the P series drawings in **Part IV - Conceptual Drawings**.

Operation

The NDA laboratory will be configured as a vault-type room, with bar-code data collection at the process entrance and exit to support MC&A requirements. Containers to be examined will be transferred to the NDA laboratory on shielded carts. The bar-code identification labels will be scanned into the FMS and transmitted to the MASS system, and the containers will be placed into the In-process Storage Array 1. Based on container priority, the NDA laboratory container transfer system will select the container and route it through the required examination stations. On completion of all required examinations, the storage container will be placed in the In-process Storage Array 2 for disposition.

NDA Examination Services

Equipment to conduct various examinations of the physical container and the encapsulated material will be provided in this laboratory. Containers may require a visual safety inspection, a helium leak test, or x-ray imaging. Movement and placing of the SNM will be accomplished through the use of automated handling systems as much as practical. The examination of encapsulated materials will require the following specialized equipment:

Quantity	Equipment
3	Calorimeters
1	Shuffler
1	Neutron Multiplicity Counter
2	Gamma Isotopic Systems
1	X-ray Imaging System
1	Helium Lean Testing Apparatus

TABLE 1

ESTIMATED THROUGHPUT TIMES FOR LOADING AND UNLOADING ARRAY
 MANUAL OPERATIONS

SCENARIO NO. 1: Insert basket in drywell

A. Machine already over cask in charge hall

B. Shield valve #1 in position over cask, plug already removed

C. Shield valve #2 in position over drywell, plug already removed

ITEM NO.	ACTIVITY	EST. TIMES (MINUTES)*
1	Put containers in baskets	10.0
2	Lower baskets into tube transfer cask	1.0
3	Unhook hoist from basket	0.5
4	Close hatch door	0.5
5	Cask moved into array	1.0
6	Verify cask has been moved	1.0
7	Open valve on bottom of machine	2.0
8	Open shield valve	2.0
9	Extract basket from cask	5.0
10	Close shield valve	2.0
11	Close valve on bottom of machine	2.0
12	Remove restraints from machine at deck	15.0
13	Move machine down hall to drywell	15.0
14	Position machine over drywell	10.0
15	Secure machine to deck	15.0
16	Open shield valve already over drywell	2.0
17	Open valve at bottom of machine	2.0
18	Insert basket into drywell	5.0
19	Close shield valve	5.0
20	Close valve at bottom of machine	2.0
21	Uncouple machine from deck	15.0
22	Move machine away to laydown area	15.0
	TOTAL	125.0

*See assumptions on Table 2.

TABLE 2

ESTIMATED THROUGHPUT TIMES FOR LOADING AND UNLOADING ARRAY
 MANUAL OPERATIONS

SCENARIO NO. 2: Position shield valve and remove plug
 A. Container handling machine over drywell to accept basket
 B. Assume one shield valve over cask permanently

ITEM NO.	ACTIVITY	EST. TIMES (MINUTES)*
1	Uncouple container handling machine from crane	15.0
2	Move crane trolley to plug puller	10.0
3	Rig/hook plug puller	1.0
4	Move plug puller to valve	3.0
5	Attach plug puller to shield valve	5.0
6	Rig/hook valve and plug puller	1.0
7	Lift and move plug puller/valve to drywell	10.0
8	Position assembly over drywell	10.0
9	Secure assembly to deck	10.0
10	Disconnect assembly from crane	1.0
11	Pull plug	5.0
12	Close shield valve	2.0
13	Rig/hook plug puller to crane	1.0
14	Move plug puller away to laydown area	10.0
15	Release plug puller	1.0
16	Move crane to container handling machine	10.0
17	Connect crane to machine	15.0
	TOTAL	110.0

*See assumptions below

ASSUMPTIONS

1. Two plug pullers and two shield valves will be provided.
2. One crane will be provided - 20 tons minimum capacity.
3. Times are based on Fort St. Vrain SAR, but have been speeded up somewhat because the items being moved are not as heavy.
4. Two-man crew assumed. Two cranes may be needed for simultaneous operations.
5. Reverse process to unload array.

TABLE 3
 ESTIMATED THROUGHPUT TIMES FOR LOADING AND UNLOADING ARRAY
 REMOTE OPERATIONS

Assume that the container handling machine is in the vicinity of the cask for starting position.

ITEM NO.	ACTIVITY	EST. TIMES (MINUTES)
1	Put containers in baskets in NDA laboratory	10.0
2	Lower baskets into transfer cask	1.0
3	Unhook hoist from basket	0.5
4	Close hatch door	0.5
5	Cask moves into array	1.0
6	Verify cask has been moved	1.0
7	Move bridge crane/machine over cask	2.0
8	Remove shield plug w/aux. hook	2.0
9	Move machine over cask	1.0
10	Fasten to deck/plugs (automatically)	1.0
11	Open valve on bottom of machine	1.0
12	Extract basket	5.0
13	Close valve on bottom of machine	1.0
14	Unfasten machine from deck (automatically)	1.0
15	Move machine away from cask	1.0
16	Replace plug w/aux hook on crane	2.0
17	Move bridge crane/machine to drywell	10.0
18	Remove shield plug w/aux. hook	1.0
19	Move machine over drywell	2.0
20	Fasten to deck/plugs (automatically)	1.0
21	Open valve on bottom of machine	1.0
22	Insert basket	5.0
23	Close valve on bottom of machine	1.0
24	Unfasten machine from deck (automatically)	1.0
25	Move machine away from drywell	1.0
26	Replace plug w/aux. hook on crane	2.0
27	Move bridge crane/machine away	10.0
	TOTAL	66.0

NDA Laboratory Service Requirements

Building Services. For the examination equipment to perform reliably, the following building services are required:

- UPS electrical power
- Deionized water
- Liquid nitrogen
- Computer-isolated transformers (conditioned power)

Background Radiation Exposure. The background radiation in the NDA laboratory shall not be more than 0.25 mrem/hr for personnel. This is required for accurate NDA instrument operation and to allow personnel to service the instruments in accordance with ALARA goals.

Robotic Handling. The routing of material containers for examination will require multiple instrument analysis. Robotics will be used to move material containers within the NDA laboratory. This approach addresses the following operational issues:

Radiation Exposure:	Prior to the introduction of robotics, NDA measurement personnel's radiation exposures were among the highest at LANL. The exposures resulted from manually placing containers into NDA assay equipment for each examination step in the laboratory.
Throughput:	Calorimeters require the longest container residence time of any instrument in the NDA laboratory. Sequencing container movement through this equipment throughout the day and night allows the equipment to be fully used. This will support higher performance and response for information collection.
Safeguards:	Robotic handling of containers will support MC&A programs to reduce personnel contact with SNM, reducing the risk of diversion and operator error.
Criticality:	Robotic handling will improve criticality safety because the potential for operator error is reduced.
Quality Assurance:	During isotopic counting, the exact sample-to-detector geometry may be precisely duplicated, minimizing measurement errors. Additionally, data is collected automatically from the examination by the NDA data collection system, reducing operator data-entry errors.

1.15 Criticality Analysis

Several criticality safety evaluations were performed for different forms of fissile material that might be stored in the two different types of containers proposed for the NMSF. Plutonium, as oxide and metal (pieces and compact ingots), was evaluated to provide criticality safety guidance that considered a worst-case loading scenario, minimized administrative controls, and maximized the use of engineered controls. These evaluations did not consider other possible facility constraints such as heat loading or mass loading.

Preliminary evaluations indicate that the NMSF may hold the following with substantial criticality safety margins:

- Up to 4,500 g of plutonium oxide per container
- Up to 4,500 g of plutonium metal as broken pieces (equivalent density of 9.93 g/cc)
- Up to 4,500 g of plutonium metal as "rings" per container
- One complete pit of unspecified type per AT400 containment vessel.

Plutonium as metal ingots may be stored in the array; however, only one ingot container may be stored in each drywell (i.e., one ingot container for every 14 containers in a drywell).

For a more detailed explanation, see **Part III - Supplemental Information**.

In the initial stages of CDR development, criticality affected the array configuration significantly. Further analysis demonstrated that the minimum features provided (24-in. spacing, two separate walls) yield a moderate benefit; however, administrative controls on placement and type of materials stored will be required. The analysis will be refined during detailed design as facility and storage configuration details become final.

1.16 Nuclear Material Control and Accountability

1.16.1 System Function and Basis

LANL's physical inventory of nuclear materials is implemented on a graded safeguards basis, consistent with DOE Order 5633.3B and the LANL MC&A Plan. Physical inventories provide a high level of assurance that the actual nuclear inventory contained in the MASS inventory record system is accurate. The NMSF will be equipped with both in-process and long-term storage inventory control systems for SNM surveillance.

1.16.2 System Description

Nuclear material containers will be visually inspected by operations personnel, and a permanent bar-code label will be affixed to the container as it enters the NMSF MAA. The bar-code tracking system will be used to log container movement within the facility. Each vault and vault-type storage area will contain a bar-code reader at material entrance and exit to document the location of the nuclear material.

Once a nuclear material container has completed any in-process examination and inspection, it will be placed in a basket for transfer into the NMSF storage array. The basket will provide a physical boundary with tamper indication capability. The basket will be transferred to the storage array and inserted into a drywell. The drywell will have a monitored shield plug, which will be capable of tamper or access detection.

1.16.3 Physical Inventory

Inspection of the physical inventory will be accomplished in two phases. The first phase will use a bar-code scan, physical attribute measurements, and digital photo inspection of the container inside the basket when the basket is removed from the drywell. This Phase 1 inspection is designed to occur within the storage area, inside the container handling machine. If all information is accurate, the unopened basket is reinserted into the drywell, and the monitored shield plug is reinstalled. During final design,

equipment for continuous monitoring of physical attributes of storage containers will be selected to reduce inventory frequency.

Phase 2 inspection requires that the basket with its material containers be returned to the NDA laboratory for detailed physical inspection of material attributes, bar-code labeling, and container integrity.

The frequency of container inspection will be established to provide adequate MC&A confidence for this NMSF storage array. Statistical calculation of container storage location sampling frequency will be finalized during final design. Based on hypergeometric sampling requirements and current MC&A procedures at other DOE facilities, sampling frequency can be estimated to occur at between 135 and 2000 storage locations per year. The Phase 1 inspection process will cost-effectively collect data on all storage containers within the retrieved basket; this may result in reduced Phase 2 sampling efforts.

1.17 Radiation Shielding and Radiological Protection

1.17.1 Design Function

The primary radiological design goal for the NMSF is to keep radiation exposure to ALARA levels. To meet this goal, the NMSF will be designed to limit worker exposure to less than 500 mrem per year. During normal operations, no internal exposure hazards will exist; therefore, design calculations will consider only external exposures. Other concerns that will affect radiological engineering design are security, MC&A, heat removal, and criticality. Various activities that will occur in the facility, such as NDA, shipping and receiving, and MC&A, also affect dose and are, therefore, part of the radiological design.

Because of the preliminary nature of the conceptual design, the analyses presented here are intended only to provide an estimate of the shielding requirements to be included in the project design cost estimate. More detailed calculations will be performed at a later date for use in Title I and II designs. An optimization analysis, per the requirements of 10 CFR 835, will be completed at Title I to determine the best combination of shielding configuration and materials.

1.17.2 System Design Basis

The following codes were used to evaluate shielding requirements:

- ONEDANT Discrete-Ordinates Computer Code. This code was used to calculate the dose rate contributions from the neutron and the neutron-induced photons (n, γ) by using a simplified, infinite-slab model. This approach allowed timely examination of the relative merits of multiple shielding materials.

The neutron cross-section used in this model was a 42 energy-group set of coupled neutron-(n, γ) cross-sections (30 neutron groups and 12 photon groups) generated by the LANL Radiation Transport Group.

- MicroShield Computer Code. This code was used to calculate the dose rate contribution of photons originating in plutonium isotopes and ^{241}Am (intrinsic gamma radiation) by using a simplified, infinite-slab model.

1.17.3 Modeling Assumptions

- For conceptual design purposes, the dose received by a worker is assumed to emanate from the storage array, since the storage array has the greatest source term.
- To establish dose rate criteria to meet ALARA goals for shielding design, it is necessary to know the occupancy factor for various locations throughout the facility. For the conceptual design phase, and to maintain flexibility for the operation of the facility, the shielding requirements were based on continuous occupancy (2000 hours per year) and 10% occupancy (200 hours per year).
- The material stored in the vault is assumed to be weapon-grade plutonium. An isotopic mix representative of weapon-grade plutonium with maximum ^{241}Am content was used.
- The neutron source term includes spontaneous fission, induced fission, and neutrons produced from (α, n) reactions at plutonium-beryllium interfaces. A representative area for the Pu-Be interface is assumed for each 4.5 kg of stored material. Although not all stored items will have a Pu-Be interface, the dose contribution from this interface is roughly equivalent to that from (α, n) reactions in PuO_2 .
- The gamma source term includes the gamma photons accompanying the alpha and beta decay of the fissile material (intrinsic gamma photons) and the induced gamma photons from the (n, γ) reactions. Depending on the shielding material, the (n, γ) component is a significant dose contributor outside the shield.
- The intrinsic gamma photons from the radioactive decay of Pu and ^{241}Am were determined to be a negligible contributor to the dose outside the shield. The amount of shielding for the intrinsic gamma radiation is much less than that required for neutrons and (n, γ) photons.
- The neutron and gamma fluence-to-dose Frontal (AP) exposure geometry conversion factors from ANSI/ANS-6.1.1-1991 were used in the calculations.
- The charge-deck shielding calculations assumed a homogenous Pu matrix with a vertical storage density based on a stack of items 14 units high, with 4.5 kg of Pu per unit.
- The storage array east-wall calculations assumed a homogenous Pu matrix with a horizontal storage density based on a stack of items 9 units deep, with 4.5 kg of Pu per unit.

1.17.4 System Design Description

Using infinite-slab models, the ONEDANT code was used to determine the shielding necessary to attenuate neutrons and (n, γ) photons. The calculations were performed to estimate the shielding requirements for the charge deck and the east wall of the storage array.

Neutrons from induced fission were included in all neutron plus (n, γ) dose calculations by adjusting model parameters to maintain a constant neutron multiplication factor, k_{eff} . To be consistent but conservative with respect to the calculations conducted by criticality safety (Table 2, ESH-6-95-35), a value of 0.8 was used for k_{eff} .

Each dose determination consisted of two parts:

- A calculation adjusting a model parameter to achieve $k_{\text{eff}} = 0.8$
- A set of dose calculations in which the shield thickness is adjusted until the desired dose rate is achieved

The results of the ONEDANT and MicroShield calculations are provided in **Part III - Supplemental Information**.

1.17.5 System Specification Data

The radiation-shielding material in the charge deck and the east wall of the storage array will be concrete. Where there is adequate space for its placement, concrete is nearly always the least expensive shielding material; it provides moderate attenuation of both neutrons and photons. Most of the neutron attenuation is provided by the water in hydration with the cement, and most of the photon attenuation is provided by the intermediate atomic-weight constituents.

Based on the analyses using the models in Section 1.17.3, the thickness of concrete in the charge deck and east wall of the storage array is estimated to be from 2 to 3 ft. The final design thickness will depend on the following factors:

- The quantity of cement in the concrete
- Whether boron frit is added to the concrete
- The time anticipated to be spent by workers on the charge deck and outside the east wall of the storage array
- The storage density of Pu in the vault

These factors will be resolved during the Title I and II designs. Additionally, enough contingency has been written into the estimate to account for any changes.

Greater cement content and boron addition reduces the thickness of the concrete to achieve a particular dose level. Greater cement content increases the water of hydration and therefore neutron attenuation. Boron reduces both neutron and (n,γ) dose contributions because of its greater neutron capture and lower-energy photons from capture.

The choice of cement content and whether to add boron frit will be based largely on the following factors:

- The cost of increasing cement content
- The cost of boron addition
- Evaluation of the possible structural degradation of concrete from boron addition
- Satisfaction of compressive strength requirements for concrete with increased cement content
- The availability of space for shielding
- The extent of criticality safety benefit from boron addition

Neither increasing cement content nor adding boron frit is expected to significantly increase the cost of constructing the storage-array shields.

Using a much higher cement-content concrete in the charge deck than in the east wall of the storage array may be possible. Since the concrete in the charge deck will be supported by a steel plate, it will not provide structural support.

Special curing procedures and quality control will be necessary to ensure proper curing of the concrete shields. These procedures are necessary for uniform curing and to maximize cement hydration. Moist curing will likely be necessary for longer than is standard practice for ordinary concrete construction. Techniques will have to be devised to increase the probability of maintaining moisture control during curing.

The radiation shields around temporary storage and holding areas in the NMSF (NDA lab, Temporary SNM Storage, etc.) will also be concrete. Because of the comparatively small amount of nuclear material in these areas, concrete with normal construction cement content will most likely suffice. The estimated thickness of these concrete shields will be ~ 1 ft.

1.18 Special Facilities Equipment

1.18.1 System Design Description

Specialized equipment is required to make the dry storage concept practical. The major components are the charge deck, drywells, shield plugs, baskets, container handling machine, shield valves, plug pullers, and bridge crane. Equipment similar to that described is already in service in a number of locations, thereby illustrating its practicality and functionality. Discussions with the operators and designers of the Fort St. Vrain Modular Vault Dry Storage Facility (Colorado) indicated that the necessary technology and capabilities exist, are feasible, and have been successfully used for many years.

The dry storage concept and equipment are dependent upon the type of containers expected to be stored. The storage array will provide secure monitored storage of approximately 6,600 kg of actinides in two types of storage containers: the metal and oxide container and the inner capsule of the AT400A. These containers are discussed more thoroughly in the **Functional and Operational Requirements Document** (June 1995). The metal and oxide container is a stainless steel right-circular can containing another stainless steel right-circular can. The AT400A capsule (the inner vessel) is cylindrical with

hemispherical ends, similar to a propane can. Sketches of the storage container and the special facilities equipment (SFE) discussed can be found in **Part IV - Conceptual Drawings**.

1.18.2 System Design Basis, Description, and Specification Data

The system components and functions are described below.

Drywells

The storage array will consist of 507 drywells. The drywells will be attached to and supported by the charge deck. The drywells provide the outermost level of physical protection to the containers within the baskets, provide part of the facility's tertiary confinement boundary, provide criticality control spacing, and provide a heat rejection surface to cool the stored nuclear materials. The drywells can be monitored for leaks from the containers. The drywells will be about 17 ft long, with almost 14 ft available for storage in the cooling airstream. They are specified as 18-in.-diameter pipes, which provide some flexibility should the container sizes change slightly. The current metal/oxide containers will be no larger than 14 in. tall by 5 in. diameter, and the AT400A capsule is no larger than 19 in. tall by 14 in. diameter.

The product/boundary containers will be stored in two 7-container assemblies within baskets in the drywells. The baskets will maintain the product/boundary containers in a subcritical geometry. These baskets will provide limited physical protection as well as a practical means of inserting and extracting multiple containers simultaneously.

A guide assembly will be attached to the bottom of each drywell to permit only vertical movement from thermal and structural deflections. All connections will be welded in accordance with AWS D1.1. The drywells will be designed to meet the Special Facilities section of DOE Order 6430.1A. They will be seal-welded to the charge deck to create a pressure boundary between the charge hall and the array. Based on experience in similar facilities, carbon steel tubes with a flame-sprayed, corrosion-resistant aluminized coating will be used. The drywells should also be subject to applicable ASME NQA-1 Standards to ensure pressure boundary.

A concrete, gasketed shield plug placed over each drywell will provide another barrier for security and MC&A needs.

Baskets

The baskets will serve the following functions:

- Ensure that subcritical geometry is maintained between the containers while in the drywell.
- Act as a shock absorber for the containers if they are dropped or are involved in an off-normal occurrence.
- Ease material-handling operations for inserting and extracting containers from the drywell.

These frame assemblies will be fabricated from ASTM A36 low-carbon steel bar and plate with welded connections made in accordance with AWS D1.1 and D1.4 standards. The shell of the basket will be a 9-gauge carbon-steel expanded metal mesh. Each basket will be designed to hold up to seven containers. Different-size baskets will be needed to accommodate the two types of containers, but the baskets should be similar in design and cost.

The design of the storage basket was selected to comply with preliminary criticality, thermal, material-handling, and MC&A requirements. The baskets will maintain container location and spacing during all postulated accident scenarios. The open web of the expanded metal mesh facilitates the thermal cooling and visual inspection of the stored containers, as well as providing structural ductility to absorb strain energy from accident scenario loadings.

Charge Deck

The deck will:

- Provide part of the tertiary confinement boundary
- Serve as a platform from which to access the container/basket assemblies
- Provide lateral and vertical support for the drywells
- Provide drywell spacing for criticality control
- Shield the charge hall and workers who might occupy the charge deck surface from the storage array and possible radioactive emissions
- Replace the first-floor slab in providing stability and stiffness for the building

The drywells will be spaced north-south on 2-ft centers on a square pitch and welded to the deck. The deck will be fabricated from ASTM A36 low-carbon steel, 1-in.-thick plate, top and bottom, with 18-in. holes punched to accept the drywells. Steel webs, 1 in. thick, will be spaced at 24 in. on center (o.c.) and staggered to avoid the drywells. The deck will be fabricated in approximately 8-ft by 28-ft sections to facilitate fabrication and shipping. The section cavities will be filled with concrete in the shop to ease field construction. The deck sections will be erected in the field with the bridge crane; joints will be field-welded using a semiautomatic process.

Great care and precision will be required to set, level, and adjust the sections before the drywells are installed. Anchor and levelling bolts cast into the thickened basement wall will tie the deck to the structure. After levelling and adjustment, the deck will be grouted or drypacked into place.

All deck connections will be welded per AWS D1.1-90. The deck will be designed to meet DOE Order 6430.1A, Special Facilities Section. The deck materials should also be subject to ASME NQA-1 standards. The deck must be designed for minimal deflection because of the close tolerances needed to maintain drywell spacing and to prevent the baskets from binding during insertion and extraction.

Shield Plugs

The shield plugs will prevent radiation streaming in the storage array from entering the charge hall and also provide a substantial barrier to unauthorized drywell access by their size and weight (approximately 800 lb). They will also serve as support for the container handling machine during operations. The shield

plugs are made from 5000 psi concrete. They are designed to fit into the drywell and have a lip, which rests on a flange welded to the charge deck. The plugs will be gasketed.

The plugs will be provided with a threaded insert and a lifting lug or hook. The plugs will be designed to resist the vertical and horizontal load imposed by the container handling machine.

The plugs will be provided with a monitoring port that can be used to determine if any trace gas has escaped from the containers into the drywell. The drywells should be monitored with this device before plug removal.

Shield Valves

The shield valves will enable removal and replacement of the shield plug and access to the drywell while the charge hall is occupied. They will provide radiation shielding between the drywell contents and the charge hall and prevent streaming from the storage array.

The shield valves will be equipped with a gate on the bottom through which the shield plug can be pulled. The shield valve will be fastened to the deck/plugs to ensure a snug fit and eliminate lateral and vertical movements. The shield valve does not have to be airtight, since the charge hall is HEPA-filtered. The container handling machine will also be fastened to the shield valve. The valves will be moved by the bridge crane and be manually operated.

The shield valves will be fabricated from various grades of steel and components, according to ASME NQA-1 and other applicable standards.

Two shield valves will be required so that simultaneous operations can occur at the drywells and the transfer airlock.

Plug Puller

The plug puller is designed to remove the shield plug from the charge deck using a shield valve and a crane. The device will be fastened on top of the shield valve. With the valve open, a grapple or rod will allow connection to the plug. The crane hoist will raise the plug through the valve. The plug puller will be fabricated from various grades of steel and components, according to ASME NQA-1 and B30, and other applicable standards.

Two devices will be required so that simultaneous operations can occur at the drywells and the transfer airlock.

Bridge Crane

A remotely operated, 20-ton, electrically powered bridge crane will be provided in the charge hall. It will move the container handling machine, shield valves, and plug puller. It will have the capability to be operated by a pendant control switch. The crane will be indexed, with an electronic grid for precise positioning. Lock-down features will also be provided to prevent drift.

Container Handling Machine

The container handling machine is the means by which baskets and containers may be retrieved from the drywells. The machine will raise and lower a single basket into place at a time. It will provide

shielding as well as an approved means of being fastened to the charge deck and shield valve to prevent overturning while the drywell is open. The machine will be provided with outriggers to prevent overturning when it is not fastened to the charge deck. It also will have an integral shield valve. It will be moved and supported from above with a bridge crane. If an automated system mode is selected, the machine will not have to be fastened to the charge deck or the shield valve.

The grapple mechanism provides a highly reliable means by which to lift and lower the baskets. The grapple and mechanism are single-fault-proof, so the failure of any component will not result in dropping an item.

The grapple will be raised and lowered by a leadscrew/nut through two duplex chains. The chains are connected at one end to the top of the grapple and at the other end to an equalizing beam mounted on the top of the machine. Each chain will run over a sprocket mounted on a trunnion block and over two more sprockets mounted on top of the machine body.

Machine Controls

The container handling machine will be controlled either from a pendant, from a panel-mount on the base of the machine, or remotely by a terminal inside the operations area. The control panel will contain all the necessary contactors and relays. Control push buttons, displays, and warning lights will be mounted on the control panel. The remote terminal will pick up signals from the control panel via an umbilical cord. The machine will be as automated as possible, but ability to perform operations manually with cranks will be provided in case of problems or electromechanical failure.

Interlocks will be required between the shield valves, the container handling machine, and the bridge crane so that

- the machine may not be lifted if it is attached to a shield valve;
- the shield valve must be fully opened before the grapple is lowered;
- the shield valve must be closed before the machine is moved;
- the machine hoist cannot lower if the hoist weight sensor indicates that the winch load is less than the grapple weight; and
- the crane will not be able to be moved before the machine completes its operations.

If the crane were to fail while lifting the machine above the charge deck, the drop height is limited, minimizing the risk of structural damage.

Special Features

The container handling machine will be fitted with monitoring and assay devices, including closed-circuit television, digital video capture, bar-code readers, and scales or other devices that can capture basket and container attributes. These features will make operations efficient. Power to the machine will be supplied via festooning.

1.19 Critical Systems Analysis

1.19.1 System Function

Based on a review of the original CDR, a summary Critical Systems Analysis (CSA) has been performed for the NMSF to make a preliminary determination of which SSC are safety class. A detailed and documented CSA will be performed as the design concepts become fixed. SSCs were assigned an importance level based on the adverse consequences of their failure.

1.19.2 System Design Basis

As stated in the initial CDR, CSA is a qualitative risk assessment process that uses a technique of failure modes, effects, and criticality analysis to determine the importance of an SSC. The first step is the identification of the worst-case initiating event. Next, all failures caused directly by the initiating event are assumed to occur. Finally, a single active failure is assumed for the SSC being analyzed.

The consequences of this single active failure are evaluated in terms of five hazard categories (radiological damage, toxicological damage, industrial safety, environmental damage, and property loss) and three programmatic risk categories (facility cost-effectiveness, reputation, and availability). For each category, a grade of 1 to 4 is assigned, which is based on the severity of the failure consequences (i.e., 1 represents the most severe consequences and 4 represents the least severe). The SSC is graded according to the category having the lowest grade.

CSA also uses DOE Order 6430.1A criteria to determine which SSCs are safety-class. Safety-class determination is based on SSC function and not related to probability of failure. For example, no credible failure modes have yet been identified for the storage array, so this system is graded 4 because there can be no adverse consequences if no credible failure can be postulated. However, the function of the storage array is to maintain the nuclear material in a safe configuration (passive safe shutdown); therefore, this system is safety-class.

1.19.3 System Description

The Quality Assurance section (Section F) summarizes the systems and their respective safety significance.

Safe shutdown for this facility has been defined as a passive mode which does not require electrical power. Therefore, the active function of the MAA HVAC system is not safety-class. Only the HEPA filters, filter housings, and ductwork from the housings to the MAA boundary are safety-class because these components support the secondary confinement function. The storage array normally operates in a passive mode, so loss of electrical power will not cause loss of its functionality. The material-handling equipment will be designed in a fail-safe manner so that loss of power will not cause items to drop. The grapples will have a default position that locks onto the lifting lugs and hooks.

As stated previously, a detailed CSA will be performed as the document and PHA are further defined.

2. ENERGY CONSERVATION ANALYSIS

This project will include energy conservation design features that can be economically justified. Principal considerations will be climatic conditions, thermostat settings, building envelopes, and mechanical systems design and operation. Other energy conservation items to be included are the use of winter and summer temperature control setbacks and energy-saving lighting and controls. Energy conservation design features will be reevaluated, and an Energy Conservation Report will be completed during the design phase (or Title I design, depending on procurement decisions) or the detailed design, in accordance with DOE Order 6430.1A.

Active solar energy systems have been evaluated and found not to be cost-effective. A life-cycle cost analysis is included in **Part III - Supplemental Information, "Renewable Energy Systems Analysis."**

To meet the goals of the LANL Energy Management Plan, a source-energy budget target of 415,000 Btu/ft²/yr for laboratory space, 115,000 Btu/ft²/yr for office space, and 80,000 Btu/ft²/yr for storage areas will not be exceeded.

Comparative Analysis Methods

As part of the original CDR, the Trace 600 energy analysis program was used to simulate the base case and alternatives for this project. The National Institute of Standards and Technology (NIST) BLCC analysis program was used to calculate payback on investment. The costs for utilities were obtained from LANL. The cost for electricity is \$ 0.07 per Kwh. The cost for natural gas is \$0.366 per therm. The cost for water is \$6.40/1000 gal.

LCC analysis was used to compare the total life-cycle value of the described alternatives with the base case. The LCC analysis included initial costs, annual maintenance costs, and annual operation costs. Furthermore, the present value of future benefits has been calculated for the defined base case and alternatives.

Study life:	20 years
Inflation rates:	Federal projects are required to be performed in current dollars
Discount rate:	4%
Energy escalation:	The latest escalation rates are built into the BLCC program

Base Case Building Features

"U" values:	walls:	0.0608
	roof:	0.0337

Percent of gross wall area occupied by fenestration is 2.2%. Glass is double pane treated with a "U" factor of 0.65 and a shading coefficient of 0.80.

The HVAC systems are comprised of a constant-air volume fan with an air-cooled chiller and hot-water terminal heat for zone temperature control. The pneumatic control system uses a DDC interface for reset and monitoring. A pneumatic system was selected because of the potential of high-temperature operation within the MAA. The HVAC system for the MAA uses HEPA filtration for safety and has automatic shutdown features in case of a radiation detection.

The potable water is heated using a gas-fired water heater. The hot potable water is recirculated through the heat exchanger and maintained at 140°F.

Energy Conservation Features

Selection of the proposed HVAC system was based on a comparative analysis of life-cycle costs, which indicated the most cost-effective system to be the constant-air volume fan with air-cooled chiller and hot-water terminal heat. The comparison is as follows:

- Constant-air volume fan with air-cooled chiller and hot-water terminal heat, life-cycle cost: \$1,326,124.
- Constant-air volume fan with air-cooled chiller and electric terminal heat, life-cycle cost: \$1,362,990.
- Constant-air volume fan with water-cooled chiller and hot-water terminal heat, life-cycle cost: \$1,406,520.

For a breakdown of the life-cycle costs per component, see the NIST BLCC analysis.

The HVAC system for the MAA does not have an economizer cycle because the area requires pressure differential control between zones. This type of control is not possible with any precision when using an economizer cycle. A constant-air-volume system was selected in lieu of a variable-air-volume system for the MAA because of better pressure differential control. The system for the support area is constant-air-volume to minimize the influence of support-area pressure changes on the MAA.

Additional energy-conserving features include the following:

- Air locks provided at entries with high volumes
- Doors and windows provided with weather gaskets
- Power factor capacitors used to improve power factors, if necessary
- High-efficiency light fixtures and energy-saving lighting controls

With the proposed renovation and operations, electrical usage will be lower than that of the original facility.

3. UTILITY ASSESSMENT

The existing site contains all the utilities necessary to serve the renovated building. The current gas and water services are sufficient for the new utility building, which will house the gas-fired boilers, chillers, and associated pumps and equipment. The gas service currently connected to the NMSF will be disconnected and rerouted to the new utility building. This is necessary to comply with DOE 6430.1A, which precludes natural gas service to a nuclear facility.

Refer to Section E, 1.5 for a more thorough discussion of existing and proposed utilities.

4. ENVIRONMENTAL CONSIDERATIONS

An Environmental Assessment (EA) was completed for the original facility in 1985 and accepted. Expected for storage are the following forms of material: oxides (in a powder form); metals (in cast shapes); and metal pieces. More specific information on the type, density, and other relevant properties of materials to be stored can be found in the **Functional and Operational Requirements Document** (June 1995).

The environmental program must develop the required environmental analysis reports and permits as well as verify compliance with DOE orders, federal regulations, state regulations, and LANL policies. The contents of these requirements, and the sequence of events and approvals required to meet them, have been highly dynamic and are expected to remain so throughout the project execution. An environmental program plan will be developed before initiation of design activities and preliminary safety analysis report (PSAR) development. The purpose of the plan will be to establish baseline requirements, a baseline path to document approval, and a schedule of events required to support project design and construction schedules. Changes that occur as a result of the changing regulatory climate will be reconciled against the baseline plan to determine appropriate plan changes.

The following environmental considerations have been identified for this proposed project. Costs of the required surveys and National Environmental Policy Act (NEPA) document preparation (an EA) have been included in the conceptual-design cost estimate (**Part III - Supplemental Information**). Because the project involves renovating an existing facility, the site is fixed. However, costs of mitigation measures have not been included because neither the need for nor the extent of such measures has been established at this time.

- National Environmental Policy Act

A DOE Environmental Checklist will be prepared for this project and submitted to DOE. The required level of NEPA documentation will be determined by the relevant Program Office. An upgrade to the existing EA, reflecting the CDR design, is not anticipated.

- Floodplains/Wetlands

The proposed site has been surveyed by LANL biological staff. The proposed project will not adversely affect a floodplain or wetland.

- Threatened and Endangered Species

The completed EA found no state or federally listed threatened and endangered species at the existing site and also found no significant evidence of characteristic habitat for those species. If any such species is subsequently identified within the project area, mitigation measures will be developed and implemented before construction begins. This is further discussed in the EA.

- Archaeological and Cultural Resources

The site has been surveyed to determine the presence of any archaeological or cultural areas of interest. None were identified. If any are subsequently identified, a mitigation plan and, if appropriate, a data recovery plan will be developed and implemented in consultation with the New Mexico Historic Preservation Officer and the Council on Historic Preservation.

5. FACILITY AND EQUIPMENT MAINTENANCE AND OPERATION CONSIDERATIONS

This CDR considers most significant aspects of maintenance and operation, including accessibility, dismantling, replacement, repair, frequency of preventive maintenance, inspection needs, personnel safety, and day-to-day operation as the design configuration at this stage allows. Schematic and one-line drawings of mechanical systems are furnished in **Part IV - Conceptual Drawings**. The operational procedures and specific equipment must be fixed before considerations can be finalized. Standard

operating procedures (SOP) will be developed during the Title II design phase of this project by LANL, the designer, the contractor, and the vendors.

- Facility Maintenance

Materials and finishes selected for use throughout the building will be appropriate for their intended use, durable, and low-maintenance. Architectural provisions will be made for ease of necessary housekeeping operations associated with occupancy. This includes items such as wall-hung plumbing fixtures, overhead braced toilet partitions, mud mats at all entrances, and an adequate number of janitorial closets distributed throughout the structure. Janitorial amenities are provided in both the controlled and the uncontrolled portion of the facility.

Building exterior walls will be exterior insulation and finish system (EIFS) and color-coated metals. Roof surfaces, which will be sloped a minimum of 0.25 in. per ft for proper drainage, will be covered with a roofing system consisting of a single-ply adhered or ballasted membrane over rigid insulation (or non-thermal-resistant batts over the vault roof to enhance heat rejection).

Concrete floors with epoxy coatings/sealers will be used throughout the operational areas of the building to promote decontamination procedures. Toilet areas will be ceramic tile. Laboratories and other areas with hard surfaces will be sealed. Permanent interior partitions will be concrete masonry unit construction with special protective coatings and finishes.

- Equipment Maintenance and Operation

The design of this facility will consider all aspects of maintenance and operation, including accessibility, dismantling, replacement, repair, frequency of preventive maintenance, inspection needs, personnel safety, and day-to-day facility operation. Equipment rooms will be sized and equipment arranged to provide adequate clear space for operation, maintenance, inspection, and repair or replacement. In selecting equipment and construction materials that require maintenance, consideration will be given to the availability and replacement cost of materials and parts, need for special tools and maintenance instructions, and complexity of equipment and controls. Typical equipment includes air filters, pumps, fans, heat exchangers, compressors, chillers, valves, unit substations, MCCs, switchgears, UPS systems, and cranes and other lifting systems.

The CDR attempts to provide a facility layout that enhances ease of maintenance and operation within the constraints and design assumptions listed elsewhere in the document. The drawings and layouts in the CDR were developed with maintenance and ease of access in mind.

The design criteria will direct the AE to specify that the construction contractor provide the following as a minimum:

- Schematic and one-line drawings of mechanical and electrical systems
- O&M instructions for equipment and systems
- Mechanical piping and instrument drawings
- Electrical and instrument equipment lists
- Copies of equipment catalog data and a list of spare parts

- List of special tools for adjustment and maintenance of equipment and systems
- For the final systems, performance test data that reflect technical compliance with contract requirements

A complete set of draft SOPs will be written as part of the detailed Title II package. The SOPs will include operating conditions and requirements, off-normal condition response procedures, paper and digital forms and checklists, and QA procedures in a specification format. The SOPs will be the basis for development of the final safety analysis review. They will be tested and revised as needed to reflect as-built conditions included in start-up testing.

Each operation that can be identified will be listed and described in a narrative sequence of operation and control logic as part of the preliminary design (Title I) summary report. Two important systems integration prerequisites are satisfied by this activity. First, narration of the operational sequence provides a check of the functionality of the design drawings. Second, the operational sequence narrative is a basis for the event/fault tree model and PSAR development. The reliability-availability-maintainability analysis will, in turn, determine calibration and operations required on a regular basis to ensure that key safety systems are functional.

- Facility Monitoring

The FMS will supervise many of the SOPs and maintenance procedures. Following the operational philosophy incorporated in NMSF, as many decisions as possible regarding component-status monitoring, switching of backup systems, executing test and calibration procedures, and controlling system responses should be automated. This automation is discussed in detail in Section 1.11.

- Training

A training program will be developed to transfer operations and maintenance of the facility to NMT and Facilities, Securities, and Safeguards (FSS) management for user operations. The training program will teach the contents of the NMSF manual. This manual will be a multi-section document beginning with operating philosophy for the NMSF and including SOPs, maintenance procedures, safety procedures, and other necessary information.

The draft training program will be prepared during construction by a team of project staff and NMT and FSS personnel. It will be revised and verified using operational readiness testing. The final project activity will be a series of training sessions for the staff and the users.

Safeguards and Security Training will be accomplished through existing programs and facilities.

- Operational Readiness

The project execution philosophy will be to maintain continuity of the project/program team from project initiation through startup so that fully informed and trained user staff take over an operational facility at the close of the project. The project design team will be responsible for the generation of test procedures and the operations readiness test plan, which will be treated as a design deliverable.

A conceptual set of systems test procedures and the conceptual operations readiness test plan will be prepared as part of the Title I design summary report. Test procedures ranging from shop tests and receiving tests, to individual installed component tests and system performance tests, and finally

to integrated systems tests (including off-normal incident response tests), will be listed and summarized in descriptive narrative form. All systems, including controls, will be addressed.

A complete draft plan with procedures, checklists, and acceptance criteria will be completed as a Title II deliverable.

The final operational readiness test plan and test procedures created by updating the draft to incorporate any Title III changes will be completed near the end of construction and submitted for approval prior to initiation of the formal operations readiness review.

The operations readiness review will be conducted by a team drawn from outside the project staff to assure independent oversight.

6. SAFETY CONSIDERATIONS

An SAR will be necessary because of the sensitive nature and operations of the facility, which should be prepared in accordance with DOE Order 5480.23. The facility has been determined to be a DOE Category 2 Hazard Classification, based on the latest PHA (July 1995). The PHA and the quantitative systems analysis form the basis for completion of a draft PSAR, to be submitted as part of the Title I design package. The quantitative models will be updated as part of the Title II design. The PSAR will be completed with the Title II design phase. The FSAR will be completed before the facility is commissioned.

The SARs assume a given set of activities and system configurations. An electronic database will be established at the beginning of the design phase to track each facility component. Data will include component number, system identification, size and performance data, drawing references, fault tree number, quantitative risk parameters, make and model number, SOP number, and maintenance procedure number. The database will be complete when the SAR is submitted. The database will ease maintenance of the configuration and the SAR throughout the lifetime of the facility while minimizing the effort required to track changes.

A PHA was completed in April 1994 for the concept proposed in the original CDR. Although the function of the NMSF has not changed substantially since preparation of the original CDR in June 1994, the storage techniques and proposed facility layouts have. Hence, the operations inside the facility required to store, retrieve, assay, pack, unpack, etc., have changed slightly, primarily because the containers available to the project have changed, the Complex 21 container system is no longer available, and different material-handling equipment is proposed. A revised PHA has been prepared, which incorporates the passive air-cooled concept.

Development of this CDR considered the philosophy and results of the initial (1994) PHA as well as ALARA levels, worker safety, and environmental protection. Like the original PHA, performed in parallel with the original CDR development, this CDR was developed before a complete, revised PHA, based on the new design, was available. Therefore, a number of assumptions were made based on the previous PHA. The following assumptions were made regarding handling errors that could potentially rupture a container:

- Handling errors resulting in a release of material are not credible on the loading dock. The containers are received inside shipping containers that have been certified for over-the-road shipment. This means that they are designed to withstand a trucking accident and have been qualified by drop testing. Consequently, the truck is considered adequate containment during

shipping. The garage is considered to be analogous to the truck. The garage structure is not treated as a confinement structure and is not ventilated through HEPA filters.

- Handling errors considered to have the highest probability of release will occur during unpacking the shipping container in the pack/unpack and NDA areas. Unpacking may result in a release if a container was improperly packed. Therefore, unpacking will occur in a hood to supplement confinement from the building HEPA filtering system, thus limiting potential contamination to a small area. The hood exhaust will be separately ducted to the HEPA filters. The container will be verified to be free from contamination before it is removed from the hood. All areas of potential release are within the confinement barrier of the facility and are exhausted through multiple HEPA filters.
- Handling errors could result in a drop of about 25 ft in the charge hall if the container handling machine were to release the basket while it is over the drywell, or almost 15 ft if it is over the charge deck. Similarly, the basket could be dropped almost 20 ft while being removed from the transfer cask. The grapples will be designed to mechanically lock around the basket-lifting lug so that lifting and transfer will occur without power. Therefore, power outages will not result in a drop. This area will be contained within the confinement structure of the facility.
- Internal pressure could cause a container to rupture if plutonium oxide were not fully dried. This is unlikely, however, because the SNM undergoes a thorough quality assurance check before being placed in the container. In addition, the container systems (with primary and secondary confinement) can operate at an internal pressure of 300 psig with adequate safety margins.
- The drywells will be capable of being monitored with a helium (or trace gas) leak detector to determine if a container develops a leak. Should a leak be detected, a local tent can be erected, and the drywell can be accessed for corrective action. The contamination spread will be limited to the vicinity of the drywell.
- The likelihood of a stuck basket is low because enough clearance has been provided between the basket and the drywell to allow for thermal expansion and limited movement. The containers will also be designed for high internal pressures. Therefore, the containers cannot swell significantly.

The dominant event (for design) is the predicted seismic disturbance. Additionally, a fire hazard analysis has been performed and concludes that a facility-wide fire is not credible. The confinement structure and the necessary HEPA filters will provide their safety function in the event of a design basis event.

Nuclear criticality is an important consideration for a storage facility. The combination of the baskets and drywell storage array provides a positive sizing feature that maintains the containers in a subcritical geometry. Preliminary analysis has shown that the K_{eff} is about 0.85. The rigidity of the array and the charge deck does not allow movement or displacement that credibly results in a failure to maintain container spacing. Containers in temporary storage are held within shipping containers. The diameter of the shipping containers allows for close packing without achieving a critical condition. The NDA, pack/unpack, staging, and other areas outside the array are areas of concern because a hand-stacking accident could occur, given a breach of administrative controls and/or human error. Engineered controls will be implemented to preclude such an accident. An administrative control will also be provided for the number of containers in these areas.

The PHA has been revised to reflect the new storage and configuration concepts and the CDR incorporates many of the PHA elements. Below are general guidelines that will govern the design, construction, and operation of the renovated facility:

- Health and Safety Design Requirements

The minimum design criteria will be in accordance with the fundamental design requirements contained in DOE Order 6430.1A, the UBC, and the National Fire Code (NFPA 101, Life Safety Code, for exit requirements). Other significant regulations and standards followed in preparing this CDR are listed in Part I/E8, Section 9a. The Health Physics/Radiological Engineering report will be reviewed and approved by ESH Division.

In addition to the above design criteria, the project will be reviewed by LANL's ESH and Chemical Science and Technology (CST) divisions, along with others at LANL throughout development of the project. The following LANL groups will provide support: Radiation Protection (ESH-1), Facility Risk Management (ESH-3), Industrial Hygiene and Safety (ESH-5), Environmental Systems and Waste Characterization (CST-7), Radiologic Engineering/ALARA (ESH-12), and Environmental Protection (ESH-17, ESH-18, ESH-19, and ESH-20).

An SAR will be considered as part of this project, with PSAR approval due before the start of construction. The construction, testing, and start-up preparation will modify the design somewhat and augment it with standard procedures for operation, maintenance, and management. These modifications will be reflected in the SAR that will be issued and reviewed prior to authorization to begin storage operations.

- Building Occupancy/Type

The renovated NMSF will be designed to meet a Special Purpose Occupancy in accordance with NFPA 101, Chapter 28, and assigned an Ordinary Hazard, Group 2 occupancy in accordance with NFPA 13. DOE Order 6430.1A indicates that the intent of the classifications and codes should be met to the practical extent possible.

- Fire Protection

All building construction related to this project will meet the requirements described in Part I/E6, Section 6b. Portions of the building will be protected with an automatic sprinkler system, while others will not require such a system because of the low risk of fire and associated hazards in those areas. A Preliminary Fire Hazards Analysis is included in **Part III - Supplemental Information**. Also see Section 1.9 for fire protection features.

- Identification and Impact of Potential Hazards

Fire. An automatic fire alarm and suppression system (wet-pipe or preaction automatic sprinklers) will control and extinguish a primary fire. Fire extinguisher cabinets will be located throughout the facility in conformance with NFPA codes.

The Preliminary Fire Hazards Analysis concludes it is not probable that the storage array or containers could be breached and cause a release to the public. There will not be large quantities of combustibles, and the building materials will be either metallic or masonry for the most part.

Toxicity/Corrosives. This facility will not store or use any toxic or corrosive material except the SNM, which will be stored in sealed containers as described elsewhere in this document. Potential exposures to employees will be identified and controlled through proper design of the building and operating systems.

Radiographic Sources. The radiographic sources, described in the **Functional and Operational Requirements Document** (June 1995) in detail, are summarized here:

Plutonium-239 ¹	Enriched Uranium ¹	Tritium ²
Plutonium-238 ³	Normal Uranium ²	Thorium
Plutonium-242	Depleted Uranium ²	
Neptunium-237	Uranium-233	
Americium-241	Curium	
Americium-243	Californium	

The facility will store up to 6,600 kg of actinides.

High Explosives. This facility will not house or process any high explosives.

Natural Hazards. The hazard classification will be identified by FSS-6 with input from the user in accordance with the guidelines in DOE Standard 1027-94, Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards. Seismic analysis will be conducted in accordance with DOE Standard 1020-94.

7. SECURITY CONSIDERATIONS

Security considerations will significantly affect the design, construction, operation, and maintenance of this facility because the facility will store large quantities of Category I and II SNM. During the development of this CDR, security considerations have dictated many aspects of the configuration. The MAA will also be expanded.

The existing facility is in a secured area at TA-55, and renovations will require temporary modifications to the area to ease construction as well as new, permanent features. Although no new security areas will be provided, the level of detection and alarms will be enhanced in the vicinity of the NMSF.

The following is a detailed discussion of the security requirements for this project.

Classification of Facility

In accordance with DOE Order 5632.1C, the NMSF will be designed for the storage of Category I materials and associated documentation. Materials to be stored include production items from PF-4, off-site materials, and relocated on-site products.

¹Enrichment levels will vary.

²Only that present as incidental contamination will be stored.

³Each container will contain no more than 31.5g of material.

Facility Design Requirements

Facility construction, security systems, and operational requirements must be in compliance with the following DOE guidance and requirements:

DOE 5500.3A	Planning and Preparedness for Operational Emergencies
DOE 5630.16A	Safeguards and Security Acceptance and Validation Testing
DOE 5632.1C	Protection and Control of Safeguards and Security Interests
DOE 5632.7A	Protective Force
DOE 5633.3B	Control and Accountability of Nuclear Materials
DOE 5634.1B	Facility Approvals, Security Surveys, and Nuclear Materials Surveys
DOE 6430.1A	General Design Criteria
SAND 87-1926/UC-515	Access Delay Technology Transfer Manual
SAND 90-0729/UC515	Alarm Communication and Display Technology Transfer

General Area Activities

The NMSF is located within the present Protected Area surrounding the TA-55 complex. The NMSF will be an extension of the present PF-4 MAA; however, the NMSF is designed and constructed to exist as a stand-alone MAA if required.

During construction of this facility, substantial cost and schedule savings will result if the project can be conducted as a non-protected area activity. Implementation of this approach will require the installation of a PIDAS system at the original security boundary between PF-4 and the NMSF construction site. A detailed drawing of this feature is provided in **Part IV - Conceptual Drawings**.

Following construction operations, the NMSF will be thoroughly inspected for unauthorized materials and approved for use as required by DOE Order 5634.1B. Then the existing PIDAS system will be returned to service, and the PIDAS and the construction zone barrier to PF-4 will be removed.

Alarm Zone Concept

The facility design will implement a protection-in-depth approach for control of stored materials throughout the receiving, inspection, and storage process. Materials will be contained within vaults and vault-type rooms to control access and limit the amount of material available for diversion.

Perimeter

The outer zone is the protected area completely surrounding the entire TA-55 complex. Perimeter detection features, response requirements, and physical protection properties are shared with the present PF-4 facility. Review of response team characteristics will be performed to compensate for the additional protection area.

MAA Boundary

The second zone is the MAA boundary, which will be completely enclosed by the NMSF structure. This zone will be designed to satisfy the requirements for a vault structure and is further partitioned to provide additional detection and delay areas.

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8. SITE DEVELOPMENT PLAN COORDINATION

Since this project is a renovation, the site is predetermined and thus is fixed. The site selection was approved and developed when the facility was first constructed. Subsequently, environmental documentation that further investigated site specifics and impacts has been prepared, and additional documentation will also be prepared.

This site location conforms to LANL's 1990 Site Development Plan — Technical Site Information, and the 1995 Site Development Plan. The site and renovation option were chosen because of the site's location within TA-55 and its proximity to other related facilities.

9. OUTLINE SPECIFICATIONS AND STANDARDS

The following is a summary list of design codes and standards applicable to the NMSF renovation project. The latest editions/revisions of these codes and standards will be applied during the design phase. The list is not all-inclusive; additional codes and standards may be identified during the detailed design phase and applied to the project design.

9.1 Generic Design Codes and Standards

10 CFR 834	Radiation Protection of Public and the Environment
10 CFR 835	Occupational Radiation Protection
29 CFR 1926	Occupational Safety and Health Administration, Labor
40 CFR 61	National Emission Standard for Radionuclide Emissions from Department of Energy Services
ANS 8.1-83	Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors
ANS 8.3-86	Criticality Accident Alarm System
ANS 8.5-86	Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material
ANS 8.7	Guide for Nuclear Criticality Safety in Storage of Fissile Materials
ANS 8.15-81	Nuclear Criticality Control of Special Actinide Elements
ANS 8.19-84	Administrative Practices for Nuclear Criticality Safety
ANS 57.2	Design Requirements for LWR Spent Fuel Storage Facilities
ANS 57.3	Design Requirements for New Fuel Storage Facilities at LWR
ANSI Z97.1	Glazing Performance Specification
ANSI/ANS 57.9	Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type)
ANSI A117.1	Accessibility and Usability for Physically Handicapped People for Buildings & Facilities
DOE Order 2200.6	Standard Service Lives
DOE Order 4700.1A	Project Management System
DOE Order 5000.3B	Occurrence Reporting and Processing of Operations Information
DOE Order 5400	Radiation Protection of the Public and the Environment
DOE Order 5400.1	General Environmental Protection Program Requirements
DOE Order 5400.5	Radiation Protection of the Public and Environment

DOE Order 5440.11
DOE Order 5440.1C
DOE Order 5440.1E
DOE Order 5480.1B

DOE Order 5480.4

DOE Order 5480.24
DOE Order 5484.1
DOE Order 5639.6A

DOE Order 6430.1A
DOE STD 101

DOE STD 3013
DOE/EH-0256T
DOE/TIC 11603

ICBO
IRI
LANL

LANL
LANL LM107-01-1

LANL

LANL
NRC R.G. 3.43
NRC R.G. 8.8

Radiation Protection
National Environmental Policy Act
National Environmental Policy Compliance
Environmental, Safety, and Health Program for DOE
Operations
Environmental Protection, Safety, and Health Protection
Standards
Nuclear Criticality Safety
Environmental Protection, Safety, and Health Protection
Classified Automated Information System Security
Program
General Design Criteria
Compilation of Nuclear Safety Criteria for Potential
Application to DOE Non-Reactor Nuclear Facilities
Criteria for Safe Storage of Plutonium Metals and Oxides
Radiological Control Manual
Nonreactor Nuclear Facilities, Standards, and Criteria
Guide
Uniform Building Code (UBC)
IRI Manual
Quality Assurance Manual for Engineering and
Construction
Environment, Safety, and Health Manual
Los Alamos National Laboratory Radiological Control
Manual
Los Alamos National Laboratory Radiation Protection
Plan
Facilities Engineering Standards Manuals
Criticality
Information Relevant to Ensuring that Occupational
Radiation Exposures at Nuclear Power Stations will be as
Low as Reasonably Achievable

9.2 Specific Design Codes and Standards

9.2.1 Civil/Structural

16 CFR 1201
40 CFR 101
ABC N690-84

ACI 207.1R
ACI 207.4R
ACI 211.1

ACI 211.2

ACI 304(304R)

ACI 305R

Safety Standard for Architectural Glazing Material
Uniform Federal Accessibility Standards
Specification for the Design, Fabrication, and Erection of
Steel Safety-Related Structures for Nuclear Facilities
Mass Concrete
Cooling and Insulating Systems for Mass Concrete
Standard Practice for Selecting Proportions for Normal,
Heavy Weight, and Mass Concrete
Standard Practice for Selecting Proportions for Structural
Lightweight Concrete
Guide for Measuring, Mixing, Transporting and Placing
Concrete
Hot Weather Concreting; Cold Weather Concreting

ACI 307-88	Standard Practice for the Design and Construction of Cast-in-Place Reinforced Concrete Chimneys
ACI 318 RM-92	Building Code Requirements for Reinforced Concrete
ACI 347	Formwork for Concrete
ACI 349	Code Requirements for Nuclear Safety-Related Concrete Structures
ACI 349R	Commentary on Code Requirements for Nuclear Safety-Related Concrete Structures
ACI 531	Building Code Requirements for Concrete Masonry Structures
ACI 531.1	Specification for Concrete Masonry
AISC 5326	Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings
AISC M018L-94	Manual of Steel Construction, Load & Resistance Factor Design
AISC N690-84	Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities
AISC-ASD	Manual of Steel Construction, Allowable Stress Design, 9th Edition, 1990
AISC-LRFD	Manual of Steel Construction, Load Resistant Factor Design
AISI	Specifications for the Design of Cold-Formed Steel Structural Members
AISI SG-673	Specifications for the Design of Cold-Formed Steel Structural Members
ANS 11.13	Concrete Radiation Shields
ANS 6.4	Guidelines on Nuclear Analysis and Design of Concrete Radiation Shielding for Nuclear Power Plants
ANS 6.4.2	Specification for Radiation Shielding Materials
ANSI A58.1	Building Code Requirements for Minimum Design Loads in Building and Other Structures
ANSI A117.1	Accessibility and Usability for Physically Handicapped People for Buildings & Facilities
ANSI Z88.2	Respiratory Protection
ANSI Z97.1	Glazing Performance Specification
ASCE 1-82	Guidelines for Design and Analysis of Nuclear Safety-Related Structures
ASCE 4-86	Seismic Analysis of Safety-Related Structures and Commentary for Seismic Analysis of Safety-Related Structures
ASCE 7-93	Building Code Requirements for Minimum Design Loads in Buildings and Other Structures
ASTM A361	Standard Specification for Steel Sheet Zinc-Coated (Galvanized) by the Hot-Dip Process for Roofing and Siding
ASTM C635	Standard Specification for Metal Suspension Systems for Acoustical Tile and for Lay-in Panels
ASTM C636	Standard Recommended Practice for Installation of Metal Ceiling Systems for Acoustical Tile and for Lay-in Panels

ASTM C840	Standard Specification for Application and Finishing of Gypsum Board
ASTM D1586	Penetration Test and Split Barrel Sampling of Soils
ASTM D1587	Thin-Walled Tube Sampling of Soils
ASTM D2113	Diamond Core Drilling for Site Investigation
ASTM E580	Standard Recommended Practice for Application of Ceiling Suspension Systems for Acoustical Tile and for Lay-in Panels
AWI	Architectural Woodwork Quality Standards
AWS-D1.1-90	Structural Welding Code - Steel
AWS-D1.3-89	Structural Welding Code - Sheet Steel
AWS-D1.4-92	Structural Welding Code - Reinforcing Steel
AWWA C600	Standard for the Installation of Ductile Iron Water Mains and Their Appurtenances
DDM01	SDI Diaphragm Design Manual, 1st Ed.
DOE Order 5480.28	Natural Phenomena Hazards Mitigation
DOE STD 1020	Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities
DOE STD 1021	Natural Phenomena Hazards Performance Categorization
DOE STD 1022	Guidelines for Structures, Systems, and Components
DOE STD 1024	Natural Phenomena Hazards Site Characterization Criteria
DOE STD 1027	Guidelines for Use of Probabilistic Seismic Hazard Curves at DOE Sites
FGMA	Guidelines on Preliminary Hazard Classification and Accident Analysis Techniques for Compliance with DOE 5480.23, Safety Analysis
FSWW-P-541	Glazing Manual
IAPMCO	FS WW-P-541 series, Plumbing Fixtures
IEEE 344	Uniform Plumbing Code (UPC)
	Recommended Practice for Seismic Qualifications of Class 1E Equipment for Nuclear Power Generating Stations
LANL	National Glove Box Standards
LBL-9143	Seismic Safety Guide
MLSFA	Steel Framing Systems Manual
NAAMM	Metal Finishes Manual
NEBB	Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems
NMSHTD	Standard Specifications for Road & Bridge Construction
NSPC	National Standard Plumbing Code
PCA	Clear Coatings for Exposed Architectural Concrete
PCA	Effect of Substances on Concrete and Guide to Protective Treatment
PCA	Painting Concrete
PCA	Surface Treatments for Concrete Floors
PDCA	Architectural Painting and Wall Covering Manual
RCFE	Recommended Work Procedures for Resilient Floor Covering
TCA	Handbook for Ceramic Tile Installation

TIMA
UBC
UCRL 15714

UCRL 15815

UCRL 53526

UCRL 53582

Economic Thickness Manual
Uniform Building Code
Suspended Ceiling System Survey and Seismic Bracing
Recommendations
The Practical Equipment Seismic Upgrade and
Strengthening Guidelines
Natural Phenomena Hazards Modeling Project, Extreme
Wind/Tornado Hazard Models for DOE Sites
Natural Phenomena Hazard Modeling Project, Seismic
Model for DOE Sites

9.2.2 Mechanical

9.2.2.1 Heating, Ventilation, and Air Conditioning (HVAC)

A-82

AABC National Standards for Total System Balance Air
Distribution-Hydronic Systems-Sounds-Vibration-Field
Surveys for Energy Audits
Industrial Ventilation Manual of Recommended Practice
Testing of Nuclear Air Cleaning System
Safety Criteria for HVAC Systems
Applications Handbook
Design of Smoke Management Systems
Equipment Handbook
Fundamentals Handbook
HVAC Systems and Equipment
Refrigeration Handbook
Systems Handbook
Ventilation for Acceptable Indoor Air Quality
Safety Code for Mechanical Refrigeration
Thermal Environmental Conditions for Human
Occupancy

ASHRAE 62
ASHRAE 90A
ASHRAE 100
ASHRAE 158
ASME AG-1
ASME N509
EPA-450/4-80-023

Ventilation for Acceptable Indoor Air Quality
Energy Conservation in New Building Design
Energy Conservation in Existing Buildings
Cooling and Heating Load Calculation Manual
Code on Nuclear Air and Gas Treatment
Nuclear Power Plant Air-Cleaning Units and Components
Determination of Good Engineering Practice, Stack
Height

ERDA 76-21

(ORNL-NSIC-65-1) Nuclear Air Cleaning Handbook: The
Design, Construction and Testing of High Efficiency Air
Cleaning Systems

NFPA 90A
NFPA 90B

Air Conditioning and Ventilation Systems
Standard for Installation of Warm Air Heating and Air
Conditioning Systems

SMACNA 1975

Accepted Industry Practice for Industrial Duct
Construction

SMACNA 1985
SMACNA 1985

HVAC Air Duct Leakage Test Manual
HVAC Duct Construction Standards - Metal and Flexible

UL-207

Refrigerant-Containing Components and Accessories,
Non-electrical

9.2.2.2 High Efficiency Particulate Air Filter (HEPA)

ANSF N101.1
ARI 850
ASME N509
ASME N510
IES-RP-CC-001-86
MIL-F-51068C
MIL-F-51079A
NEF3-41T

NEF3-43
NEF3-44
NEF3-45
UL586

UL900

Efficiency Testing of Air Treatment System
Commercial and Industrial Air Filter Equipment
Nuclear Power Plant Air-Cleaning Units and Components
Testing of Nuclear Air-Treatment Systems
HEPA filters
Filter Particulate, High Efficiency, Fire Resistant
Filter Medium, Fire-Resistant, High Efficiency
In-Place Testing of HEPA Filter Systems by the Single
Particle
Quality Assurance Testing of HEPA Filter
Quality Assurance Testing of HEPA Filters
Specification for HEPA Filters used by DOE Contractor
Standard for Safety High-Efficiency Particulate Air Filter
Units
Test Performance for Air Filter Units

9.2.2.3 Air Handling Units

ARI 410
ARI 430
ARI 450
ARI 460

ARI 520

ARI 550
ARI 570

Forced Circulation Air-Cooling and Air-Heating Coils
Central Station Air-Handling Units
Remote Type Water-Cooled Refrigerant Condensers
Remote Mechanical-Draft Air-Cooled Refrigerant
Condensers
Positive Displacement Refrigerant Compressors,
Compressor Units, and Condensing Units
Centrifugal Rotary Screw Water Chilling Packages
Reciprocating Water Chilling Packages

9.2.2.4 Fans/Blowers

AMCA 201
AMCA 210
ASHRAE 51
NFPA 91

Fans and Systems
Laboratory Methods for Testing Fans for Rating
Methods for Testing Fans for Rating
Blower and Exhaust Systems

9.2.2.5 Mechanical Components

ASME B16
ASME B31.1
AWS 5.2

NE E15-2NB-T

Fittings, Flanges, and Valves
Power Piping
Standard for Welded Steel, Elevated Tanks, Stand Pipes,
and Reservoirs
Class 1 Nuclear Components (Supplement to ASME
Boiler and Pressure Vessel Code Section III, Subsection
NCA and NB)

NE E15-2NC-T

Class 2 Nuclear Components (Supplement to ASME Boiler and Pressure Vessel Code Section III, Subsection NCA and NC)

NE E15-2ND-T

Class 3 Nuclear Components (Supplement to ASME Boiler and Pressure Vessel Code Section III, Subsection NCA and ND)

NE-E15-2NE-T

Class MC Nuclear Components (Supplement to ASME Boiler and Pressure Vessel Code Section III, Subsection NCA and NE)

9.2.2.6 Boilers

ASME SEC I-92
NFPA 8501
NFPA 85A

Boiler and Pressure Vessel Codes
Standard for Single-Boiler Burner Operation
Prevention of Furnace Explosion in Fuel Oil and Natural Gas-Fired Single-Burner Boiler Furnaces

NFPA 85B

Prevention of Furnace Explosion in Natural Gas-Fired Multiple-Burner Boiler Furnaces

NFPA 85D

Prevention of Furnace Explosion in Fuel Oil-Fired Multiple-Burner Boiler Furnaces

9.2.2.7 Air System

ANS 59.3
CGA

Safety-Related Control Air System
Handbook of Compressed Gases

9.2.2.8 Cranes and Conveying Systems

29 CFR 1910.179
ANSI/ASME B30.11
ANSI/ASME B30.17

OSHA - Overhead and Gantry Cranes
Monorails and Underhung Cranes
Overhead and Gantry Cranes (Top-running bridge, single girder, underhung hoist)

ANSI/ASME B30.2

Overhead and Gantry Cranes (Top-running bridge, single or multiple girder, top-running trolley hoist)

ASME 17.1 - 1993
CMAA-70
CSAO
NE-F8-6T

Safety Codes for Elevators and Escalators
Specifications of Electrical Overhead Traveling Cranes
Crane Handbook
Hoisting and Rigging of Critical Components and Related Equipment

NUREG 0554

Single Failure-Proof Cranes for Nuclear Power Plants

9.2.3 Fire Protection

DOE Order 5480.7
FM
FM5-4/14-8
NFPA 10
NFPA 12
NFPA 13

Fire Protection
Fire Protection Manual
Loss Prevention Data Sheet on Transformers
Portable Fire Extinguishers, 1988
Carbon Dioxide Extinguishing Systems, 1989
Installation of Sprinkler Systems

NFPA 13A	Recommended Practice for Inspection, Testing, and Maintenance of Sprinkler Systems
NFPA 14	Installation of Standpipe and Hose Systems
NFPA 20	Installation of Centrifugal Fire Pumps
NFPA 24	Installation of Private Fire Service Mains and their Appurtenances
NFPA 25	Inspection, Testing, and Maintenance of Water-Based Systems
NFPA 26	Supervision of Valves Controlling Water Supplies, 1988
NFPA 30	Flammable and Combustible Liquids Code, 1990
NFPA 37	Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 45	Fire Protection for Laboratories Using Chemicals
NFPA 70	National Electric Code
NFPA 72	Installation, Maintenance, and Use of Central Station Signaling Systems
NFPA 80	Fire Doors and Windows
NFPA 80A	Protection from Exposure Fire
NFPA 92A	Recommended Practice for Smoke Control
NFPA 101	Safety to Life from Fire in Buildings and Structures
NFPA 105	Recommended Practice for Installation of Smoke-Control Door Assemblies
NFPA 220	Standard on Types of Building Construction
NFPA 255	Test of Surface Burning Characteristics of Building Materials
NFPA 291	Fire Flow Testing and Marking of Hydrants
NFPA 780	Lightning Protection Code
NFPA 801	Recommended Fire Protection Practice for Facilities Handling Radioactive Materials
NFPA 1963	Screw Threads and Gaskets for Fire Hose Connections
NFPE	Society of Fire Protection Engineers Handbook
UL 96A	Standard for Safety Installation Requirements for Lightning Protection Systems
UL 555	Standard for Safety Fire Dampers
UL 723	Standard for Safety Test for Surface Burning Characteristics of Building Materials
9.2.4 Instrumentation and Control	
ANSI 42-18	Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents
ANSI N 317	Performance Criteria for Instrumentation Used for In-Plant Plutonium Monitoring
ANSI N 8.3	Criticality Accident Alarm System
ANSI N42-17B	Radiation Instrumentation Performance Specifications for Health Physics Instrumentation - Occupational Airborne Radioactivity Monitoring Instrumentation
ANSI/UL 508	Industrial Control Equipment
DOE/EP 0108	Standard for the Fire Protection of DOE Electronic Computer/Data Processing Systems

IEEE 336	Standard Installation, Inspection, and Testing Requirements for Power Instrumentation and Control Equipment at Nuclear Facilities
IEEE 467	Standard Quality Assurance Program Requirement for Design and Manufacture of Class 1E Instrumentation
IEEE 498	Standard Requirements for Calibration and Control of Measuring and Test Equipment Used in Nuclear Facilities
NEC 1-IT	Instrumentation and Control Equipment Grounding and Shielding Practices
NEMA ICS-1	Industrial Controls and Systems
NFPA 75	Standard for Protection of Electronic Computer Data Processing Equipment

9.2.5 Human Factors Engineering

EPRI-NP 3659	Human Factors Guide for Nuclear Power Plant Control Room
IEEE 1023	Guide for Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations
MIL-STD 1472C	Human Engineering Design Criteria for Military Systems, Equipment, and Facilities
NUREG 0700	Guidelines for Control Room Design Reviews
NUREG/CR 3331	A Methodology for Allocating Nuclear Power Plant Control Function to Human or Automatic Control
UCRL 15673	Human Factors Design Guidelines for Maintainability of DOE Nuclear Facilities

9.2.6 Electrical

9.2.6.1 Electrical Power

ANSI/NFPA 70	National Electrical Code
ANSI C-2	National Electrical Safety Code
ANSI C84-1	Electric Power Systems and Equipment
IEEE 80	Guide for Safety in Substation Grounding
IEEE 141	Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 142	Recommended Practice for Grounding Industrial and Commercial Power Systems
IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE 308	Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations
IEEE 323	Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations
IEEE 344	Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

IEEE 379	Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems
IEEE 384	Standard Criteria for Independence of Class 1E Equipment and Circuits
IEEE 399	Recommended Practice for Power System Analysis
IEEE 493	Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems
IEEE 603	Standard Criteria for Safety Systems for Nuclear Power Generating Stations
IEEE 690	IEEE Standard for Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations
IEEE 741	Standard Criteria for Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations
IEEE 837	Standards for Qualifying Permanent Connections Used in Substation Grounding
IEEE C37.91-85	Guide for Protective Relay Application to Power Transformers
NEMA MG-1	Motors and Generators

9.2.6.2 Uninterruptable Power Supply (UPS)

IEEE 241	Recommended Practice for Electric Power Systems in Commercial Buildings
IEEE 450	Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations
IEEE 946	Standard for Design of Safety-Related DC Auxiliary Power System for Nuclear Power Generating Stations

9.2.6.3 Emergency Power

IEEE 387	Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Stations
IEEE 446	Recommended Practice for Emergency and Standby Power for Industrial and Commercial Applications
IEEE 749	Standard for Periodic Testing of DG Units Applied as Standby Power Supplies at Nuclear Power Generating Stations
NFPA 110	Standard for Emergency and Standby Power Systems

9.2.6.4 Grounding and Lightning Protection

LPI-175	Installation Standard
MIL-HDBK-419	Grounding, Bonding, and Shielding for Electric Equipment and Facilities
NFPA 78	Lightning Protection Code

9.2.6.5 Emergency Communication

NFPA 1221

Public Fire Service Communication Systems

9.2.6.6 Lighting

IESNA

Lighting Handbook

9.2.7 Energy Conservation

ASHRAE 100
IEEE 739

Energy Conservation in Existing Buildings
Recommended Practice for Energy Conservation and
Cost-Effective Planning in Industrial Facilities

9.2.8 Safeguards and Security

DOE Order 5630.11B
DOE Order 5630.12A
DOE Order 5630.14A
DOE Order 5630.16A
DOE Order 5632.1C

DOE Order 5632.7A
DOE Order 5633.3A
DOE Order 5634.1B

DOE Order 5639.6A
NFPA 241

SAND87-1926/UC-515

Safeguards and Security Program
Safeguards and Security Inspection & Assessment
Safeguards and Security Program Planning
Safeguards and Security Acceptance and Validation
Protection and Control of Safeguards and Security
Interests
Protective Fore Program
Control and Accountability of Nuclear Materials
Facility Approvals, Security Surveys, and Nuclear Material
Surveys
Classified Automated Information
Standard for Safeguarding Construction Alteration and
Demolition Operations
Access Delay Technology Transfer Manual

9.2.9 Decontamination and Decommissioning

DOE/EM-0142P
DOE/EM-40

Decommissioning Handbook
Decontamination and Decommissioning Guidance
Document, Draft 3

9.2.10 Safety Analysis

29 CFR 1626
29 CFR 1910
ANS83-86
ANSI Z358.1
ANSI A13.1

ANSI A17.1
ASCE 4-86
DOE Order 5480.11
DOE Order 5480.19
DOE Order 5480.21

Safety and Health Regulations for Construction
Occupational Safety and Health Standards
Criticality Accident Alarm System
Eyewash and Shower Equipment, Emergency
Piping & Conduit Marking Identification for People for
Buildings and Facilities
Safety Code for Elevators and Escalators
Seismic Analysis of Safety-Related Nuclear Structures
Radiation Protection for Occupational Workers
Conduct of Operations Requirements for DOE Facilities
Unreviewed Safety Questions

DOE Order 5480.22
DOE Order 5480.23
DOE STD 5502
NEF 1-2T

SAND90-0729/UC-515

Technical Safety Requirements
Nuclear Safety Analysis
Hazard Baseline Documentation
Preparation of Plant and System Design Description Documents
Alarm Communication and Display Technology Transfer

9.2.11 Quality Assurance

10 CFR 830.120
ASME NQA-1

ASME NQA-2

DOE Order 5700.6C

Nuclear Safety Management (Quality Assurance)
Quality Assurance Program Requirements for Nuclear Facilities
Quality Assurance Requirements for Nuclear Facility Applications
Quality Assurance

9.3 Civil

General Civil. Work will consist of grading and additions of and modifications to underground utilities, including potable water, natural gas, industrial water, fire protection, and radioactive liquid waste lines.

Earthwork and Landscaping. All backfill, compaction, and excavation will be accomplished in accordance with OSHA, AASHTO, and NMSHTD standards. The site will be revegetated per LANL Standards.

Utilities. All new and modified utilities will be constructed in accordance with, but not limited to, FM, NFPA, UL, ASME, AWWA, IEEE, and other applicable standards.

9.4 Architectural

General. Architectural work will include finishes, doors, roofing, walls, masonry, and other items. The facility should incorporate design features that facilitate decontamination and decommissioning. For example, corners of rooms within the MAA should be rounded to preclude square edges. Also, protective coatings should be applied that will be durable and not present a hazard under varying thermal conditions. The major applicable materials are listed below.

Thermal and Moisture Protection

Waterproofing:

All exterior surfaces of exterior walls of habitable rooms or spaces in contact with the earth will be waterproofed. Waterproofing will be a one-component urethane-modified asphaltic compound.

Insulation:

Insulation will be required at the roof, walls, and foundation perimeter in accordance with DOE Order 6430.1A.

Insulation will have a UL-listed flame-spread rating of 25 or less and smoke development of 50 or less.

Roofing:

The roof system will be a single-ply reinforced membrane roof.

The roof will have a minimum slope of 0.25 in. per ft.

Where fan-houses or other roof-mounted equipment requires frequent service and maintenance, walkways will be provided on the roof to prevent damage to the roofing materials.

Flashing and
and Sheet Metal:

Flashing will be provided over doors, outside openings, at all wall and roof penetrations. Flashing will be galvanized steel (minimum 24 gauge), painted to match adjacent materials, and meet the requirements of ASTM A361.

Joint Sealers:

Caulking or sealants will be required, as needed, in joints in exterior walls to make the building air- and watertight.

Doors, Windows,
and Glass:

General Requirements — UL, FM, or other approved labels will be placed on all doors, frames, and hardware required to be fire rated. Vision panels will be 6 in. by 16 in. and fully tempered.

Metal Doors and Frames — All door frames will be metal. Exterior doors will be insulated hollow metal. Vault doors will be Class V doors, per LANL and NFPA standards.

Wood and Plastic Doors — Interior doors will be solid core, with wood veneer- or plastic laminate-covered faces.

Special Doors — Exterior and interior overhead doors will be roll-up type, insulated, fully weatherstripped. All overhead doors will be electrically operated with manual override capability.

Interior Windows:

Design of interior windows will relate to the architectural concept and to ease of maintenance. Window dimensions, and location layout, shall be determined by security concerns appropriate to area locations. Window glass shall be as required by function.

Hardware:

All exterior doors will be weatherstripped and insulated. Hardware finish will be US-26 polished chrome. All doors requiring locks will be provided with Best seven-pin tumbler locks compatible with Best cores, which UC will provide. Automatic door closers will be installed on all doors where functionally necessary and on all fire-rated or corridor doors. Mortise locksets with

lever handles will be provided on all doors except those with panic hardware. Required exit doors will have panic exit hardware. Entry airlock doors will have pulls and push plates only on interior door(s). Electromagnetic hold opening devices, astragals, automatic door bottoms, coordinators, and electronic latching must meet LANL and DOE security requirements as specified in DOE Order 5632.1C.

Finishes

- Walls:** Interior partitions will consist of CMUs or concrete walls painted with a protective coating.
- Ceilings:** Suspended ceilings for dry areas will be grid system with acoustical panels. Suspended ceilings for wet areas will be moisture-resistant gypsum board or concrete with a protective coating.
- Flooring:** Concrete floors — Two coats of protective coating (10 mil).
- Toilet rooms — ceramic tile.
- Lobbies — concrete floors (see above).
- Corridors and other areas — concrete floors (see above).
- Base — 4 in. coved rubber base with 1-in. radius toe (typical); 5-in. ceramic base (in restrooms).

Painting

Painting will be coordinated with all finish materials and furniture. Application schedule (minimum requirements) will be as follows:

- Exterior concrete — primer and two coats of latex masonry paint.
- Exterior ferrous metals — two coats of metal primer and two coats of enamel.
- Exterior galvanized metal — one coat of primer and two coats of enamel.
- Interior metals — one coat of primer and two coats of enamel.
- Steel doors and door frames — two coats of primer and two coats of enamel.
- Wood doors — one coat of stain sealer and three coats of varnish.
- Interior exposed concrete, concrete masonry walls, and exposed concrete ceilings — one coat of masonry sealer and two coats of masonry paint.
- Interior gypsum wallboard — one coat of latex wall primer and two coats of latex semigloss.

Specialties

- Dressing Compartments:** Shower stalls and 8 in. CMU partitions will be installed for shower and dressing areas.

Fire Extinguishers,
Cabinets, Accessories:

Semi-recessed fire extinguisher cabinets for extinguishers of appropriate type will be located throughout the facility and spaced according to NFPA codes.

Toilet Accessories:

Dispensers for paper towel rolls, toilet tissue, liquid soap, feminine napkins, and toilet seat covers, as well as disposal receptacles for paper towels and feminine napkins, will be included.

Identifying Devices

An integrated system of internal and external building graphics will be incorporated into the design. This system will include a directory, nameplate holders, and room signs.

Equipment

An existing dock leveler will be modified in the truck loading area to accommodate renovation.

Furnishings

Laboratory Furnishings:

Laboratory benches and desk units will be floor-mounted, modular units that allow for future modifications. Counter-top types will be based on specific lab requirements. Cabinetry will be fabricated to allow field interchange of doors, drawers, and similar parts.

Office Furnishings:

Office furnishings will include free-standing and modular systems furniture to suit functional requirements. Each office, work station, and lab area will be equipped with a dustless markerboard.

Conveying Systems

Design and construction of elevators will be in accordance with ANSI/ASME Standard A.17.1 and ANSI A117.1. Design and construction of cranes shall be consistent with CMAA-70.

9.5 Structural

Subsurface explorations and soil analysis will be performed to establish design parameters for structural foundations. The minimum building design live loads and dead loads will be determined by the latest edition of ASCE 7-93, "Minimum Design Loads for Buildings and Other Structures."

Wind loading will be in accordance with the latest DOE Standard 1020, Natural Phenomena Hazards Design and Evaluation Criteria for DOE Facilities (Performance Categories 1-4), in conjunction with ASCE 7-93. Part V - Structural/Seismic Evaluation contains the loading criteria. Minimum seismic design will be in accordance with the latest DOE Standard 1020, Performance Category 3, in conjunction with the 1988 Uniform Building Code.

The majority of structural modifications will be constructed of reinforced concrete. The charge deck will be fabricated from steel plate (with concrete for shielding); other structures will be lightly framed steel and masonry. Materials used should conform to:

Concrete:	28-day compressive strength of 4000 psi. Concrete exposed to weather should be air-entrained.
Reinforcing:	60,000 psi, ASTM A615
Structural Steel/Plate:	ASTM A36
Welding:	E7018 electrodes
Bolting:	ASTM A325 high-strength bolts
Foundations:	Bear on undisturbed volcanic tuff or compacted fill; minimum allowable soil-bearing value of 5000 psf

9.6 Mechanical

Specification data for Mechanical Equipment is contained in Section 1. E, part 1.8.

9.7 Electrical

Electrical equipment specifications are in Section 1.E, part 1.10.

9.8 Special Facilities Equipment and Other Systems

Material requirements will be specified during detailed design.

9.9 Human Factors

Renovation of the PF-41 NMSF will require application of the following regulations and guidelines:

- U.S. Nuclear Regulatory Commission NUREG-0700
- EPRI - NP 3659
- U.S. Department of Defense MIL-STD 1472C
- UCRL 15673
- NUREG CR3331

The regulations apply to the following areas of the facility design:

- Human dimension consideration (all cases)
- Environmental considerations
- Ventilation
- Lighting
- Emergency lighting
- Component arrangement
- Protective equipment
- Display devices

- System controls
- Component controls
- Warning and annunciation system
- Communication system

10. SPACE PROGRAM

The Space Programs represent a compilation of all the identifiable spaces, areas, and rooms, along with their salient features. The Space Program is presented on the following pages.

**THE SPACE PROGRAMMING PAGES IN THIS SECTION
HAVE BEEN INTENTIONALLY LEFT OUT.**

11. CONCEPTUAL DRAWINGS

See Part IV - Conceptual Drawings.

F. QUALITY ASSURANCE

1. GENERAL

The facility design will be conducted under a QA program that complies with DOE Order 5700.6C and that uses the elements of DOE Order 4700.1 and of ANSI/ASME NQA-1, per DOE Order 6430.1A, Section 0140.

This project will comply with the requirements established by LANL Facilities Project Delivery (FPD) procedure 1.01, Graded Approach to Project Management, dated March 28, 1995. This requirement applies to the project planning design, construction, and commissioning phases of this project. The QA program will ensure the appropriate degree of control and verification based upon the complexity of the project and the consequences of failure.

A draft Construction Quality Assurance Plan is included in **Part III - Supplemental Information**. Detailed QA plans and procedures will be developed and implemented for the design, procurement, startup, and operational phases of those activities. The cost of developing those procedures has been included in the estimated project costs.

1.1 Project Management Level and Safety Classifications

The LANL FPD Group requires that projects under its jurisdiction be classified to appropriate Management Levels, per the above procedure. The NMSF renovation project consists of various elements that are preliminarily designated as Management Levels 1, 2, 3, and 4.

The elements are as follows:

Management Level 1

Includes

Structural Systems (MAA)

New concrete walls, roof, charge deck, crane supports, and drywells.

Filtration System

Systems associated with openings to the structural systems.

Management Level 2

Architectural Systems

Finishes, coatings, masonry walls, and non-vault or vault-type doors.

Mechanical

HVAC systems and fire protection for the MAA confinement systems.

Electrical

Low-voltage distribution, lightning protection, fire alarms, and power.

Criticality Alarms

Radiation Protection and Monitoring Systems

MC&A Systems

Crane and Container Handling Machine

Intake and Exhaust Structures
(passive cooling array)

Security Devices Vault doors, alarms, intrusion devices, and cameras.

Electrical UPS Systems

Facility Monitoring Systems

Utilities Fire protection water and RLW lines.

Communications

Management Level 3

Utilities Potable water, natural gas, sanitary sewer, and industrial water.

Mechanical Sanitary waste systems, natural gas, potable and industrial water.

Management Level 4

Improvements to Land

The Management Levels assigned to the SSC may be modified, depending on the hazards analysis and PSAR once complete.

G. SCHEDULES

Attached are Gantt charts and tables detailing project elements, durations, and expected dates. Two options are presented. Option 1 details the schedule for a conventional acquisition strategy, which includes Title I, II, and III, and a competitive construction contract award. Option 2 details a design/build strategy with a single contractor/vendor. A list of Key Milestones is presented in Section H.

NMSF RENOVATION - PROPOSED SCHEDULE FOR CONVENTIONAL ACQUISITION STRATEGY

Critical [Cross-hatched bar] Progress [Solid black bar] Summary [Dotted bar with arrow]
 Noncritical [Horizontal lines bar] Milestone [Diamond] Rolled Up [Diamond]

NMSF RENOVATION - PROPOSED SCHEDULE FOR CONVENTIONAL ACQUISITION STRATEGY

Critical Progress Summary
 Noncritical Milestone Rolled Up

NMSF RENOVATION - PROPOSED SCHEDULE FOR CONVENTIONAL ACQUISITION STRATEGY

Critical

Progress

Summary

Noncritical

Milestone

Rolled Up

ICF KAISER ENGINEERS, INC.

NMSF RENOVATION - PROPOSED SCHEDULE FOR CONVENTIONAL ACQUISITION STRATEGY

Critical

Progress

Summary

Noncritical

Milestone

Rolled Up

ICF KAISER ENGINEERS, INC.

NMSF RENOVATION - PROPOSED SCHEDULE

CONVENTIONAL ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
1	1 LANL PROJ. MGMT & OVERSIGHT	2435d	8/21/93 8:00am	10/22/02 5:00pm
2	1.1 PROJECT MANAGER	487w	8/21/93 8:00am	10/22/02 5:00pm
3	1.2 PROJECT LEADER	487w	8/21/93 8:00am	10/22/02 5:00pm
4	1.3 USER REPRESENTATIVE	487w	8/21/93 8:00am	10/22/02 5:00pm
5	1.4 PROJECT CONTROLLER	136w	8/25/98 8:00am	4/2/01 5:00pm
6	1.5 ADMINISTRATIVE SUPPORT	487w	8/21/93 8:00am	10/22/02 5:00pm
7	1.6 HEALTH & SAFETY ENGINEERING	395w	2/15/95 8:00am	9/10/02 5:00pm
8	1.7 QUALITY ASSURANCE ENG'NG	221.2w	10/1/98 8:00am	12/26/00 5:00pm
9				
10	2 CONCEPTUAL DESIGN PHASE	550d	8/20/93 8:00am	8/1/95 5:00pm
11	2.1 KEY DECISION 0 (KD-0)	0w	8/20/93 8:00am	8/20/93 8:00am
12	2.2 CONCEPTUAL DES. REPORT NO. 1	32.8w	8/21/93 8:00am	2/7/94 5:00pm
13	2.3 PROJECT DEFINITION (F & OR)	38.5w	8/21/93 8:00am	3/18/94 12:00pm
14	2.4 PRELIM. HAZ. ASSESS - CDR NO. 1	11.6w	10/15/93 8:00am	1/4/94 5:00pm
15	2.5 PREPARE PHA - CDR NO. 1	13w	1/4/94 8:00am	4/4/94 5:00pm
16	2.6 SUBMIT DRAFT CDR NO. 1	1d	2/7/94 8:00am	2/7/94 5:00pm
17	2.7 CDR NO. 1 (DRAFT) - REVIEW	85d	2/8/94 8:00am	5/9/94 5:00pm
18	2.8 CDR NO. 1 - COMMENT RESPONSE	212d	5/7/94 8:00am	2/28/95 5:00pm
19	2.9 ADVANCED VALUE ENG STUDY	93d	8/15/94 8:00am	10/21/94 5:00pm
20	2.10 PREPARE CDR NO. 2	105d	10/22/94 8:00am	3/17/95 5:00pm
21	2.11 REVISE PHA	66d	1/16/95 8:00am	4/17/95 5:00pm
22	2.12 SUBMIT CDR NO.2 (90% DRAFT)	0w	3/17/95 5:00pm	3/17/95 5:00pm
23	2.13 LANL TECHNICAL REVIEW	15d	3/20/95 8:00am	4/7/95 5:00pm
24	2.14 ICR (DAME AND MOORE)	21d	3/20/95 8:00am	4/17/95 5:00pm
25	2.15 VULNERABILITY ASSESSMENT	21d	3/20/95 8:00am	4/17/95 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE
CONVENTIONAL ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
26	2.16 DOE TECH. REVIEW (ALBQ & HQ)	30d	3/20/95 8:00am	4/28/95 5:00pm
27	2.17 DOE REVIEW (STONE & WEBSTER)	30d	3/20/95 8:00am	4/28/95 5:00pm
28	2.18 INCORPORATE COMMENTS	21d	5/1/95 8:00am	5/28/95 5:00pm
29	2.19 REPRODUCE/SUBMIT 100% DRAFT	2d	5/30/95 8:00am	5/31/95 5:00pm
30	2.20 ISSUE 100% DRAFT CDR NO. 2	1d	6/1/95 8:00am	6/1/95 5:00pm
31	2.21 DOE CONCUR W/ CDR NO. 2	20d	6/2/95 8:00am	6/29/95 5:00pm
32	2.22 PREPARE PROJECT EXECUTION PLAN	9w	5/1/95 8:00am	6/30/95 5:00pm
33	2.23 ISSUE FINAL CDR NO. 2	1d	6/30/95 8:00am	6/30/95 5:00pm
34	2.24 DOE VALIDATION	21d	7/3/95 8:00am	7/31/95 5:00pm
35	2.25 KEY DECISION 1 (KD-1)	0d	8/1/95 5:00pm	8/1/95 5:00pm
36				
37	3 PRE-DESIGN PHASE	304d	8/2/95 8:00am	9/30/96 5:00pm
38	3.1 PREPARE DESIGN CRITERIA	7w	8/2/95 8:00am	9/19/95 5:00pm
39	3.2 REVIEW NEPA DOCUMENTATION	38w	12/20/95 8:00am	9/10/96 5:00pm
40	3.3 A/E SOLICIT, NEGOTIATE, AWARD	48w	9/20/95 8:00am	8/20/96 5:00pm
41	3.4 CONTINUE FACILITY/SFE R&D	60.8w	8/2/95 8:00am	9/30/96 5:00pm
42				
43	4 FACILITY AND SFE DESIGN PHASE	615d	10/1/96 8:00am	2/8/98 5:00pm
44	4.1 TITLE I DESIGN (FACILITIES & SFE)	180d	10/1/96 8:00am	6/9/97 5:00pm
45	4.2 TITLE I DESIGN REVIEW	75d	6/10/97 8:00am	9/22/97 5:00pm
46	4.3 KEY DECISION NO. 2 (KD-2)	30d	9/23/97 8:00am	11/3/97 5:00pm
47	4.4 TITLE II DESIGN (FACILITIES & SFE)	180d	11/4/97 8:00am	7/13/98 5:00pm
48	4.5 TITLE II DESIGN REVIEW	75d	7/14/98 8:00am	10/28/98 5:00pm
49	4.6 PREPARE DRAFT PSAR	50w	6/10/97 8:00am	5/25/98 5:00pm
50	4.7 REVIEW DRAFT PSAR	30d	5/26/98 8:00am	7/6/98 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE
CONVENTIONAL ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
51	4.8 APPROVE PSAR	0d	7/8/98 5:00pm	7/8/98 5:00pm
52	4.9 KEY DECISION NO. 3 (KD-3)	30d	10/27/98 8:00am	12/7/98 5:00pm
53	4.10 CONSTRUCTION SVC'S SOLICIT. BID	45d	12/8/98 8:00am	2/8/99 5:00pm
54	4.11 PERMITS	45d	12/8/98 8:00am	2/8/99 5:00pm
55				
56	5 TITLE III - CONST. INSPECTION & ENG.	705d	7/14/98 8:00am	3/28/01 5:00pm
57	5.1 CONSTRUCTION ENGINEERING	128w	7/14/98 8:00am	12/11/00 5:00pm
58	5.2 CONSTRUCTION INSPECTION	120w	12/8/98 8:00am	3/28/01 5:00pm
59	5.3 SAFETY INSPECTION	120w	12/8/98 8:00am	3/28/01 5:00pm
60				
61	6 FACILITY AND SFE CONSTRUCTION PHASE	545d	12/8/98 8:00am	1/8/01 5:00pm
62	6.1 SEGREGATE SITE (SECURITY)	30d	12/8/98 8:00am	1/18/99 5:00pm
63	6.2 SFE FABRICATION & INSTALLATION	500d	2/9/99 8:00am	1/8/01 5:00pm
64	6.3 SITEWORK /MISC. DEMOLITION	60d	2/9/99 8:00am	5/3/99 5:00pm
65	6.4 BUILDING DEMOLITION & MOD'S	300d	2/9/99 8:00am	4/3/00 5:00pm
66	6.5 MECH EQUIPMENT FAB & INSTALL	300d	8/15/99 8:00am	8/7/00 5:00pm
67	6.6 ELECTRICAL EQUIP & CONST	300d	4/13/99 8:00am	8/5/00 5:00pm
68	6.7 FIRE PROTECTION	120d	8/15/99 8:00am	11/29/99 5:00pm
69	6.8 EQUIPMENT TIE INS/INSTALL/CTRL'S	60d	8/8/00 8:00am	10/30/00 5:00pm
70	6.9 EQUIPMENT CHECKOUT	45d	10/31/00 8:00am	1/1/01 5:00pm
71	6.10 PREPARE TRANSITION PLAN	240d	12/8/98 8:00am	11/8/99 5:00pm
72	6.11 TEST PLAN	300d	12/8/98 8:00am	1/31/00 5:00pm
73	6.12 PUNCH LIST ACTIVITIES	90d	9/5/00 8:00am	1/8/01 5:00pm
74	6.13 DOE APPROVE TRANSITION PLAN	0w	1/8/01 5:00pm	1/8/01 5:00pm
75				

NMSF RENOVATION - PROPOSED SCHL

CONVENTIONAL ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
76	7 COMMISSIONING PHASE	471d	1/9/01 8:00am	10/29/02 5:00pm
77	7.1 OPERATIONS TRAINING	44d	1/9/01 8:00am	3/9/01 5:00pm
78	7.2 START UP TESTING	110d	1/9/01 8:00am	8/11/01 5:00pm
79	7.3 TURNOVER AND START UP	66d	8/12/01 8:00am	9/11/01 5:00pm
80	7.4 PREPARE FINAL SAR	120d	9/12/01 8:00am	2/28/02 5:00pm
81	7.5 REVIEW FINAL SAR	80d	2/27/02 8:00am	5/21/02 5:00pm
82	7.6 SAR APPROVAL	30d	8/7/02 8:00am	9/17/02 5:00pm
83	7.7 OPERATIONS READINESS REVIEW	285d	7/4/01 8:00am	8/8/02 5:00pm
84	7.8 DOE AND LANL APPROVAL	2w	9/18/02 8:00am	10/1/02 5:00pm
85	7.9 MOVE IN	20d	10/2/02 8:00am	10/29/02 5:00pm
86	7.10 KEY DECISION 4 (KD-4)	0d	10/29/02 5:00pm	10/29/02 5:00pm
87	7.11 OCCUPY FACILITY	0d	10/29/02 5:00pm	10/29/02 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE FOR DESIGN/BUILD ACQUISITION STRATEGY

Critical [Critical Bar Pattern] Progress [Solid Bar] Summary [Summary Bar Pattern]
 Noncritical [Noncritical Bar Pattern] Milestone [Diamond] Rolled Up [Diamond]

NMSF RENOVATION - PROPOSED SCHEDULE FOR DESIGN/BUILD ACQUISITION STRATEGY

[illegible]

ICF KAISER ENGINEERS, INC.

NMSF RENOVATION - PROPOSED SCHEDULE FOR DESIGN/BUILD ACQUISITION STRATEGY

Critical Progress Summary
 Noncritical Milestone Rolled Up

NMSF RENOVATION - PROPOSED SCHEDULE FOR DESIGN/BUILD ACQUISITION STRATEGY

ID	Name	Duration	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
70	6.12 PUNCH LIST ACTIVITIES	90d	J	J	J	J	J	J	J	J	J	J
71	6.13 DOE APPROVE TRANSITION PLAN	0w										
72												
73	7 COMMISSIONING PHASE	471d										
74	7.1 OPERATIONS TRAINING	44d										
75	7.2 START UP TESTING	110d										
76	7.3 TURNOVER AND START UP	88d										
77	7.4 PREPARE FINAL SAR	120d										
78	7.5 REVIEW FINAL SAR	60d										
79	7.6 SAR APPROVAL	30d										
80	7.7 OPERATIONS AND READINESS REVIEW	285d										
81	7.8 DOE AND LANL APPROVAL	2w										
82	7.9 MOVE IN	20d										
83	7.10 KEY DECISION 4 (KD-4)	0d										
84	7.11 OCCUPY FACILITY	0d										

Critical Progress Summary
 Noncritical Milestone Rolled Up

ICF KAISER ENGINEERS, INC.

NMSF RENOVATION - PROPOSED SCH
DESIGN/BUILD ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
1	1 LANL PROJ. MGMT. & OVERSIGHT	2190d	8/21/93 8:00am	11/13/01 5:00pm
2	1.1 PROJECT MANAGER	438w	8/21/93 8:00am	11/13/01 5:00pm
3	1.2 PROJECT LEADER	438w	8/21/93 8:00am	11/13/01 5:00pm
4	1.3 USER REPRESENTATIVE	438w	8/21/93 8:00am	11/13/01 5:00pm
5	1.4 PROJECT CONTROLLER	150w	10/28/97 8:00am	9/11/00 5:00pm
6	1.5 ADMINISTRATIVE SUPPORT	438w	8/21/93 8:00am	11/13/01 5:00pm
7	1.6 HEALTH AND SAFETY ENGINEERING	345w	2/15/95 8:00am	9/25/01 5:00pm
8	1.7 QUALITY ASSURANCE ENGINEERING	210w	10/1/96 8:00am	10/9/00 5:00pm
9				
10	2 CONCEPTUAL DESIGN PHASE	550d	8/20/93 8:00am	8/1/95 5:00pm
11	2.1 KEY DECISION 0 (KD-0)	0w	8/20/93 8:00am	8/20/93 8:00am
12	2.2 CONCEPTUAL DESIGN REPORT NO. 1	32.8w	8/21/93 8:00am	2/7/94 5:00pm
13	2.3 PROJECT DEFINITION (DRAFT F & OR)	38.5w	8/21/93 8:00am	3/18/94 12:00pm
14	2.4 PRELIMINARY HAZARDS ASSESSMENT - CDR NO. 1	11.8w	10/15/93 8:00am	1/4/94 5:00pm
15	2.5 PREPARE PHA - CDR NO. 1	13w	1/4/94 8:00am	4/4/94 5:00pm
16	2.6 SUBMIT DRAFT CDR NO. 1	1d	2/7/94 8:00am	2/7/94 5:00pm
17	2.7 CDR NO. 1 (DRAFT) - REVIEW	65d	2/8/94 8:00am	5/8/94 5:00pm
18	2.8 CDR NO. 1 (DRAFT) - COMMENT RESPONSE	61d	5/7/94 8:00am	8/1/94 5:00pm
19	2.9 ADVANCED VALUE ENGINEERING STUDY	93d	8/15/94 8:00am	10/21/94 5:00pm
20	2.10 PREPARE CDR NO. 2	105d	10/22/94 8:00am	3/17/95 5:00pm
21	2.11 REVISE PHA	88d	1/18/95 8:00am	4/17/95 5:00pm
22	2.12 SUBMIT CDR NO.2 (90% DRAFT)	0w	3/17/95 5:00pm	3/17/95 5:00pm
23	2.13 LANL TECHNICAL REVIEW	15d	3/20/95 8:00am	4/7/95 5:00pm
24	2.14 ICR (DAME AND MOORE)	21d	3/20/95 8:00am	4/17/95 5:00pm
25	2.15 VULNERABILITY ASSESSMENT	21d	3/20/95 8:00am	4/17/95 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE **DESIGN/BUILD ACQUISITION STRATEGY**

ID	Name	Duration	Scheduled Start	Scheduled Finish
26	2.16 DOE TECHNICAL REVIEW (ALBO & HQ)	30d	3/20/95 8:00am	4/28/95 5:00pm
27	2.17 DOE REVIEW (STONE AND WEBSTER)	30d	3/20/95 8:00am	4/28/95 5:00pm
28	2.18 INCORPORATE COMMENTS	21d	5/1/95 8:00am	5/28/95 5:00pm
29	2.19 REPRODUCE AND SUBMIT 100% DRAFT	2d	5/30/95 8:00am	5/31/95 5:00pm
30	2.20 ISSUE 100% DRAFT CDR NO. 2	1d	6/1/95 8:00am	6/1/95 5:00pm
31	2.21 DOE CONCURRENCE WITH CDR NO. 2	20d	6/2/95 8:00am	6/28/95 5:00pm
32	2.22 ISSUE FINAL CDR NO. 2	1d	6/30/95 8:00am	6/30/95 5:00pm
33	2.23 PREPARE PROJECT EXECUTION PLAN	8w	5/1/95 8:00am	6/30/95 5:00pm
34	2.24 DOE VALIDATION	21d	7/3/95 8:00am	7/31/95 5:00pm
35	2.25 KEY DECISION 1 (KD-1) - BEGIN DESIGN	0d	8/1/95 5:00pm	8/1/95 5:00pm
36				
37	3 PRE-DESIGN PHASE	304d	8/2/95 8:00am	8/30/96 5:00pm
38	3.1 PREPARE DESIGN CRITERIA	10w	8/2/95 8:00am	10/10/95 5:00pm
39	3.2 REVIEW NEPA DOCUMENTATION	38w	12/20/95 8:00am	9/10/96 5:00pm
40	3.3 SOLICITATION, NEGOTIATIONS, AND AWARD	50.8w	10/11/95 8:00am	8/30/96 5:00pm
41	3.4 KEY DECISION NO. 2 (KD-2)	0d	9/30/96 5:00pm	9/30/96 5:00pm
42	3.5 CONTINUE FACILITY/SFE R&D	58.8w	8/2/95 8:00am	8/18/96 5:00pm
43				
44	4 FACILITY AND SFE DESIGN PHASE	370d	10/1/96 8:00am	3/2/98 5:00pm
45	4.1 FACILITY AND SFE DESIGN	280d	10/1/96 8:00am	10/27/97 5:00pm
46	4.2 DESIGN REVIEW	90d	10/28/97 8:00am	3/2/98 5:00pm
47	4.3 PREPARE DRAFT PSAR	50w	10/1/96 8:00am	8/15/97 5:00pm
48	4.4 REVIEW DRAFT PSAR	30d	8/16/97 8:00am	10/27/97 5:00pm
49	4.5 APPROVE PSAR	0d	10/27/97 5:00pm	10/27/97 5:00pm
50	4.6 PERMITS	45d	12/30/97 8:00am	3/2/98 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE
DESIGN/BUILD ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
51	4.7 KEY DECISION NO. 3 (KD-3) - DOE APPROVAL	0w	3/2/98 5:00pm	3/2/98 5:00pm
52				
53	5 TITLE III - CONSTRUCTION INSPECTION & ENGINEERING	650d	3/3/98 8:00am	8/28/00 5:00pm
54	5.1 CONSTRUCTION ENGINEERING	130w	3/3/98 8:00am	8/28/00 5:00pm
55	5.2 CONSTRUCTION INSPECTION	130w	3/3/98 8:00am	8/28/00 5:00pm
56	5.3 SAFETY INSPECTION	130w	3/3/98 8:00am	8/28/00 5:00pm
57				
58	6 FACILITY AND SFE CONSTRUCTION PHASE	580d	10/28/97 8:00am	1/31/00 5:00pm
59	6.1 SEGREGATE SITE (SECURITY)	80d	10/28/97 8:00am	1/18/98 5:00pm
60	6.2 SPEC. FACIL. EQUIP. FABRICATION & INSTALLATION	500d	3/3/98 8:00am	1/31/00 5:00pm
61	6.3 SITEWORK AND MISCELLANEOUS DEMOLITION	60d	3/3/98 8:00am	5/25/98 5:00pm
62	6.4 BUILDING DEMOLITION AND MODIFICATIONS	300d	3/3/98 8:00am	4/28/99 5:00pm
63	6.5 MECHANICAL EQUIPMENT FABRICATION & INSTALLATION	300d	7/7/98 8:00am	8/30/99 5:00pm
64	6.6 ELECTRICAL EQUIPMENT & CONSTRUCTION	300d	5/5/98 8:00am	8/28/99 5:00pm
65	6.7 FIRE PROTECTION	120d	7/7/98 8:00am	12/21/98 5:00pm
66	6.8 EQUIPMENT TIE INS/INSTALLATION AND CONTROLS	60d	8/31/99 8:00am	11/22/99 5:00pm
67	6.9 EQUIPMENT CHECKOUT	45d	11/23/99 8:00am	1/24/00 5:00pm
68	6.10 PREPARE TRANSITION PLAN	240d	3/3/98 8:00am	2/1/99 5:00pm
69	6.11 TEST PLAN	300d	3/3/98 8:00am	4/28/99 5:00pm
70	6.12 PUNCH LIST ACTIVITIES	90d	9/28/98 8:00am	1/31/00 5:00pm
71	6.13 DOE APPROVE TRANSITION PLAN	0w	1/31/00 5:00pm	1/31/00 5:00pm
72				
73	7 COMMISSIONING PHASE	471d	2/1/00 8:00am	11/20/01 5:00pm
74	7.1 OPERATIONS TRAINING	44d	2/1/00 8:00am	3/31/00 5:00pm
75	7.2 START UP TESTING	110d	2/1/00 8:00am	7/3/00 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE**DESIGN/BUILD ACQUISITION STRATEGY**

ID	Name	Duration	Scheduled Start	Scheduled Finish
76	7.3 TURNOVER AND START UP	66d	7/4/00 8:00am	10/3/00 5:00pm
77	7.4 PREPARE FINAL SAR	120d	7/4/00 8:00am	12/18/00 5:00pm
78	7.5 REVIEW FINAL SAR	60d	12/19/00 8:00am	3/12/01 5:00pm
79	7.6 SAR APPROVAL	30d	8/29/01 8:00am	10/9/01 5:00pm
80	7.7 OPERATIONS AND READINESS REVIEW	285d	7/28/00 8:00am	8/28/01 5:00pm
81	7.8 DOE AND LANL APPROVAL	2w	10/10/01 8:00am	10/23/01 5:00pm
82	7.9 MOVE IN	20d	10/24/01 8:00am	11/20/01 5:00pm
83	7.10 KEY DECISION 4 (KD-4)	0d	11/20/01 5:00pm	11/20/01 5:00pm
84	7.11 OCCUPY FACILITY	0d	11/20/01 5:00pm	11/20/01 5:00pm

H. KEY MILESTONES

Schedules have been established for a conventional acquisition strategy using a Title I, II, and III design process, as well as for a design/build strategy using a detailed design phase (Title II) only. Detailed Gantt charts and task summary sheets are included in **Part II - Project Management**.

Key milestones are listed below.

DESIGN / BUILD ACQUISITION (capital-funded activities start on 10/1/96)

<u>ITEM</u>	<u>DATE</u>
Key Decision 1 (Authorization to Begin Title I Design)	8/1/95
Start Pre-design Phase	8/2/95
Key Decision 2 (Select Vendor)	9/30/96
Start LANL Project Management and Oversight (FSS-6 and User)	10/1/96
Complete Facility and SFE Design (Title II)	10/27/97
Approve PSAR	10/27/97
Complete Design Review	3/2/98
Key Decision 3	3/2/98
Start Construction	3/3/98
End Construction	1/31/00
Complete Operational Readiness Review	8/28/01
Final SAR Approval	10/9/01
Key Decision 4 (Transition to Operations and Occupy Facility)	11/20/01

CONVENTIONAL ACQUISITION (capital-funded activities start on 10/1/96)

<u>ITEM</u>	<u>DATE</u>
Key Decision 1 (Authorization to Begin Title I Design)	8/1/95
Start Pre-design Phase	8/2/95
Start AE Acquisition	9/20/95
Start LANL Project Management and Oversight (FSS-6 and User), and Begin Title I Design Under Capital Funds	10/1/96
Complete Title I	6/9/97
Complete Title I Design Review	9/22/97
Key Decision 2 (begin Title II Design)	11/3/97
Approve PSAR	7/6/98
Complete Title II	7/13/98
Complete Title II Design Review	10/26/98
Key Decision 3	12/7/98
Start Construction	12/8/98
End Construction and DOE Approve Transition Plan	1/8/01
Complete Operational Readiness Review	8/6/02
Final SAR Approval	9/17/02
Key Decision 4 (Transition to Operations and Occupy Facility)	10/29/02

I. COST ESTIMATE AND CONTINGENCY SUMMARY

Attached are summaries of the estimated project costs.

University of California
Los Alamos National Laboratory
TOTAL PROJECT CONSTRUCTION COST (TPC) SUMMARY
CONVENTIONAL ACQUISITION STRATEGY

PROJECT TITLE: NMSF CONCEPTUAL DESIGN REPORT

JOB NUMBER: 11813

DATE: 07/13/95

ITEM DESCRIPTION				SUBTOTAL	TOTAL COST
BURDENED TPC SUMMARY					
A. Design and Management Costs					\$8,808,833
1. Facility ED&I				\$5,159,266	
WBS	Category				
A. B1F01	Title I	(@ 6.4% of ECC)	\$1,769,456		
B. B2F01	Title II	(@ 6.2% of ECC)	\$1,727,675		
C. B3F01	Title III	(@ 6.0% of ECC)	\$1,662,133		
2. Special Facilities ED&I				\$847,413	
WBS	Category				
A. B1S01	Title I	(@ 1.9% of SFE)	\$332,070		
B. B2S01	Title II	(@ 2.2% of SFE)	\$384,394		
C. B3S01	Title III	(@ 0.7% of SFE)	\$130,949		
3. Project Management				\$2,802,154	
WBS	Category				
A. A1F01	Project Management	(@ 5.4% of ECC+ED&I+SFE)	\$1,686,110		
B. A2F01	Construction Management	(@ 3.6% of ECC+ED&I+SFE)	\$1,116,044		
B. Construction Cost (ECC+SFE)					\$27,717,979
WBS	Category				
1. C3A Building & Site (ECC)					
A. Modifications			\$7,322,410		
2. Other Structures (ECC)				\$122,044	
WBS	Category				
A. C3B	Utility Building		\$70,443.00		
B. C3C	Mech. Penthouse		\$51,601.00		
3. Special Facilities Equipment (SFE)				\$17,487,712	
WBS	Category				
A. E2O	Security Systems Equipment		\$1,037,562.00		
B. E2L	NDA Equipment		\$5,656,008.00		
C. E2C	Facility Monitoring System (Controls & Monitors)		\$1,861,390.00		
D. E2S	Storage Equipment		\$8,932,752.00		
WBS	Category				
4. C5	Utilities (ECC)		\$93,206		
5. C1C	Demolition (ECC)		\$761,074		
6. C1S	Special Security Construction (ECC)		\$636,345		
7. C2	Sitework (ECC)		\$34,600		
8. C0O11	Field Overhead & Expenses (ECC)		\$1,260,588		
WBS	Category				
C. B4M01 Laboratory Procurement Burden					\$923,892
1. Construction Contract	(\$24,185,098)	(3.25%)	\$791,112		
2. A/E Design Contracts	(\$2,227,235)	(3.25%)	\$110,698		
3. SFE Design Contract	(\$445,714)	(3.25%)	\$22,082		
SUBTOTAL				\$37,450,704	
D. Contingency					\$7,840,870
E. Total Estimated Construction Costs (TEC)					\$45,291,574
F. Other Project Costs (OPC)				(@ 25.1% of TEC)	\$11,361,099
G. Total Project Costs (TPC)					\$56,652,673

University of California
Los Alamos National Laboratory
TOTAL PROJECT CONSTRUCTION COST (TPC) SUMMARY
DESIGN/BUILD ACQUISITION STRATEGY

PROJECT TITLE: NMSF CONCEPTUAL DESIGN REPORT

JOB NUMBER: 11818

DATE: 07/13/95

ITEM DESCRIPTION		BURDENED TPC SUMMARY		SUBTOTAL	TOTAL COST
A. Design and Management Costs		(@ 24.0% % of ECC+SFE)			\$6,463,110
1. Facility ED&I				\$3,466,170	
WBS	Category				
A. B1F01	Title I	(@ 0.0% of ECC)	\$0		
B. B2F01	Title II	(@ 7.1% of ECC)	\$1,914,754		
C. B3F01	Title III	(@ 5.8% of ECC)	\$1,551,416		
2. Special Facilities ED&I				\$509,625	
WBS	Category				
A. B1S01	Title I	(@ 0.0% of SFE)	\$0		
B. B2S01	Title II	(@ 2.3% of SFE)	\$383,392		
C. B3S01	Title III	(@ 0.7% of SFE)	\$126,233		
3. Project Management				\$2,487,315	
WBS	Category				
A. A1F01	Project Management	(@ 3.8% of ECC+ED&I+SFE)	\$1,151,888		
B. A2F01	Construction Management	(@ 4.5% of ECC+ED&I+SFE)	\$1,335,427		
B. Construction Cost (ECC+SFE)					\$26,965,032
WBS	Category				
1. C3A Building & Site (ECC)					
A. Modifications				\$7,185,243	
2. Other Structures (ECC)				\$121,693	
WBS	Category				
A. C3B	Utility Building		\$70,240.00		
B. C3C	Mech. Penthouse		\$51,453.00		
3. Special Facilities Equipment (SFE)				\$17,020,355	
WBS	Category				
A. E2O	Security Systems Equipment		\$1,009,834.00		
B. E2L	NDA Equipment		\$5,504,852.00		
C. E2C	Facility Monitoring System (Controls & Monitors)		\$1,811,644.00		
D. E2S	Storage Equipment		\$8,694,025.00		
4. C5 Utilities (ECC)				\$90,451	
5. C1C Demolition (ECC)				\$729,512	
6. C1S Special Security Construction (ECC)				\$609,957	
7. C2 Sitework (ECC)				\$33,578	
8. C0011 Field Overhead & Expenses (ECC)				\$1,174,243	
WBS	Category				
C. B4M01 Laboratory Procurement Burden					\$867,940
1. Construction Contract		(\$24,143,059) (3.25%)	\$789,746		
2. A/E Design Contracts		(\$1,300,759) (3.25%)	\$65,570		
3. SFE Design Contract		\$256,772 (3.25%)	\$12,624		
SUBTOTAL				\$34,296,082	
D. Contingency					\$7,949,231
E. Total Estimated Construction Costs (TEC)					\$42,245,313
F. Other Project Costs (OPC)		(@ 25.8% of TEC)			\$10,890,295
G. Total Project Costs (TPC)					\$53,135,608

J. ACRONYMS AND ABBREVIATIONS

AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
AE	architect-engineer
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AL	Albuquerque Operations Office (DOE)
ALARA	as low as reasonably achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing Materials
AWI	American Woodwork Institute
AWS	American Welding Society
AWWA	American Water Works Association
BUS	Business Operations
CAM	continuous air monitor
CC	cooling coil
CCB	Change Configuration Board
CDR	Conceptual Design Report
CFR	Code of Federal Regulations
CFM	cubic feet per minute
CMAA	Crane Manufacturers Association of America
CMAS	criticality monitoring and alarm system
CMU	concrete masonry unit
CRT	cargo restraint transport
CSA	Critical Systems Analysis
CST	Chemical Science & Technology
DAM	data acquisition module
dB	decibel
DBA	design basis accident
DBE	design basis earthquake

DDC	direct digital control
DOE	U.S. Department of Energy
DOP	dioctyl phthalate
EA	environmental assessment
ED&I	engineering, design, and inspection
EIS	environmental impact statement
EPRI	Electric Power Research Institute
ERDA	Energy Research and Development Administration
ESH	Environment, Safety, and Health
FAS	fixed air sampler
FGMA	Flat Glass Marketing Association
FM	Factory Mutual Engineering and Research
FMS	Facility Monitoring System
FPD	Facilities Project Delivery
FS	Federal Specifications
FSS	Facilities, Security, and Safeguards
FY	fiscal year
GM	Geiger-Muller
HEPA	high-efficiency particulate air
HOA	hands-off automatic
HP	horsepower
HVAC	heating, ventilation, and air conditioning
IAEA	International Atomic Energy Agency
IAPMCO	International Association of Plumbing & Mechanical Officials
ICBO	International Conference of Building Officials
I/O	input/output
IEEE	Institute of Electrical and Electronic Engineers
IESNA	Illumination Engineering Society of North America
IRI	Industrial Risk Insurers
KD	key decision
LAO	Los Alamos Area Office (DOE)
LAN	local area network
LANL	Los Alamos National Laboratory
LPI	Lightning Protection Institute
MAA	material access area
MASS	Material Accountability & Safeguards System (LANL)
MC&A	material control and accountability
MCC	motor control center
MLSFA	Metal Lath/Steel Framing Association

MMI	man-machine interface
NAAMM	National Association for Architectural Metal Manufacturers
NAPHCC	National Association of Plumbing-Heating-Cooling Contractors
NDA	nondestructive assay
NEBB	National Environmental Balancing Bureau
NEMA	National Electric Manufacturers Association
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NMRT	Nuclear Materials & Reconfiguration Technology
NMSF	Nuclear Materials Storage Facility
NMSHTD	New Mexico State Highway & Transportation Department
NMT	Nuclear Materials Technology
NRC	Nuclear Regulatory Commission
NSPC	National Standard Plumbing Code
NTIS	National Technical Information Service
OIU	operator interface unit
O&M	operations and maintenance
OPC	other project costs
ORR	operational readiness review
PATS	Project Authorization and Tracking System
PC	microcomputer
PCA	Portland Cement Association
PDCA	Painting and Decorating Contractors of America
PF	Plutonium Facility
PHA	preliminary hazards analysis
PIDAS	perimeter intrusion detection and assessment system
PL	Project Leader
PLC	programmable logic controller
PM	Project Manager
PMD	Project Management Division
PSAR	preliminary safety analysis report
QA	quality assurance
RAM	remote area monitors
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RFCI	Resilient Floor Covering Institute
RLW	radioactive liquid waste
SAR	safety analysis report

SDI	Steel Deck Institute
SFE	special facilities equipment
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association
SNM	special nuclear material
SOP	standard operating procedure
SPC	special protective coating
SQL	structured query language
SSC	systems, structures, and components
SST	safe, secure transport
SWB	switchboard
TA	technical area
TCA	Tile Council of America, Inc.
TIMA	Thermal Insulation Manufacturers Association
UBC	Uniform Building Code
UC	University of California
UCRL	University of California Research Laboratories
UL	Underwriters Laboratories
UPC	Uniform Plumbing Code
UPS	uninterruptible power supply
WBS	work breakdown structure
WRD&T	weapons research, development, and testing
WSS	Walkie Straddle Stacker

A. PROJECT MANAGEMENT ORGANIZATION

1. GENERAL

Responsibility for the NMSF Project flows from the DOE Assistant Secretary for Defense Programs (DP-1), through the Principal Deputy Assistant Secretary for Facilities (DP-3) and the Deputy Assistant Secretary for Facilities (DP-30), to the Office of Construction and Capital Projects (DP-32).

Robert Hamby is the designated Project Director within the DP-32 organization. As such, he has overall responsibility for this project from the standpoint of project management, budgeting, and scheduling. The Project Director is responsible for ensuring that the program requirements of the Office of Stockpile Support (DP-2) are included in the project scope; he interacts closely with the DP-2 Director or his appointee. Under the direction of the Assistant Secretary for Defense Programs, the DP-32 Project Director is responsible for DOE project management.

Day-to-day responsibility for the execution of the project is delegated to the DOE Albuquerque Operations Office (DOE/AL) and, through it, to the DOE Los Alamos Area Office (DOE/LAAO) and the Project Manager (PM), Juan Griego. The Director, Project Management Division (PMD), DOE/AL, is directly responsible for authorizing the various elements of work and funding associated with this project, controlling the project baselines within the established AL thresholds, providing quality assurance oversight, and maintaining coordination between AL and DP-32. Day-to-day project interface is the responsibility of the assigned PMD Project Engineer.

The LAAO Project Manager is directly responsible for

- implementing design and construction controls to ensure adherence to scope, cost, and schedule baselines;
- ensuring that ES&H issues are addressed;
- reporting;
- instituting change control;
- maintaining effective communications;
- coordinating with DOE Headquarters, project, and program offices; and
- providing direction and guidance to LANL.

The LAAO PM also serves as the primary DOE source of information for all issues relating to the project and interface for all communications between DOE and LANL.

The organization and functions shown on the following NMSF Project Functional Organization Chart included in this section conform to the requirements established by LANL. These functions and responsibilities are briefly described in the following paragraphs.

1.1 Department of Energy Organization

Assistant Secretary for Defense Programs (DP-1). The Assistant Secretary has full responsibility for the planning and execution of program activities, subject to the constraints of plans, policies, strategies, legislation, allocation, and the DOE project management system.

Project Director, Office of Construction and Capital Projects (DP-32). Management responsibility for the NMSF Project has been delegated to the DP-32 Project Director. Management responsibilities include

- reviewing and approving DOE-controlled baselines and milestones;
- securing resources;
- providing program policy and program budget/funding fiscal year guidance; and
- monitoring and evaluating cost, schedule, and overall project progress.

The Project Director is responsible for program interfaces and functions as the formal and primary point of contact for NMSF Project activities within DOE.

Project Engineer, DOE/AL. The PMD Project Engineer is responsible for authorizing work elements and funding associated with those elements, controlling the project baselines within the established AL thresholds, providing QA oversight, and maintaining adequate and efficient coordination with DP-32.

Project Manager, DOE/LAAO. DOE/Field Office responsibility has been assigned to DOE/AL and delegated to DOE/LAAO. Responsibilities of LAAO include surveillance of the execution and management of project activities, preparation of environmental documentation, development of internal management plans, implementation of management and control systems, and review of progress reporting. These efforts are under the direction of Juan Griego, LAAO Project Manager.

1.2 Los Alamos National Laboratory Organization

LANL Management Team. The NMSF Project requires the resources of three directorates in the LANL organization. Nuclear Materials and Reconfiguration Technology (NMRT) Programs provides the operational funding to carry out the Stockpile Support program activities at LANL. The NMT Division facilitates the coordination of the functional, operational, and technical requirements of the NMSF Project in relation to the Stockpile Support program requirements.

The FSS Division is responsible for facilities construction project management at LANL. This project management effort is executed by the Facilities Project Delivery Group (FSS-6) through the FSS-6 Group Leader, the Projects Team Leader, and the Project Leader. The FSS Division is ultimately responsible for establishing and maintaining project baselines and implementing the Configuration Control Board (CCB). The Projects Team Leader serves as a liaison between the Stockpile Support Program and the NMSF project. The FSS-6 Project Leader and the NMT Facility Project Leader are

responsible for ensuring that adequate NMSF staffing needs are identified to their group and program managers.

Should staff support conflicts arise, the FSS-6 Project Leader or the NMT Facility Project Leader will identify project impacts to LANL for management resolution. Should inadequate staffing or any other unanticipated change of plan (such as scope increase, schedule slippage, or cost increase) occur, the FSS-6 Project Leader will initiate a CCB action if the effect exceeds those cost, scope, or schedule thresholds set forth in the NMSF Project Plan.

FSS-6 Project Leader (PL). The PL has overall day-to-day responsibility for the successful completion of the project, including planning, organizing, directing, and coordinating project activities. The PL is responsible for meeting the project scope as set forth in the Construction Project Data Sheet and for completing the project within authorized funding and the approved schedule. The PL will work closely with the user's technical representative to ensure that the project accomplishes LANL's needs by meeting approved technical specifications and scope of work. The PL is ultimately responsible for configuration control and will initiate any CCB actions required to revise the project's cost, schedule, or technical baselines.

NMT Facility Project Leader. The NMT Facility Project Leader has responsibility within LANL to ensure that the completed project meets programmatic objectives. During the implementation stage (after line-item funding), this manager will work closely with the PL and coordinate the technical efforts of the various LANL participants so that the project can be completed within scope, cost, and schedule.

The NMT Facility Project Leader will coordinate the input from the user group and ensure that these requirements are addressed by the Design/Construction Team. In addition, he or she will provide contract technical authority for all design and fabrication contracts for SFE. The final completion and successful start-up of the NMSF Project will be the NMT Facility Project Leader's responsibility.

Facilities Project Design Team. A FSS-6 project design team, consisting of an architect and engineers of the civil, structural, mechanical, and electrical disciplines, has been assigned to this project. The FSS-6 Project Leader will serve as the point of contact with the team and will assist the user in planning, organizing, directing, and controlling LANL project activities relating to facility design and construction. The project design team is responsible for preparation of the CDR and Facilities Design Criteria documents. The functions of the team during Title I, II, and III phases include

- being available to interpret the project's design criteria document (prepared by the Design Team) and
- monitoring the project's design phase to ensure that design solutions proposed by the AE firm will properly accommodate the activities to be housed, including space, functional, technical, and environmental requirements as set forth by the design criteria.

The preliminary and final drawings, specifications, calculations, design analysis, and cost estimates are reviewed by the project design team. In performance of the above, the design team will participate in meetings and presentations concerning the AE's design. FSS-6 representatives will observe ongoing facilities construction to ensure that performance is in accordance with the contract requirements and applicable codes and standards. Any deviations will be reported to the FSS-6 Project Leader. An FSS-6 Cost Estimating Engineer will provide oversight of AE estimating activities and will provide government estimates as required to provide a basis for contractor cost proposal comparison.

NMT-8 Quality Assurance Group. The NMT-8 QA Group is responsible for management of QA-related activities for the NMSF construction project. QA administration will be performed by the FSS-6 Project Leader with the assistance of the QA representative and the facility operating group.

Environment, Safety, and Health Division. The LANL ESH Division will be responsible for all aspects of health and safety, including environmental protection, safety analysis, and safety inspection of the project. It will review plans and specifications to ensure that the design complies with all applicable environmental, safety, and health codes and standards.

LANL Business Operations (BUS) Division. The Contract Administration Group within the BUS Division serves as the focal point for procuring contracts with the AE and design/engineering firms as well as construction contractors and equipment vendors. BUS will be responsible for procurement, award, and contract administration functions.

Legal Counsel. The LANL legal counsel will review all specifications, secure the University of California (UC) legal counsel's approval, serve as the focal point for comments from the UC legal staff, and conduct the defense of all disputed claims.

Other LANL Support. Other LANL divisions and groups, such as Security Operations (FSS-10), Material Control and Accountability (FSS-12), Radiology (ESH-12), Criticality Safety (ESH-6), Heat Transfer (TSA-8), Process Analysis (TSA-7), Radiation Shielding (ESH-12), and NDA Equipment Design (NIS-5) will support the FSS-6 Project Leader and the NMT Facility Project Leader in their areas of responsibility.

Support Services Subcontractor. The support services subcontractor will make all connections to existing utility systems and make any required modifications to other operating systems. This contractor may also be used to provide rigging support.

1.3 Other Organizations

Architect-Engineer. The functions of the AE team during the Titles I, II, and III phases include executing preliminary and final drawings, specifications, calculations, design analysis, and cost estimates. In performance of the above, the AE team will participate in meetings and presentations concerning the design. During construction, the AE team will provide technical support to address questions and problems that are encountered in the field.

Facilities Construction Contractors. The construction contractors are responsible for the construction of the facilities and utilities in accordance with the terms and conditions of the construction contracts.

B. PROJECT MANAGEMENT ELEMENTS

All manpower required for administration of this project by DOE and LANL exists within the established organizations. Section A.1, Project Management Organization, discusses the dedicated project staff. Project development and management will be in accordance with DOE and LANL documents referenced in Section C.3, Project Controls and Reporting Systems.

This section presents the work breakdown structure (WBS), WBS index, WBS definition sheets, and project schedules for two acquisition strategies. The first set of tables illustrates a conventional acquisition strategy; the second set presents a design/build acquisition strategy.

1. WORK BREAKDOWN STRUCTURE

The WBS is a hierarchial development of the work elements required to complete the NMSF project. The WBS depicts the work in a formalized manner and is the basis of the technical scope, cost, and schedule. The WBS is used for planning, measurement, and control of all work elements for the project.

2. WBS INDEX

The WBS Index identifies the indenture level and numbering of each work element within the project scope. It is designed to assist the FSS-6 Project Leader in developing the rationale for the WBS hierarchy, and is the index for all work elements within the project.

3. WBS ELEMENT DEFINITION SHEETS

The WBS Element Definition Sheets define the technical, cost, and schedule content of the Level I and II WBS elements. These WBS Element Definition Sheets are intended for project guidance and examples and will be developed as part of the Project Management Plan.

4. PROJECT SCHEDULE

The Project Schedule includes those project development activities required to validate the project to support the FY97 budget submittal. The format of the schedule is driven by the project WBS. The schedule presents the scheduled activities within each of the WBS Level III work elements. (See the Schedules in **Part I, Section G.**)

The schedule was completed based on the following assumptions:

- Validation will be completed in time to support FY97 budget submittal.
- Operating funding will be used for Pre-Title I activities.
- Initial FY97 line-item funding will be available for project use on 10/1/96.
- DOE Title I review and KD-2 approval will be completed within six weeks of Title I design summary distribution.

NMSF RENOVATION
OPTION NO. 1
CONVENTIONAL ACQUISITION STRATEGY

WORK BREAKDOWN STRUCTURE

U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART I - INDEX

1. PROJECT TITLE/PARTICIPANT NMSF: Los Alamos National Laboratory						2. DATE 06/26/95		3. IDENTIFICATIONNUMBER 11818		
4. LINE NO.	5. WBS ELEMENTS					TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET REPORTING NO.	8. PHASE	9. OTHER
	INDENTURE LEVEL									
	1	2	3	4	5					
1	X					NMSF	1.0			
2		X				Project Management	1.1			
3			X			Project Manager	1.1.1			
4			X			Project Leader	1.1.2			
5			X			User Representative	1.1.3			
6			X			Project Controller	1.1.4			
7			X			Administrative Support	1.1.5			
8			X			Health & Safety Engineering	1.1.6			
9			X			Quality Assurance Engineering	1.1.7			
10		X				Conceptual Design	1.2			
11			X			Key Decision 0 (KD-0)	1.2.1			
12			X			Conceptual Design Report #1	1.2.2			
13			X			Project Definition (F&OR)	1.2.3			
14			X			Review NEPA Documentation	1.2.4			
15			X			Preliminary Hazard Assessment - CDR#1	1.2.5			
16			X			Prepare PHA - CDR#1	1.2.6			
17			X			Submit CDR#1 - DRAFT	1.2.7			
18			X			CDR#1 (DRAFT)- Review	1.2.8			
19			X			CDR#1 - Comment Response	1.2.9			
20			X			Advanced Value Engineering Study	1.2.10			
21			X			Prepare CDR#2	1.2.11			
22			X			Revise PHA	1.2.12			
23			X			Submit CDR#2 - DRAFT	1.2.13			

1. PROJECT TITLE/PARTICIPANT NMSF: Los Alamos National Laboratory						2. DATE 06/26/95		3. IDENTIFICATIONNUMBER 11818		
4. LINE NO.	5. WBS ELEMENTS					TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET REPORTING NO.	8. PHASE	9. OTHER
	INDENTURE LEVEL									
	1	2	3	4	5					
24			X			LANL Technical Review	1.2.14			
25			X			ICR (Dames & Moore)	1.2.15			
26			X			Vulnerability Assessment	1.2.16			
27			X			DOE Technical Review (ALBQ & HDQ)	1.2.17			
28			X			DOE Review (Stone & Webster)	1.2.18			
29			X			Incorporate Comments	1.2.19			
30			X			Reproduce/Submit 100% DRAFT	1.2.20			
31			X			Issue 100% Draft CDR #2	1.2.21			
32			X			DOE Concur W/CDR#2	1.2.22			
33			X			Prepare Project Execution Plan	1.2.23			
34			X			Issue Final CDR#2	1.2.24			
35			X			DOE Validation	1.2.25			
36			X			Key Decision 1 (KD-1)	1.2.26			
37		X				Pre-Design Phase	1.3			
38			X			Prepare Design Criteria	1.3.1			
39			X			NEPA Disposition	1.3.2			
40			X			A/E Solicit, Negotiate, Award	1.3.3			
41			X			Continue Facility/SFE R&D	1.3.4			
42		X				Facility & SFE Design	1.4			
43			X			Title I Design (Facilities & SFE)	1.4.1			
44			X			Title I Design Review	1.4.2			
45			X			Key Decision #2 (KD-2)	1.4.3			
46			X			Title II Design (Facilities & SFE)	1.4.4			
47			X			Title II Design Review	1.4.5			
48			X			Prepare DRAFT PSAR	1.4.6			
49			X			Review DRAFT PSAR	1.4.7			
50			X			Approve PSAR	1.4.8			
51			X			KEY Decision #3 (KD-3)	1.4.9			

1. PROJECT TITLE/PARTICIPANT NMSF: Los Alamos National Laboratory						2. DATE 06/26/95		3. IDENTIFICATIONNUMBER 11818		
4. LINE NO.	5. WBS ELEMENTS					TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET REPORTING NO.	8. PHASE	9. OTHER
	INDENTURE LEVEL									
	1	2	3	4	5					
52			X			Construction Services Solicit, Bid	1.4.10			
53			X			Permits	1.4.11			
54		X				Title III- Construction Engineering & Inspec.	1.5			
55			X			Construction Engineering	1.5.1			
56			X			Construction Inspection	1.5.2			
57			X			Safety Inspection	1.5.3			
58		X				Facility & SFE Construction	1.6			
59			X			Segregate Site (Security)	1.6.1			
60			X			SFE Fabrication & Installation	1.6.2			
61			X			Sitework/Misc. Demolition	1.6.3			
62			X			Building Demolition & Modifications	1.6.4			
63			X			Mechanical Equipment Fabrication & Installation	1.6.5			
64			X			Electrical Equipment Fabrication & Installation	1.6.6			
65			X			Fire Protection Equipment	1.6.7			
66			X			Equipment Tie-ins/Cntrls	1.6.8			
67			X			Equipment Checkout	1.6.9			
68			X			Prepare Transition Plan	1.6.10			
69			X			Test Plan	1.6.11			
70			X			Punch List Activities	1.6.12			
71			X			DOE Approve Transition Plan	1.6.13			
72		X				Commissioning Phase	1.7			
73			X			Operations Training	1.7.1			
74			X			Start-Up Testing	1.7.2			
75			X			Turnover/Start-Up	1.7.3			
76			X			Prepare Final SAR	1.7.4			
77			X			Review Final SAR	1.7.5			

1. PROJECT TITLE/PARTICIPANT NMSF: Los Alamos National Laboratory						2. DATE 06/26/95		3. IDENTIFICATIONNUMBER 11818		
4. LINE NO.	5. WBS ELEMENTS					TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET REPORTING NO.	8. PHASE	9. OTHER
	INDENTURE LEVEL									
	1	2	3	4	5					
78			X			SAR Approval	1.7.6			
79			X			Operations Readiness Review	1.7.7			
80			X			DOE & LANL Approval	1.7.8			
81			X			Move-In	1.7.9			
82			X			Key Decision 4 (KD-4)	1.7.10			
83			X			Occupy Facility	1.7.11			

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO.																																																			
4. WBS ELEMENT CODE 1.0	5. WBS ELEMENT TITLE NMSF																																																				
6. INDEX LINE NO. 1	7. REV. NO & AUTH 0	8. DATE 06/21/95																																																			
9. APPROVED CHANGES NONE																																																					
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER																																																			
<div style="border: 1px solid black; padding: 5px;"> <p>ELEMENT TASK DESCRIPTION</p> <p>A. TECHNICAL CONTENT:</p> <ul style="list-style-type: none"> 1.1 LANL Project Management & Oversight 1.2 Conceptual Design Phase 1.3 Pre Design Phase 1.4 Facility and SFE Design Phase 1.5 Title III Const. Eng. and Inspection 1.6 Facility and SFE Construction 1.7 Commissioning Phase <p>B. SCHEDULE CONTENT:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">START</th> <th style="text-align: center;">FINISH</th> </tr> </thead> <tbody> <tr> <td>1.1 LANL Project Management & Oversight</td> <td style="text-align: center;">6/21/93</td> <td style="text-align: center;">10/22/02</td> </tr> <tr> <td>1.2 Conceptual Design Phase</td> <td style="text-align: center;">6/20/93</td> <td style="text-align: center;">8/01/95</td> </tr> <tr> <td>1.3 Pre Design Phase</td> <td style="text-align: center;">8/02/95</td> <td style="text-align: center;">9/30/96</td> </tr> <tr> <td>1.4 Facility and SFE Design Phase</td> <td style="text-align: center;">10/01/96</td> <td style="text-align: center;">2/08/99</td> </tr> <tr> <td>1.5 Title III Const. Eng. and Inspection</td> <td style="text-align: center;">7/14/98</td> <td style="text-align: center;">3/26/01</td> </tr> <tr> <td>1.6 Facility and SFE Construction</td> <td style="text-align: center;">12/08/98</td> <td style="text-align: center;">1/08/01</td> </tr> <tr> <td>1.7 Commissioning Phase</td> <td style="text-align: center;">1/09/01</td> <td style="text-align: center;">10/29/02</td> </tr> </tbody> </table> <p>C. COST CONTENT</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">TEC</th> <th style="text-align: center;">OPC</th> </tr> </thead> <tbody> <tr> <td>1.1 LANL Project Management & Oversight</td> <td style="text-align: right;">\$3,362,585</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td>1.2 Conceptual Design Phase</td> <td style="text-align: right;">\$0</td> <td style="text-align: right;">\$3,298,049</td> </tr> <tr> <td>1.3 Pre Design Phase</td> <td style="text-align: right;">\$132,780</td> <td style="text-align: right;">\$3,228,742</td> </tr> <tr> <td>1.4 Facility and SFE Design Phase</td> <td style="text-align: right;">\$5,873,257</td> <td style="text-align: right;">\$469,604</td> </tr> <tr> <td>1.5 Title III Const. Eng. and Inspection</td> <td style="text-align: right;">\$2,158,250</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td>1.6 Facility and SFE Construction</td> <td style="text-align: right;">\$33,764,702</td> <td style="text-align: right;">\$247,355</td> </tr> <tr> <td>1.7 Commissioning Phase</td> <td style="text-align: right;">\$0</td> <td style="text-align: right;">\$4,117,349</td> </tr> <tr> <td style="text-align: right;">WBS 1.0 TOTAL</td> <td style="text-align: right; border-top: 1px solid black;">\$45,291,574</td> <td style="text-align: right; border-top: 1px solid black;">\$11,361,099</td> </tr> </tbody> </table> </div>				START	FINISH	1.1 LANL Project Management & Oversight	6/21/93	10/22/02	1.2 Conceptual Design Phase	6/20/93	8/01/95	1.3 Pre Design Phase	8/02/95	9/30/96	1.4 Facility and SFE Design Phase	10/01/96	2/08/99	1.5 Title III Const. Eng. and Inspection	7/14/98	3/26/01	1.6 Facility and SFE Construction	12/08/98	1/08/01	1.7 Commissioning Phase	1/09/01	10/29/02		TEC	OPC	1.1 LANL Project Management & Oversight	\$3,362,585	\$0	1.2 Conceptual Design Phase	\$0	\$3,298,049	1.3 Pre Design Phase	\$132,780	\$3,228,742	1.4 Facility and SFE Design Phase	\$5,873,257	\$469,604	1.5 Title III Const. Eng. and Inspection	\$2,158,250	\$0	1.6 Facility and SFE Construction	\$33,764,702	\$247,355	1.7 Commissioning Phase	\$0	\$4,117,349	WBS 1.0 TOTAL	\$45,291,574	\$11,361,099
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**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.1	5. WBS ELEMENT TITLE LANL PROJECT MANAGEMENT & OVERSIGHT	
6. INDEX LINE NO. 2	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION: LANL PROJECT MANAGEMENT & OVERSIGHT		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.1.1 Project Manager
- 1.1.2 Project Leader
- 1.1.3 User Representative
- 1.1.4 Project Controller
- 1.1.5 Administrative Support
- 1.1.6 Health & Safety Engineering
- 1.1.7 Quality Assurance

B. SCHEDULE CONTENT:

	START	FINISH
1.1.1 Project Manager	6/21/93	10/22/02
1.1.2 Project Leader	6/21/93	10/22/02
1.1.3 User Representative	6/21/93	11/13/01
1.1.4 Project Controller	10/28/97	9/11/00
1.1.5 Administrative Support	6/21/93	11/13/01
1.1.6 Health & Safety Engineering	2/15/95	9/25/01
1.1.7 Quality Assurance	10/01/96	10/9/00

C. COST CONTENT

	TEC	OPC
1.1.1 Project Manager	\$0	\$--
1.1.2 Project Leader	\$794,738	\$--
1.1.3 User Representative	\$794,738	\$--
1.1.4 Project Controller	\$222,151	\$--
1.1.5 Administrative Support	\$627,425	\$--
1.1.6 Health & Safety Engineering	\$315,174	\$--
1.1.7 Quality Assurance	\$608,358	\$--
WBS 1.1 TOTAL	\$3,362,585	\$--

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818																																																
4. WBS ELEMENT CODE 1.2	5. WBS ELEMENT TITLE CONCEPTUAL DESIGN PHASE																																																	
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<div style="border: 1px solid black; padding: 5px;"> ELEMENT TASK DESCRIPTION A. TECHNICAL CONTENT: <ul style="list-style-type: none"> 1.2.1 Key Decision 0 (KD-0) 1.2.2 Conceptual Design Report #1 1.2.3 Project Definition (F&OR) 1.2.4 Review NEPA Documentation 1.2.5 Prelim. Haz. assess-CDR No. 1 1.2.6 Prepare PHA-CDR No. 1 1.2.7 Submit Draft CDR-No. 1 B. SCHEDULE CONTENT: <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th></th> <th style="text-align: center;">START</th> <th style="text-align: center;">FINISH</th> </tr> </thead> <tbody> <tr><td>1.2.1 Key Decision 0 (KD-0)</td><td style="text-align: center;">6/20/93</td><td style="text-align: center;">6/20/93</td></tr> <tr><td>1.2.2 Conceptual Design Report #1</td><td style="text-align: center;">6/21/93</td><td style="text-align: center;">2/07/94</td></tr> <tr><td>1.2.3 Project Definition (F&OR)</td><td style="text-align: center;">6/21/93</td><td style="text-align: center;">3/18/94</td></tr> <tr><td>1.2.4 Review NEPA Documentation</td><td style="text-align: center;">6/21/93</td><td style="text-align: center;">6/21/94</td></tr> <tr><td>1.2.5 Prelim. Haz. assess-CDR No. 1</td><td style="text-align: center;">10/15/93</td><td style="text-align: center;">1/4/94</td></tr> <tr><td>1.2.6 Prepare PHA-CDR No. 1</td><td style="text-align: center;">1/4/94</td><td style="text-align: center;">4/4/94</td></tr> <tr><td>1.2.7 Submit Draft CDR-No. 1</td><td style="text-align: center;">2/7/94</td><td style="text-align: center;">2/7/94</td></tr> </tbody> </table> C. COST CONTENT <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th></th> <th style="text-align: center;">TEC</th> <th style="text-align: center;">OPC</th> </tr> </thead> <tbody> <tr><td>1.2.1 Key Decision 0 (KD-0)</td><td style="text-align: center;">\$--</td><td style="text-align: center;">\$0</td></tr> <tr><td>1.2.2 Conceptual Design Report #1</td><td style="text-align: center;">\$--</td><td style="text-align: center;">\$1,006,960</td></tr> <tr><td>1.2.3 Project Definition (F&OR)</td><td style="text-align: center;">\$--</td><td style="text-align: center;">\$500,435</td></tr> <tr><td>1.2.4 Review NEPA Documentation</td><td style="text-align: center;">\$--</td><td style="text-align: center;">\$139,378</td></tr> <tr><td>1.2.5 Prelim. Haz. assess-CDR No. 1</td><td style="text-align: center;">\$--</td><td style="text-align: center;">\$24,540</td></tr> <tr><td>1.2.6 Prepare PHA-CDR No. 1</td><td style="text-align: center;">\$--</td><td style="text-align: center;">\$30,000</td></tr> <tr><td>1.2.7 Submit Draft CDR-No. 1</td><td style="text-align: center;">\$--</td><td style="text-align: center;">\$0</td></tr> </tbody> </table> </div>				START	FINISH	1.2.1 Key Decision 0 (KD-0)	6/20/93	6/20/93	1.2.2 Conceptual Design Report #1	6/21/93	2/07/94	1.2.3 Project Definition (F&OR)	6/21/93	3/18/94	1.2.4 Review NEPA Documentation	6/21/93	6/21/94	1.2.5 Prelim. Haz. assess-CDR No. 1	10/15/93	1/4/94	1.2.6 Prepare PHA-CDR No. 1	1/4/94	4/4/94	1.2.7 Submit Draft CDR-No. 1	2/7/94	2/7/94		TEC	OPC	1.2.1 Key Decision 0 (KD-0)	\$--	\$0	1.2.2 Conceptual Design Report #1	\$--	\$1,006,960	1.2.3 Project Definition (F&OR)	\$--	\$500,435	1.2.4 Review NEPA Documentation	\$--	\$139,378	1.2.5 Prelim. Haz. assess-CDR No. 1	\$--	\$24,540	1.2.6 Prepare PHA-CDR No. 1	\$--	\$30,000	1.2.7 Submit Draft CDR-No. 1	\$--	\$0
	START	FINISH																																																
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U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.2 (continued)	5. WBS ELEMENT TITLE CONCEPTUAL DESIGN PHASE	
6. INDEX LINE NO. 10	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.2.8 CDR No. 1 (Draft) - Review
- 1.2.9 CDR No. 1 - Comment Response
- 1.2.10 Advanced Value Eng Study
- 1.2.11 Prepare CDR No. 2
- 1.2.12 Revise PHA
- 1.2.13 Submit CDR No. 2

B. SCHEDULE CONTENT:

	START	FINISH
1.2.8 CDR No. 1 (Draft)-Review	2/08/94	5/09/94
1.2.9 CDR No. 1-Comment Response	5/07/94	2/28/95
1.2.10 Advanced Value Eng Study	6/15/94	10/21/94
1.2.11 Prepare CDR No. 2	10/22/94	3/17/95
1.2.12 Revise PHA	1/16/95	4/17/95
1.2.13 Submit CDR No. 2 (Draft)	3/17/95	3/17/95

C. COST CONTENT

	TEC	OPC
1.2.8 CDR No. 1 (Draft) - Review	\$--	\$0
1.2.9 CDR No. 1 - Comment Response	\$--	\$89,351
1.2.10 Advanced Value Eng Study	\$--	\$226,958
1.2.11 Prepare CDR No. 2	\$--	\$811,325
1.2.12 Revise PHA	\$--	\$50,000
1.2.13 Submit CDR No. 2	\$--	\$0

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.2 (continued)	5. WBS ELEMENT TITLE CONCEPTUAL DESIGN PHASE	
6. INDEX LINE NO. 10	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:	11. BUDGET & REPORTING NUMBER	

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.2.14 LANL Technical Review (Cost Included in 1.1)
- 1.2.15 ICR (Dames & Moore)
- 1.2.16 Vulnerability Assessment
- 1.2.17 DOE Technical Review (ALBQ & HQ)
- 1.2.18 DOE Review (Stone & Webster)
- 1.2.19 Incorporate Comments

B. SCHEDULE CONTENT:

	START	FINISH
1.2.14 LANL Technical Review (Cost Included in 1.1)	3/20/95	4/07/95
1.2.15 ICR (Dames & Moore)	3/20/95	4/17/95
1.2.16 Vulnerability Assessment	3/20/95	4/17/95
1.2.17 DOE Technical Review (ALBQ & HQ)	2/20/95	4/28/95
1.2.18 DOE Review (Stone & Webster)	3/20/95	4/28/95
1.2.19 Incorporate Comments	5/01/95	5/29/95

C. COST CONTENT

	TEC	OPC
1.2.14 LANL Technical Review (Cost Included in 1.1)	\$---	\$50,000
1.2.15 ICR (Dames & Moore)	\$---	\$80,348
1.2.16 Vulnerability Assessment	\$---	\$15,131
1.2.17 DOE Technical Review (ALBQ & HQ)	\$---	\$76,000
1.2.18 DOE Review (Stone & Webster)	\$---	\$76,000
1.2.19 Incorporate Comments	\$---	\$100,000

U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
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1. PROJECT TITLE/PARTICIPANT NMSF LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.2 (continued)	5. WBS ELEMENT TITLE CONCEPTUAL DESIGN PHASE	
6. INDEX LINE NO. 10	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION		
A. TECHNICAL CONTENT:		
1.2.20 Reproduce/Submit 100% Draft 1.2.21 Issue 100% Draft CDR 1.2.22 DOE Concur with CDR No. 2 1.2.23 Prepare Project Execution Plan 1.2.24 Issue Final CDR No. 2 1.2.25 DOE Validation 1.2.26 Key Decision 1 (KD-1)		
B. SCHEDULE CONTENT:		
	START	FINISH
1.2.20 Reproduce/Submit 100% Draft	5/30/95	5/31/95
1.2.21 Issue 100% Draft CDR	6/01/95	6/01/95
1.2.22 DOE Concur with CDR No. 2	6/02/95	6/29/95
1.2.23 Prepare Project Execution Plan	5/01/95	6/30/95
1.2.24 Issue Final CDR No. 2	6/30/95	6/30/95
1.2.25 DOE Validation	7/03/95	7/31/95
1.2.26 Key Decision 1 (KD-1)	8/01/95	8/01/95
C. COST CONTENT		
	TEC	OPC
1.2.20 Reproduce/Submit 100% Draft	\$---	\$20,000
1.2.21 Issue 100% Draft CDR	\$---	\$0
1.2.22 DOE Concur with CDR No. 2	\$---	\$0
1.2.23 Prepare Project Execution Plan	\$---	\$0
1.2.24 Issue Final CDR No. 2	\$---	\$0
1.2.25 DOE Validation	\$---	\$31,623
1.2.26 Key Decision 1 (KD-1)	\$---	\$0
WBS 1.2 TOTAL	\$0	\$3,298,049

U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.3	5. WBS ELEMENT TITLE PRE DESIGN PHASE	
6. INDEX LINE NO. 37	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.3.1 Prepare Design Criteria
- 1.3.2 NEPA Disposition
- 1.3.3 A/E Solicit, Negotiate, Award
- 1.3.4 Continue Facility/SFE R&D

B. SCHEDULE CONTENT:

	START	FINISH
1.3.1 Prepare Design Criteria	8/02/95	09/19/95
1.3.2 NEPA Disposition	12/20/95	9/10/96
1.3.3 A/E Solicit, Negotiate, Award	9/20/95	8/20/96
1.3.4 Continue Facility/SFE R&D	8/2/95	9/30/96

C. COST CONTENT

	TEC	OPC
1.3.1 Prepare Design Criteria	\$---	\$211,077
1.3.2 NEPA Disposition	\$---	\$0
1.3.3 A/E Solicit, Negotiate, Award	\$132,780	\$--
1.3.4 Continue Facility/SFE R&D	\$---	\$3,017,665
WBS 1.3 TOTAL	\$132,780	\$3,228,742

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.4	5. WBS ELEMENT TITLE FACILITY AND SFE DESIGN PHASE	
6. INDEX LINE NO. 42	7. REV. NO & AUTH 0	8. DATE 6/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:	11. BUDGET & REPORTING NUMBER	

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.4.1 Title I Design (Facilities and SFE)
- 1.4.2 Title I Design Review
- 1.4.3 Key Decision No. 2 (KD-2)
- 1.4.4 Title II Design (Facilities and SFE)
- 1.4.5 Title II Design Review
- 1.4.6 Prepare Draft PSAR
- 1.4.7 Review Draft PSAR

B. SCHEDULE CONTENT:

	START	FINISH
1.4.1 Title I Design (Facilities and SFE)	10/01/96	6/09/97
1.4.2 Title I Design Review	6/10/97	9/22/97
1.4.3 Key Decision No. 2 (KD-2)	9/23/97	11/03/97
1.4.4 Title II Design (Facilities and SFE)	11/04/97	7/13/98
1.4.5 Title II Design Review	7/14/98	10/26/98
1.4.6 Prepare Draft PSAR	6/10/97	5/25/98
1.4.7 Review Draft PSAR	5/26/98	7/06/98

C. COST CONTENT

	TEC	OPC
1.4.1 Title I Design (Facilities and SFE)	\$1,903,830	\$---
1.4.2 Title I Design Review	\$634,610	\$---
1.4.3 Key Decision No. 2 (KD-2)	\$---	\$---
1.4.4 Title II Design (Facilities and SFE)	\$1,915,279	\$---
1.4.5 Title II Design Review	\$628,426	\$---
1.4.6 Prepare Draft PSAR	\$---	\$376,857
1.4.7 Review Draft PSAR	\$---	\$50,000

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.4 (continued)	5. WBS ELEMENT TITLE FACILITY AND SFE DESIGN PHASE	
6. INDEX LINE NO. 42	7. REV. NO & AUTH 0	8. DATE 6/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION			
A. TECHNICAL CONTENT:			
1.4.8 Approve PSAR 1.4.9 Key Decision No. 3 (KD-3) 1.4.10 Construction Services Solicitation/Bid 1.4.11 Permits			
B. SCHEDULE CONTENT:			
	START	FINISH	
1.4.8 Approve PSAR	7/06/98	7/06/98	
1.4.9 Key Decision No. 3 (KD-3)	10/27/98	12/07/98	
1.4.10 Construction Services Solicitation/Bid	12/08/98	2/08/99	
1.4.11 Permits	12/08/98	2/08/99	
C. COST CONTENT			
	TEC	OPC	
1.4.8 Approve PSAR	\$---	\$---	
1.4.9 Key Decision No. 3 (KD-3)	\$---	\$---	
1.4.10 Construction Services Solicitation/Bid	\$791,112	\$---	
1.4.11 Permits	\$---	\$42,747	
WBS 1.4 TOTAL	\$5,873,257	\$469,604	

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818																											
4. WBS ELEMENT CODE 1.5	5. WBS ELEMENT TITLE TITLE III - CONSTRUCTION INSPECTION AND ENGINEERING																												
6. INDEX LINE NO. 54	7. REV. NO & AUTH 0	8. DATE 06/21/95																											
9. APPROVED CHANGES NONE																													
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER																											
<div style="border: 1px solid black; padding: 5px;"> ELEMENT TASK DESCRIPTION A. TECHNICAL CONTENT: 1.5.1 Construction Engineering 1.5.2 Construction Inspection 1.5.3 Safety Inspection B. SCHEDULE CONTENT: <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="width: 20%; text-align: center;">START</th> <th style="width: 20%; text-align: center;">FINISH</th> </tr> </thead> <tbody> <tr> <td>1.5.1 Construction Engineering</td> <td style="text-align: center;">7/14/98</td> <td style="text-align: center;">12/11/00</td> </tr> <tr> <td>1.5.2 Construction Inspection</td> <td style="text-align: center;">12/08/98</td> <td style="text-align: center;">3/26/01</td> </tr> <tr> <td>1.5.3 Safety Inspection</td> <td style="text-align: center;">12/08/98</td> <td style="text-align: center;">3/26/01</td> </tr> </tbody> </table> C. COST CONTENT <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="width: 20%; text-align: center;">TEC</th> <th style="width: 20%; text-align: center;">OPC</th> </tr> </thead> <tbody> <tr> <td>1.5.1 Construction Engineering</td> <td style="text-align: center;">\$1,387,230</td> <td style="text-align: center;">\$---</td> </tr> <tr> <td>1.5.2 Construction Inspection</td> <td style="text-align: center;">\$385,510</td> <td style="text-align: center;">\$---</td> </tr> <tr> <td>1.5.3 Safety Inspection</td> <td style="text-align: center;">\$385,510</td> <td style="text-align: center;">\$---</td> </tr> <tr> <td style="text-align: right;">WBS 1.5 TOTAL</td> <td style="text-align: center; border-top: 1px solid black;">\$2,158,250</td> <td style="text-align: center; border-top: 1px solid black;">\$0</td> </tr> </tbody> </table> </div>				START	FINISH	1.5.1 Construction Engineering	7/14/98	12/11/00	1.5.2 Construction Inspection	12/08/98	3/26/01	1.5.3 Safety Inspection	12/08/98	3/26/01		TEC	OPC	1.5.1 Construction Engineering	\$1,387,230	\$---	1.5.2 Construction Inspection	\$385,510	\$---	1.5.3 Safety Inspection	\$385,510	\$---	WBS 1.5 TOTAL	\$2,158,250	\$0
	START	FINISH																											
1.5.1 Construction Engineering	7/14/98	12/11/00																											
1.5.2 Construction Inspection	12/08/98	3/26/01																											
1.5.3 Safety Inspection	12/08/98	3/26/01																											
	TEC	OPC																											
1.5.1 Construction Engineering	\$1,387,230	\$---																											
1.5.2 Construction Inspection	\$385,510	\$---																											
1.5.3 Safety Inspection	\$385,510	\$---																											
WBS 1.5 TOTAL	\$2,158,250	\$0																											

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.6	5. WBS ELEMENT TITLE FACILITY AND SFE CONSTRUCTION PHASE	
6. INDEX LINE NO. 58	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.6.1 Segregate Site Security
- 1.6.2 SFE Fabrication and Installation
- 1.6.3 Sitework/Miscellaneous Demolition
- 1.6.4 Building Demolition and Modifications
- 1.6.5 Mechanical Equipment Fabrication/Installation
- 1.6.6 Electrical Equipment and Construction
- 1.6.7 Fire Protection

B. SCHEDULE CONTENT:

	START	FINISH
1.6.1 Segregate Site Security	12/08/98	1/08/01
1.6.2 SFE Fabrication and Installation	2/09/99	1/08/01
1.6.3 Sitework/Miscellaneous Demolition	2/09/99	5/03/99
1.6.4 Building Demolition and Modifications	2/09/99	4/03/99
1.6.5 Mechanical Equip. Fabrication/Installation	6/15/99	8/07/00
1.6.6 Electrical Equipment and Construction	4/13/99	6/05/00
1.6.7 Fire Protection	6/15/99	11/29/99

C. COST CONTENT

	TEC	OPC
1.6.1 Segregate Site Security	\$831,673	\$---
1.6.2 SFE Fabrication and Installation	\$19,923,062	\$---
1.6.3 Sitework/Miscellaneous Demolition	\$954,834	\$---
1.6.4 Building Demolition and Modifications	\$4,812,918	\$---
1.6.5 Mechanical Equipment Fabrication/Installation	\$3,069,671	\$---
1.6.6 Electrical Equipment and Construction	\$1,253,605	\$---
1.6.7 Fire Protection	\$364,748	\$---

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.6 (continued)	5. WBS ELEMENT TITLE FACILITY AND SFE CONSTRUCTION PHASE	
6. INDEX LINE NO. 58	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:	11. BUDGET & REPORTING NUMBER	

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.6.8 Equipment Tie-Ins & Controls
- 1.6.9 Equipment Checkout
- 1.6.10 Prepare Transition Plan
- 1.6.11 Test Plan
- 1.6.12 Punch List Activities
- 1.6.13 DOE Approve Transition Plan

B. SCHEDULE CONTENT:

	START	FINISH
1.6.8 Equipment Tie-Ins & Controls	8/08/00	10/30/00
1.6.9 Equipment Checkout	10/31/00	1/01/01
1.6.10 Prepare Transition Plan	12/08/98	11/08/99
1.6.11 Test Plan	12/08/98	1/31/00
1.6.12 Punch List Activities	9/05/00	1/08/01
1.6.13 DOE Approve Transition Plan	1/08/01	1/08/01

C. COST CONTENT

	TEC	OPC
1.6.8 Equipment Tie-Ins & Controls	\$2,435,465	\$---
1.6.9 Equipment Checkout	\$36,242	\$50,000
1.6.10 Prepare Transition Plan	\$---	\$50,000
1.6.11 Test Plan	\$36,242	\$147,355
1.6.12 Punch List Activities	\$36,242	\$---
1.6.13 DOE Approve Transition Plan	\$---	\$---
WBS 1.6 TOTAL	\$33,764,702	\$247,355

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO.
4. WBS ELEMENT CODE 1.7	5. WBS ELEMENT TITLE COMMISSIONING PHASE	
6. INDEX LINE NO. 72	7. REV. NO & AUTH 0 —	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.7.1 Operations Training
- 1.7.2 Start Up Testing
- 1.7.3 Turnover and Start Up
- 1.7.4 Prepare Final SAR
- 1.7.5 Review Final SAR
- 1.7.6 SAR Approval
- 1.7.7 Operations Readiness Review

B. SCHEDULE CONTENT:

	START	FINISH
1.7.1 Operations Training	1/09/01	3/09/01
1.7.2 Start Up Testing	1/09/01	6/11/01
1.7.3 Turnover and Start Up	6/12/01	9/11/01
1.7.4 Prepare Final SAR	9/12/01	2/26/02
1.7.5 Review Final SAR	2/27/02	5/21/02
1.7.6 SAR Approval	8/07/02	9/17/02
1.7.7 Operations Readiness Review	7/04/01	8/06/02

C. COST CONTENT

	TEC	OPC
1.7.1 Operations Training	\$---	\$523,695
1.7.2 Start Up Testing	\$---	\$603,124
1.7.3 Turnover and Start Up	\$---	\$787,518
1.7.4 Prepare Final SAR	\$---	\$300,000
1.7.5 Review Final SAR	\$---	\$100,000
1.7.6 SAR Approval	\$---	\$50,000
1.7.7 Operations Readiness Review	\$---	\$1,657,369

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 1)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO.
4. WBS ELEMENT CODE 1.7 (continued)	5. WBS ELEMENT TITLE COMMISSIONING PHASE	
6. INDEX LINE NO. 72	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.7.8 DOE and LANL Approval
- 1.7.9 Move In
- 1.7.10 Key Decision 4 (KD-4)
- 1.7.11 Occupy Facility

B. SCHEDULE CONTENT:

	START	FINISH
1.7.8 DOE and LANL Approval	9/18/02	10/01/02
1.7.9 Move In	10/02/02	10/29/02
1.7.10 Key Decision 4 (KD-4)	10/29/02	10/29/02
1.7.11 Occupy Facility	10/29/02	10/29/02

C. COST CONTENT

	TEC	OPC
1.7.8 DOE and LANL Approval	\$---	\$33,838
1.7.9 Move In	\$---	\$61,805
1.7.10 Key Decision 4 (KD-4)	\$---	\$---
1.7.11 Occupy Facility	\$---	\$---
WBS 1.7 TOTAL	\$0	\$4,117,349

NMSE RENOVATION - PROPOSED SCHEDULE FOR CONVENTIONAL ACQUISITION STRATEGY

NMSE RENOVATION - PROPOSED SCHEDULE FOR CONVENTIONAL ACQUISITION STRATEGY

NMSF RENOVATION - PROPOSED SCHEDULE FOR CONVENTIONAL ACQUISITION STRATEGY

NMSF RENOVATION - PROPOSED SCHEDULE FOR CONVENTIONAL ACQUISITION STRATEGY

ICF KAISER ENGINEERS, INC.

NMSF RENOVATION - PROPOSED SCHEDULE
CONVENTIONAL ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
1	1 LANL PROJ. MGMT & OVERSIGHT	2435d	6/21/93 8:00am	10/22/02 5:00pm
2	1.1 PROJECT MANAGER	487w	6/21/93 8:00am	10/22/02 5:00pm
3	1.2 PROJECT LEADER	487w	6/21/93 8:00am	10/22/02 5:00pm
4	1.3 USER REPRESENTATIVE	487w	6/21/93 8:00am	10/22/02 5:00pm
5	1.4 PROJECT CONTROLLER	138w	8/25/98 8:00am	4/2/01 5:00pm
6	1.5 ADMINISTRATIVE SUPPORT	487w	6/21/93 8:00am	10/22/02 5:00pm
7	1.6 HEALTH & SAFETY ENGINEERING	395w	2/15/95 8:00am	9/10/02 5:00pm
8	1.7 QUALITY ASSURANCE ENG'NG	221.2w	10/1/96 8:00am	12/26/00 5:00pm
9				
10	2 CONCEPTUAL DESIGN PHASE	550d	6/20/93 8:00am	8/1/95 5:00pm
11	2.1 KEY DECISION 0 (KD-0)	0w	6/20/93 8:00am	6/20/93 8:00am
12	2.2 CONCEPTUAL DES. REPORT NO. 1	32.8w	6/21/93 8:00am	2/7/94 5:00pm
13	2.3 PROJECT DEFINITION (F & OR)	38.5w	6/21/93 8:00am	3/18/94 12:00pm
14	2.4 REVIEW NEPA DOCUMENTATION	52w	6/21/93 8:00am	6/21/94 5:00pm
15	2.5 PRELIM. HAZ. ASSESS - CDR NO. 1	11.6w	10/15/93 8:00am	1/4/94 5:00pm
16	2.6 PREPARE PHA - CDR NO. 1	13w	1/4/94 8:00am	4/4/94 5:00pm
17	2.7 SUBMIT DRAFT CDR NO. 1	1d	2/7/94 8:00am	2/7/94 5:00pm
18	2.8 CDR NO. 1 (DRAFT) - REVIEW	65d	2/8/94 8:00am	5/9/94 5:00pm
19	2.9 CDR NO. 1 - COMMENT RESPONSE	212d	5/7/94 8:00am	2/28/95 5:00pm
20	2.10 ADVANCED VALUE ENG STUDY	93d	6/15/94 8:00am	10/21/94 5:00pm
21	2.11 PREPARE CDR NO. 2	105d	10/22/94 8:00am	3/17/95 5:00pm
22	2.12 REVISE PHA	66d	1/18/95 8:00am	4/17/95 5:00pm
23	2.13 SUBMIT CDR NO.2 (90% DRAFT)	0w	3/17/95 5:00pm	3/17/95 5:00pm
24	2.14 LANL TECHNICAL REVIEW	15d	3/20/95 8:00am	4/7/95 5:00pm
25	2.15 ICR (DAME AND MOORE)	21d	3/20/95 8:00am	4/17/95 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE

CONVENTIONAL ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
26	2.16 VULNERABILITY ASSESSMENT	21d	3/20/95 8:00am	4/17/95 5:00pm
27	2.17 DOE TECH. REVIEW (ALBQ & HQ)	30d	3/20/95 8:00am	4/28/95 5:00pm
28	2.18 DOE REVIEW (STONE & WEBSTER)	30d	3/20/95 8:00am	4/28/95 5:00pm
29	2.19 INCORPORATE COMMENTS	21d	5/1/95 8:00am	5/29/95 5:00pm
30	2.20 REPRODUCE/SUBMIT 100% DRAFT	2d	5/30/95 8:00am	5/31/95 5:00pm
31	2.21 ISSUE 100% DRAFT CDR NO. 2	1d	6/1/95 8:00am	6/1/95 5:00pm
32	2.22 DOE CONCUR W/ CDR NO. 2	20d	6/2/95 8:00am	6/29/95 5:00pm
33	2.23 PREPARE PROJECT EXECUTION PLAN	9w	5/1/95 8:00am	6/30/95 5:00pm
34	2.24 ISSUE FINAL CDR NO. 2	1d	6/30/95 8:00am	6/30/95 5:00pm
35	2.25 DOE VALIDATION	21d	7/3/95 8:00am	7/31/95 5:00pm
36	2.26 KEY DECISION 1 (KD-1)	0d	8/1/95 5:00pm	8/1/95 5:00pm
37				
38	3 PRE-DESIGN PHASE	304d	8/2/95 8:00am	9/30/96 5:00pm
39	3.1 PREPARE DESIGN CRITERIA	7w	8/2/95 8:00am	9/19/95 5:00pm
40	3.2 NEPA DISPOSITION	38w	12/20/95 8:00am	9/10/96 5:00pm
41	3.3 A/E SOLICIT, NEGOTIATE, AWARD	48w	9/20/95 8:00am	8/20/96 5:00pm
42	3.4 CONTINUE FACILITY/SFE R&D	60.8w	8/2/95 8:00am	9/30/96 5:00pm
43				
44	4 FACILITY AND SFE DESIGN PHASE	615d	10/1/96 8:00am	2/8/98 5:00pm
45	4.1 TITLE I DESIGN (FACILITIES & SFE)	180d	10/1/96 8:00am	6/9/97 5:00pm
46	4.2 TITLE I DESIGN REVIEW	75d	6/10/97 8:00am	9/22/97 5:00pm
47	4.3 KEY DECISION NO. 2 (KD-2)	30d	9/23/97 8:00am	11/3/97 5:00pm
48	4.4 TITLE II DESIGN (FACILITIES & SFE)	180d	11/4/97 8:00am	7/13/98 5:00pm
49	4.5 TITLE II DESIGN REVIEW	75d	7/14/98 8:00am	10/26/98 5:00pm
50	4.6 PREPARE DRAFT PSAR	50w	6/10/97 8:00am	5/25/98 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE **CONVENTIONAL ACQUISITION STRATEGY**

ID	Name	Duration	Scheduled Start	Scheduled Finish
51	4.7 REVIEW DRAFT PSAR	30d	5/26/98 8:00am	7/6/98 5:00pm
52	4.8 APPROVE PSAR	0d	7/6/98 5:00pm	7/6/98 5:00pm
53	4.9 KEY DECISION NO. 3 (KD-3)	30d	10/27/98 8:00am	12/7/98 5:00pm
54	4.10 CONSTRUCTION SVC'S SOLICIT. BID	45d	12/8/98 8:00am	2/8/99 5:00pm
55	4.11 PERMITS	45d	12/8/98 8:00am	2/8/99 5:00pm
56				
57	5 TITLE III - CONST. INSPECTION & ENG.	705d	7/14/98 8:00am	3/26/01 5:00pm
58	5.1 CONSTRUCTION ENGINEERING	126w	7/14/98 8:00am	12/11/00 5:00pm
59	5.2 CONSTRUCTION INPECTION	120w	12/8/98 8:00am	3/26/01 5:00pm
60	5.3 SAFETY INSPECTION	120w	12/8/98 8:00am	3/26/01 5:00pm
61				
62	6 FACILITY AND SFE CONSTRUCTION PHASE	545d	12/8/98 8:00am	1/8/01 5:00pm
63	6.1 SEGREGATE SITE (SECURITY)	30d	12/8/98 8:00am	1/18/99 5:00pm
64	6.2 SFE FABRICATION & INSTALLATION	500d	2/9/99 8:00am	1/8/01 5:00pm
65	6.3 SITEWORK /MISC. DEMOLITION	80d	2/9/99 8:00am	5/3/99 5:00pm
66	6.4 BUILDING DEMOLITION & MOD'S	300d	2/9/99 8:00am	4/3/00 5:00pm
67	6.5 MECH EQUIPMENT FAB & INSTALL	300d	8/15/99 8:00am	8/7/00 5:00pm
68	6.6 ELECTRICAL EQUIP & CONST	300d	4/13/99 8:00am	8/5/00 5:00pm
69	6.7 FIRE PROTECTION	120d	8/15/99 8:00am	11/29/99 5:00pm
70	6.8 EQUIPMENT TIE IN/INSTALL/CTRL'S	80d	8/8/00 8:00am	10/30/00 5:00pm
71	6.9 EQUIPMENT CHECKOUT	45d	10/31/00 8:00am	1/1/01 5:00pm
72	6.10 PREPARE TRANSITION PLAN	240d	12/8/98 8:00am	11/8/99 5:00pm
73	6.11 TEST PLAN	300d	12/8/98 8:00am	1/31/00 5:00pm
74	6.12 PUNCH LIST ACTIVITIES	90d	9/5/00 8:00am	1/8/01 5:00pm
75	6.13 DOE APPROVE TRANSITION PLAN	0w	1/8/01 5:00pm	1/8/01 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE

CONVENTIONAL ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
76				
77	7 COMMISSIONING PHASE	471d	1/9/01 8:00am	10/29/02 5:00pm
78	7.1 OPERATIONS TRAINING	44d	1/9/01 8:00am	3/9/01 5:00pm
79	7.2 START UP TESTING	110d	1/9/01 8:00am	8/11/01 5:00pm
80	7.3 TURNOVER AND START UP	86d	6/12/01 8:00am	9/11/01 5:00pm
81	7.4 PREPARE FINAL SAR	120d	9/12/01 8:00am	2/28/02 5:00pm
82	7.5 REVIEW FINAL SAR	60d	2/27/02 8:00am	5/21/02 5:00pm
83	7.6 SAR APPROVAL	30d	8/7/02 8:00am	9/17/02 5:00pm
84	7.7 OPERATIONS READINESS REVIEW	285d	7/4/01 8:00am	8/8/02 5:00pm
85	7.8 DOE AND LANL APPROVAL	2w	9/18/02 8:00am	10/1/02 5:00pm
86	7.9 MOVE IN	20d	10/2/02 8:00am	10/29/02 5:00pm
87	7.10 KEY DECISION 4 (KD-4)	0d	10/29/02 5:00pm	10/29/02 5:00pm
88	7.11 OCCUPY FACILITY	0d	10/29/02 5:00pm	10/29/02 5:00pm

**NMSF RENOVATION
OPTION NO. 2
DESIGN/BUILD ACQUISITION STRATEGY
WORK BREAKDOWN STRUCTURE**

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 2)
PART I - INDEX**

1. PROJECT TITLE/PARTICIPANT NMSF: Los Alamos National Laboratory						2. DATE 06/26/95		3. IDENTIFICATIONNUMBER 11818		
4. LINE NO.	5. WBS ELEMENTS					TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET REPORTING NO.	8. PHASE	9. OTHER
	INDENTURE LEVEL									
	1	2	3	4	5					
1	X					NMSF	1.0			
2		X				Project Management	1.1			
3			X			Project Manager	1.1.1			
4			X			Project Leader	1.1.2			
5			X			User Representative	1.1.3			
6			X			Project Controller	1.1.4			
7			X			Administrative Support	1.1.5			
8			X			Health & Safety Engineering	1.1.6			
9			X			Quality Assurance Engineering	1.1.7			
10		X				Conceptual Design	1.2			
11			X			Key Decision 0 (KD-0)	1.2.1			
12			X			Conceptual Design Report #1	1.2.2			
13			X			Project Definition (F&OR)	1.2.3			
14			X			Review NEPA Documentation	1.2.4			
15			X			Preliminary Hazard Assessment - CDR#1	1.2.5			
16			X			Prepare PHA - CDR#1	1.2.6			
17			X			Submit CDR#1 - DRAFT	1.2.7			
18			X			CDR#1 (DRAFT)- Review	1.2.8			
19			X			CDR#1 - Comment Response	1.2.9			
20			X			Advanced Value Engineering Study	1.2.10			
21			X			Prepare CDR#2	1.2.11			
22			X			Revise PHA	1.2.12			

1. PROJECT TITLE/PARTICIPANT NMSF: Los Alamos National Laboratory						2. DATE 06/26/95		3. IDENTIFICATIONNUMBER 11818		
4. LINE NO.	5. WBS ELEMENTS					TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET REPORTING NO.	8. PHASE	9. OTHER
	INDENTURE LEVEL									
	1	2	3	4	5					
23			X			Submit CDR#2 - DRAFT	1.2.13			
24			X			LANL Technical Review	1.2.14			
25			X			ICR (Dames & Moore)	1.2.15			
26			X			Vulnerability Assessment	1.2.16			
27			X			DOE Technical Review (ALBQ & HDQ)	1.2.17			
28			X			DOE Review (Stone & Webster)	1.2.18			
29			X			Incorporate Comments	1.2.19			
30			X			Reproduce/Submit 100% DRAFT	1.2.20			
31			X			Issue 100% Draft CDR #2	1.2.21			
32			X			DOE Concur W/CDR#2	1.2.22			
33			X			Issue Final CDR #2	1.2.23			
34			X			Prepare Project Execution Plan	1.2.24			
35			X			DOE Validation	1.2.25			
36			X			Key Decision 1 (KD-1)	1.2.26			
37		X				Pre-Design Phase	1.3			
38			X			Prepare Design Criteria	1.3.1			
39			X			Final NEPA Disposition	1.3.2			
40			X			Solicitation, Negotiate, Award	1.3.3			
41			X			Key Decision #2 (KD-2)	1.3.4			
42			X			Continue Facility/SFE R&D	1.3.5			
43		X				Facility & SFE Design	1.4			
44			X			Facility & SFE Design	1.4.1			
45			X			Design Review	1.4.2			
46			X			Prepare DRAFT PSAR	1.4.3			
47			X			Review DRAFT PSAR	1.4.4			
48			X			Approve PSAR	1.4.5			
49			X			Permits	1.4.6			
50			X			KEY Decision #3 (KD-3)	1.4.7			

1. PROJECT TITLE/PARTICIPANT NMSF: Los Alamos National Laboratory						2. DATE 06/26/95		3. IDENTIFICATIONNUMBER 11818		
4. LINE NO.	5. WBS ELEMENTS					TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET REPORTING NO.	8. PHASE	9. OTHER
	INDENTURE LEVEL									
	1	2	3	4	5					
51		X				Title III- Construction Engineering & Inspec.	1.5			
52			X			Construction Engineering	1.5.1			
53			X			Construction Inspection	1.5.2			
54			X			Safety Inspection	1.5.3			
55		X				Facility & SFE Construction	1.6			
56			X			Segregate Site (Security)	1.6.1			
57			X			SFE Fabrication & Installation	1.6.2			
58			X			Sitework/Misc. Demolition	1.6.3			
59			X			Building Demolition & Modifications	1.6.4			
60			X			Mechanical Equipment Fabrication & Installation	1.6.5			
61			X			Electrical Equipment Fabrication & Installation	1.6.6			
62			X			Fire Protection Equipment	1.6.7			
63			X			Equipment Tie-ins/Cntrls	1.6.8			
64			X			Equipment Checkout	1.6.9			
65			X			Prepare Transition Plan	1.6.10			
66			X			Test Plan	1.6.11			
67			X			Punch List Activities	1.6.12			
68			X			DOE Approve Transition Plan	1.6.13			
69		X				Commissioning Phase	1.7			
70			X			Operations Training	1.7.1			
71			X			Start-Up Testing	1.7.2			
72			X			Turnover/Start-Up	1.7.3			
73			X			Prepare Final SAR	1.7.4			
74			X			Review Final SAR	1.7.5			
75			X			SAR Approval	1.7.6			

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4. LINE NO.	5. WBS ELEMENTS					TITLE	6. PARTICIPANT WBS ELEMENT CODE	7. BUDGET REPORTING NO.	8. PHASE	9. OTHER
	INDENTURE LEVEL									
	1	2	3	4	5					
76			X			Operations Readiness Review	1.7.7			
77			X			DOE & LANL Approval	1.7.8			
78			X			Move-In	1.7.9			
79			X			Key Decision 4 (KD-4)	1.7.10			
80			X			Occupy Facility	1.7.11			

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 2)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO.
4. WBS ELEMENT CODE 1.0	5. WBS ELEMENT TITLE NMSF	
6. INDEX LINE NO. 1	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.1 LANL Project Management & Oversight
- 1.2 Conceptual Design Phase
- 1.3 Pre Design Phase
- 1.4 Facility and SFE Design Phase
- 1.5 Title III Const. Eng. and Inspection
- 1.6 Facility and SFE Construction
- 1.7 Commissioning Phase

B. SCHEDULE CONTENT:

	START	FINISH
1.1 LANL Project Management & Oversight	6/21/93	11/13/01
1.2 Conceptual Design Phase	6/20/93	8/01/95
1.3 Pre Design Phase	8/02/95	9/30/96
1.4 Facility and SFE Design Phase	10/01/96	3/02/98
1.5 Title III Const. Eng. and Inspection	3/03/98	8/28/00
1.6 Facility and SFE Construction	10/28/97	1/31/00
1.7 Commissioning Phase	2/01/00	11/20/01

C. COST CONTENT

	TEC	OPC
1.1 LANL Project Management & Oversight	\$2,984,781	\$0
1.2 Conceptual Design Phase	\$0	\$3,328,042
1.3 Pre Design Phase	\$1,084,926	\$3,198,243
1.4 Facility and SFE Design Phase	\$3,755,662	\$469,604
1.5 Title III Const. Eng. and Inspection	\$1,214,087	\$0
1.6 Facility and SFE Construction	\$33,205,857	\$240,150
1.7 Commissioning Phase	\$0	\$3,654,249
WBS 1.0 TOTAL	\$42,245,313	\$10,890,295

**U.S. DEPARTMENT OF ENERGY
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10. SYSTEM DESIGN DESCRIPTION: LANL PROJECT MANAGEMENT & OVERSIGHT	11. BUDGET & REPORTING NUMBER																																																				
ELEMENT TASK DESCRIPTION A. TECHNICAL CONTENT: <ul style="list-style-type: none"> 1.1.1 Project Manager 1.1.2 Project Leader 1.1.3 User Representative 1.1.4 Project Controller 1.1.5 Administrative Support 1.1.6 Health & Safety Engineering 1.1.7 Quality Assurance B. SCHEDULE CONTENT: <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th></th> <th style="text-align: center;">START</th> <th style="text-align: center;">FINISH</th> </tr> </thead> <tbody> <tr> <td>1.1.1 Project Manager</td> <td style="text-align: center;">6/21/93</td> <td style="text-align: center;">11/13/01</td> </tr> <tr> <td>1.1.2 Project Leader</td> <td style="text-align: center;">6/21/93</td> <td style="text-align: center;">11/13/01</td> </tr> <tr> <td>1.1.3 User Representative</td> <td style="text-align: center;">6/21/93</td> <td style="text-align: center;">11/13/01</td> </tr> <tr> <td>1.1.4 Project Controller</td> <td style="text-align: center;">10/28/97</td> <td style="text-align: center;">9/11/00</td> </tr> <tr> <td>1.1.5 Administrative Support</td> <td style="text-align: center;">6/21/93</td> <td style="text-align: center;">11/13/01</td> </tr> <tr> <td>1.1.6 Health & Safety Engineering</td> <td style="text-align: center;">2/15/95</td> <td style="text-align: center;">9/25/01</td> </tr> <tr> <td>1.1.7 Quality Assurance</td> <td style="text-align: center;">10/01/96</td> <td style="text-align: center;">10/9/00</td> </tr> </tbody> </table> C. COST CONTENT <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th></th> <th style="text-align: center;">TEC</th> <th style="text-align: center;">OPC</th> </tr> </thead> <tbody> <tr> <td>1.1.1 Project Manager</td> <td style="text-align: center;">\$0</td> <td style="text-align: center;">\$--</td> </tr> <tr> <td>1.1.2 Project Leader</td> <td style="text-align: center;">\$738,422</td> <td style="text-align: center;">\$--</td> </tr> <tr> <td>1.1.3 User Representative</td> <td style="text-align: center;">\$738,422</td> <td style="text-align: center;">\$--</td> </tr> <tr> <td>1.1.4 Project Controller</td> <td style="text-align: center;">\$162,328</td> <td style="text-align: center;">\$--</td> </tr> <tr> <td>1.1.5 Administrative Support</td> <td style="text-align: center;">\$582,965</td> <td style="text-align: center;">\$--</td> </tr> <tr> <td>1.1.6 Health & Safety Engineering</td> <td style="text-align: center;">\$315,322</td> <td style="text-align: center;">\$--</td> </tr> <tr> <td>1.1.7 Quality Assurance</td> <td style="text-align: center;">\$447,322</td> <td style="text-align: center;">\$--</td> </tr> <tr> <td style="text-align: right;">WBS 1.1 TOTAL</td> <td style="text-align: center; border-top: 1px solid black;">\$2,984,781</td> <td style="text-align: center; border-top: 1px solid black;">\$--</td> </tr> </tbody> </table>				START	FINISH	1.1.1 Project Manager	6/21/93	11/13/01	1.1.2 Project Leader	6/21/93	11/13/01	1.1.3 User Representative	6/21/93	11/13/01	1.1.4 Project Controller	10/28/97	9/11/00	1.1.5 Administrative Support	6/21/93	11/13/01	1.1.6 Health & Safety Engineering	2/15/95	9/25/01	1.1.7 Quality Assurance	10/01/96	10/9/00		TEC	OPC	1.1.1 Project Manager	\$0	\$--	1.1.2 Project Leader	\$738,422	\$--	1.1.3 User Representative	\$738,422	\$--	1.1.4 Project Controller	\$162,328	\$--	1.1.5 Administrative Support	\$582,965	\$--	1.1.6 Health & Safety Engineering	\$315,322	\$--	1.1.7 Quality Assurance	\$447,322	\$--	WBS 1.1 TOTAL	\$2,984,781	\$--
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**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 2)
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1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818																																																
4. WBS ELEMENT CODE 1.2	5. WBS ELEMENT TITLE CONCEPTUAL DESIGN PHASE																																																	
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1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.2 (continued)	5. WBS ELEMENT TITLE CONCEPTUAL DESIGN PHASE	
6. INDEX LINE NO. 10	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.2.8 CDR No. 1 (Draft) - Review
- 1.2.9 CDR No. 1 - Comment Response
- 1.2.10 Advanced Value Eng Study
- 1.2.11 Prepare CDR No. 2
- 1.2.12 Revise PHA
- 1.2.13 Submit CDR No. 2

B. SCHEDULE CONTENT:

	START	FINISH
1.2.8 CDR No. 1 (Draft)-Review	2/08/94	5/09/94
1.2.9 CDR No. 1-Comment Response	5/07/94	8/01/94
1.2.10 Advanced Value Eng Study	6/15/94	10/21/94
1.2.11 Prepare CDR No. 2	10/22/94	3/17/95
1.2.12 Revise PHA	1/16/95	4/17/95
1.2.13 Submit CDR No. 2 (Draft)	3/17/95	3/17/95

C. COST CONTENT

	TEC	OPC
1.2.8 CDR No. 1 (Draft) - Review	\$--	\$0
1.2.9 CDR No. 1 - Comment Response	\$--	\$89,351
1.2.10 Advanced Value Eng Study	\$--	\$226,958
1.2.11 Prepare CDR No. 2	\$--	\$811,325
1.2.12 Revise PHA	\$--	\$50,000
1.2.13 Submit CDR No. 2	\$--	\$0

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4. WBS ELEMENT CODE 1.2 (continued)	5. WBS ELEMENT TITLE CONCEPTUAL DESIGN PHASE	
6. INDEX LINE NO. 10	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.2.14 LANL Technical Review (Cost Included in 1.1)
- 1.2.15 ICR (Dames & Moore)
- 1.2.16 Vulnerability Assessment
- 1.2.17 DOE Technical Review (ALBQ & HQ)
- 1.2.18 DOE Review (Stone & Webster)
- 1.2.19 Incorporate Comments

B. SCHEDULE CONTENT:

	START	FINISH
1.2.14 LANL Technical Review (Cost Included in 1.1)	3/20/95	4/07/95
1.2.15 ICR (Dames & Moore)	3/20/95	4/17/95
1.2.16 Vulnerability Assessment	3/20/95	4/17/95
1.2.17 DOE Technical Review (ALBQ & HQ)	2/20/95	4/28/95
1.2.18 DOE Review (Stone & Webster)	3/20/95	4/28/95
1.2.19 Incorporate Comments	5/01/95	5/29/95

C. COST CONTENT

	TEC	OPC
1.2.14 LANL Technical Review (Cost Included in 1.1)	\$---	\$50,000
1.2.15 ICR (Dames & Moore)	\$---	\$80,348
1.2.16 Vulnerability Assessment	\$---	\$15,131
1.2.17 DOE Technical Review (ALBQ & HQ)	\$---	\$76,000
1.2.18 DOE Review (Stone & Webster)	\$---	\$76,000
1.2.19 Incorporate Comments	\$---	\$100,000

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ELEMENT TASK DESCRIPTION A. TECHNICAL CONTENT: <ul style="list-style-type: none"> 1.2.20 Reproduce/Submit 100% Draft 1.2.21 Issue 100% Draft CDR 1.2.22 DOE Concur with CDR No. 2 1.2.23 Issue Final CDR No. 2 1.2.24 Prepare Project Execution Plan 1.2.25 DOE Validation 1.2.26 Key Decision 1 (KD-1) B. SCHEDULE CONTENT: <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th></th> <th style="text-align: center;">START</th> <th style="text-align: center;">FINISH</th> </tr> </thead> <tbody> <tr> <td>1.2.20 Reproduce/Submit 100% Draft</td> <td style="text-align: center;">5/30/95</td> <td style="text-align: center;">5/31/95</td> </tr> <tr> <td>1.2.21 Issue 100% Draft CDR</td> <td style="text-align: center;">6/01/95</td> <td style="text-align: center;">6/01/95</td> </tr> <tr> <td>1.2.22 DOE Concur with CDR No. 2</td> <td style="text-align: center;">6/02/95</td> <td style="text-align: center;">6/29/95</td> </tr> <tr> <td>1.2.23 Issue Final CDR No. 2</td> <td style="text-align: center;">6/30/95</td> <td style="text-align: center;">6/30/95</td> </tr> <tr> <td>1.2.24 Prepare Project Execution Plan</td> <td style="text-align: center;">5/01/95</td> <td style="text-align: center;">6/30/95</td> </tr> <tr> <td>1.2.25 DOE Validation</td> <td style="text-align: center;">7/03/95</td> <td style="text-align: center;">7/31/95</td> </tr> <tr> <td>1.2.26 Key Decision 1 (KD-1)</td> <td style="text-align: center;">8/01/95</td> <td style="text-align: center;">8/01/95</td> </tr> </tbody> </table> C. COST CONTENT <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th></th> <th style="text-align: center;">TEC</th> <th style="text-align: center;">OPC</th> </tr> </thead> <tbody> <tr> <td>1.2.20 Reproduce/Submit 100% Draft</td> <td style="text-align: center;">\$--</td> <td style="text-align: right;">\$20,000</td> </tr> <tr> <td>1.2.21 Issue 100% Draft CDR</td> <td style="text-align: center;">\$--</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td>1.2.22 DOE Concur with CDR No. 2</td> <td style="text-align: center;">\$--</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td>1.2.23 Issue Final CDR No. 2</td> <td style="text-align: center;">\$--</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td>1.2.24 Prepare Project Execution Plan</td> <td style="text-align: center;">\$--</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td>1.2.25 DOE Validation</td> <td style="text-align: center;">\$--</td> <td style="text-align: right;">\$31,623</td> </tr> <tr> <td>1.2.26 Key Decision 1 (KD-1)</td> <td style="text-align: center;">\$--</td> <td style="text-align: right;">\$0</td> </tr> <tr> <td style="text-align: right;">WBS 1.2 TOTAL</td> <td style="text-align: center; border-top: 1px solid black;">\$0</td> <td style="text-align: right; border-top: 1px solid black;">\$3,328,049</td> </tr> </tbody> </table>				START	FINISH	1.2.20 Reproduce/Submit 100% Draft	5/30/95	5/31/95	1.2.21 Issue 100% Draft CDR	6/01/95	6/01/95	1.2.22 DOE Concur with CDR No. 2	6/02/95	6/29/95	1.2.23 Issue Final CDR No. 2	6/30/95	6/30/95	1.2.24 Prepare Project Execution Plan	5/01/95	6/30/95	1.2.25 DOE Validation	7/03/95	7/31/95	1.2.26 Key Decision 1 (KD-1)	8/01/95	8/01/95		TEC	OPC	1.2.20 Reproduce/Submit 100% Draft	\$--	\$20,000	1.2.21 Issue 100% Draft CDR	\$--	\$0	1.2.22 DOE Concur with CDR No. 2	\$--	\$0	1.2.23 Issue Final CDR No. 2	\$--	\$0	1.2.24 Prepare Project Execution Plan	\$--	\$0	1.2.25 DOE Validation	\$--	\$31,623	1.2.26 Key Decision 1 (KD-1)	\$--	\$0	WBS 1.2 TOTAL	\$0	\$3,328,049
	START	FINISH																																																			
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1.2.21 Issue 100% Draft CDR	6/01/95	6/01/95																																																			
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U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 2)
PART II - ELEMENT DEFINITION

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.3	5. WBS ELEMENT TITLE PRE DESIGN PHASE	
6. INDEX LINE NO. 37	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.3.1 Prepare Design Criteria
- 1.3.2 Final NEPA Disposition
- 1.3.3 Solicit, Negotiate, Award
- 1.3.4 Key Decision No. 2(KD-2)
- 1.3.5 Continue Facility/SFE R&D

B. SCHEDULE CONTENT:

	START	FINISH
1.3.1 Prepare Design Criteria	8/02/95	10/10/95
1.3.2 Final NEPA Disposition	12/20/95	9/10/96
1.3.3 Solicit, Negotiate, Award	10/11/95	9/30/96
1.3.4 Key Decision No. 2(KD-2)	9/30/96	9/30/96
1.3.5 Continue Facility/SFE R&D	8/2/95	9/16/96

C. COST CONTENT

	TEC	OPC
1.3.1 Prepare Design Criteria	\$---	\$211,077
1.3.2 Final NEPA Disposition	\$---	\$0
1.3.3 Solicit, Negotiate, Award	\$1,084,926	\$--
1.3.4 Key Decision No. 2(KD-2)	\$---	\$0
1.3.5 Continue Facility/SFE R&D	\$---	\$2,987,166
WBS 1.3 TOTAL	\$1,084,926	\$3,198,243

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 2)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818																																																			
4. WBS ELEMENT CODE 1.4	5. WBS ELEMENT TITLE FACILITY AND SFE DESIGN PHASE																																																				
6. INDEX LINE NO. 43	7. REV. NO & AUTH 0	8. DATE 6/21/95																																																			
9. APPROVED CHANGES NONE																																																					
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER																																																			
<div style="border: 1px solid black; padding: 5px;"> ELEMENT TASK DESCRIPTION A. TECHNICAL CONTENT: <ul style="list-style-type: none"> 1.4.1 Facility and SFE Design 1.4.2 Design Review 1.4.3 Prepare Draft PSAR 1.4.4 Review Draft PSAR 1.4.5 Approve PSAR 1.4.6 Permits 1.4.7 Key Decision No. 3(KD-3) B. SCHEDULE CONTENT: <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th></th> <th style="text-align: center;">START</th> <th style="text-align: center;">FINISH</th> </tr> </thead> <tbody> <tr><td>1.4.1 Facility and SFE Design</td><td style="text-align: center;">10/1/96</td><td style="text-align: center;">10/27/97</td></tr> <tr><td>1.4.2 Design Review</td><td style="text-align: center;">10/28/97</td><td style="text-align: center;">3/02/98</td></tr> <tr><td>1.4.3 Prepare Draft PSAR</td><td style="text-align: center;">10/01/96</td><td style="text-align: center;">9/15/97</td></tr> <tr><td>1.4.4 Review Draft PSAR</td><td style="text-align: center;">9/16/97</td><td style="text-align: center;">10/27/97</td></tr> <tr><td>1.4.5 Approve PSAR</td><td style="text-align: center;">10/27/97</td><td style="text-align: center;">10/27/97</td></tr> <tr><td>1.4.6 Permits</td><td style="text-align: center;">12/30/97</td><td style="text-align: center;">3/02/98</td></tr> <tr><td>1.4.7 Key Decision No. 3(KD-3)</td><td style="text-align: center;">3/02/98</td><td style="text-align: center;">3/02/98</td></tr> </tbody> </table> C. COST CONTENT <table style="width: 100%; margin-top: 10px;"> <thead> <tr> <th></th> <th style="text-align: center;">TEC</th> <th style="text-align: center;">OPC</th> </tr> </thead> <tbody> <tr><td>1.4.1 Facility and SFE Design</td><td style="text-align: right;">\$2,816,747</td><td style="text-align: right;">\$---</td></tr> <tr><td>1.4.2 Design Review</td><td style="text-align: right;">\$938,915</td><td style="text-align: right;">\$---</td></tr> <tr><td>1.4.3 Prepare Draft PSAR</td><td style="text-align: right;">\$---</td><td style="text-align: right;">\$376,857</td></tr> <tr><td>1.4.4 Review Draft PSAR</td><td style="text-align: right;">\$---</td><td style="text-align: right;">\$50,000</td></tr> <tr><td>1.4.5 Approve PSAR</td><td style="text-align: right;">\$---</td><td style="text-align: right;">\$---</td></tr> <tr><td>1.4.6 Permits</td><td style="text-align: right;">\$---</td><td style="text-align: right;">\$42,747</td></tr> <tr><td>1.4.7 Key Decision No. 3(KD-3)</td><td style="text-align: right;">\$---</td><td style="text-align: right;">\$---</td></tr> <tr> <td style="text-align: right;">WBS 1.4 TOTAL</td> <td style="text-align: right; border-top: 1px solid black;">\$3,755,662</td> <td style="text-align: right; border-top: 1px solid black;">\$469,604</td> </tr> </tbody> </table> </div>				START	FINISH	1.4.1 Facility and SFE Design	10/1/96	10/27/97	1.4.2 Design Review	10/28/97	3/02/98	1.4.3 Prepare Draft PSAR	10/01/96	9/15/97	1.4.4 Review Draft PSAR	9/16/97	10/27/97	1.4.5 Approve PSAR	10/27/97	10/27/97	1.4.6 Permits	12/30/97	3/02/98	1.4.7 Key Decision No. 3(KD-3)	3/02/98	3/02/98		TEC	OPC	1.4.1 Facility and SFE Design	\$2,816,747	\$---	1.4.2 Design Review	\$938,915	\$---	1.4.3 Prepare Draft PSAR	\$---	\$376,857	1.4.4 Review Draft PSAR	\$---	\$50,000	1.4.5 Approve PSAR	\$---	\$---	1.4.6 Permits	\$---	\$42,747	1.4.7 Key Decision No. 3(KD-3)	\$---	\$---	WBS 1.4 TOTAL	\$3,755,662	\$469,604
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U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 21)
PART II - ELEMENT DEFINITION

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818																											
4. WBS ELEMENT CODE 1.5	5. WBS ELEMENT TITLE TITLE III - CONSTRUCTION INSPECTION AND ENGINEERING																												
6. INDEX LINE NO. 51	7. REV. NO & AUTH 0	8. DATE 06/21/95																											
9. APPROVED CHANGES NONE																													
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER																											
<div style="border: 1px solid black; padding: 5px;"> ELEMENT TASK DESCRIPTION A. TECHNICAL CONTENT: 1.5.1 Construction Engineering 1.5.2 Construction Inspection 1.5.3 Safety Inspection B. SCHEDULE CONTENT: <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="width: 20%; text-align: center;">START</th> <th style="width: 20%; text-align: center;">FINISH</th> </tr> </thead> <tbody> <tr> <td>1.5.1 Construction Engineering</td> <td style="text-align: center;">3/03/98</td> <td style="text-align: center;">8/28/00</td> </tr> <tr> <td>1.5.2 Construction Inspection</td> <td style="text-align: center;">3/03/98</td> <td style="text-align: center;">8/28/01</td> </tr> <tr> <td>1.5.3 Safety Inspection</td> <td style="text-align: center;">3/03/98</td> <td style="text-align: center;">8/28/01</td> </tr> </tbody> </table> C. COST CONTENT <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="width: 20%; text-align: center;">TEC</th> <th style="width: 20%; text-align: center;">OPC</th> </tr> </thead> <tbody> <tr> <td>1.5.1 Construction Engineering</td> <td style="text-align: center;">\$530,835</td> <td style="text-align: center;">\$---</td> </tr> <tr> <td>1.5.2 Construction Inspection</td> <td style="text-align: center;">\$341,626</td> <td style="text-align: center;">\$---</td> </tr> <tr> <td>1.5.3 Safety Inspection</td> <td style="text-align: center;">\$341,626</td> <td style="text-align: center;">\$---</td> </tr> <tr> <td style="text-align: right;">WBS 1.5 TOTAL</td> <td style="text-align: center; border-top: 1px solid black;">\$1,214,087</td> <td style="text-align: center; border-top: 1px solid black;">\$0</td> </tr> </tbody> </table> </div>				START	FINISH	1.5.1 Construction Engineering	3/03/98	8/28/00	1.5.2 Construction Inspection	3/03/98	8/28/01	1.5.3 Safety Inspection	3/03/98	8/28/01		TEC	OPC	1.5.1 Construction Engineering	\$530,835	\$---	1.5.2 Construction Inspection	\$341,626	\$---	1.5.3 Safety Inspection	\$341,626	\$---	WBS 1.5 TOTAL	\$1,214,087	\$0
	START	FINISH																											
1.5.1 Construction Engineering	3/03/98	8/28/00																											
1.5.2 Construction Inspection	3/03/98	8/28/01																											
1.5.3 Safety Inspection	3/03/98	8/28/01																											
	TEC	OPC																											
1.5.1 Construction Engineering	\$530,835	\$---																											
1.5.2 Construction Inspection	\$341,626	\$---																											
1.5.3 Safety Inspection	\$341,626	\$---																											
WBS 1.5 TOTAL	\$1,214,087	\$0																											

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 2)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.6	5. WBS ELEMENT TITLE FACILITY AND SFE CONSTRUCTION PHASE	
6. INDEX LINE NO. 55	7. REV. NO & AUTH 0 —	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:	11. BUDGET & REPORTING NUMBER	

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.6.1 Segregate Site Security
- 1.6.2 SFE Fabrication and Installation
- 1.6.3 Sitework/Miscellaneous Demolition
- 1.6.4 Building Demolition and Modifications
- 1.6.5 Mechanical Equipment Fabrication/Installation
- 1.6.6 Electrical Equipment and Construction
- 1.6.7 Fire Protection

B. SCHEDULE CONTENT:

	START	FINISH
1.6.1 Segregate Site Security	10/28/97	1/19/98
1.6.2 SFE Fabrication and Installation	3/03/98	1/31/00
1.6.3 Sitework/Miscellaneous Demolition	3/03/99	5/25/98
1.6.4 Building Demolition and Modifications	3/03/98	4/26/99
1.6.5 Mechanical Equip. Fabrication/Installation	7/07/98	8/30/99
1.6.6 Electrical Equipment and Construction	5/05/98	6/28/99
1.6.7 Fire Protection	7/07/98	12/21/98

C. COST CONTENT

	TEC	OPC
1.6.1 Segregate Site Security	\$796,205	\$—
1.6.2 SFE Fabrication and Installation	\$19,411,627	\$—
1.6.3 Sitework/Miscellaneous Demolition	\$969,844	\$—
1.6.4 Building Demolition and Modifications	\$4,879,110	\$—
1.6.5 Mechanical Equipment Fabrication/Installation	\$3,073,411	\$—
1.6.6 Electrical Equipment and Construction	\$1,262,829	\$—
1.6.7 Fire Protection	\$345,721	\$—

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 2)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO. 11818
4. WBS ELEMENT CODE 1.6 (continued)	5. WBS ELEMENT TITLE FACILITY AND SFE CONSTRUCTION PHASE	
6. INDEX LINE NO. 55	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:	11. BUDGET & REPORTING NUMBER	

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.6.8 Equipment Tie-Ins & Controls
- 1.6.9 Equipment Checkout
- 1.6.10 Prepare Transition Plan
- 1.6.11 Test Plan
- 1.6.12 Punch List Activities
- 1.6.13 DOE Approve Transition Plan

B. SCHEDULE CONTENT:

	START	FINISH
1.6.8 Equipment Tie-Ins & Controls	8/31/99	11/22/99
1.6.9 Equipment Checkout	11/23/99	1/24/00
1.6.10 Prepare Transition Plan	3/03/98	2/01/99
1.6.11 Test Plan	3/03/98	4/26/99
1.6.12 Punch List Activities	9/28/99	1/31/00
1.6.13 DOE Approve Transition Plan	1/31/00	1/31/00

C. COST CONTENT

	TEC	OPC
1.6.8 Equipment Tie-Ins & Controls	\$2,365,833	\$---
1.6.9 Equipment Checkout	\$33,759	\$50,000
1.6.10 Prepare Transition Plan	\$---	\$50,000
1.6.11 Test Plan	\$33,759	\$140,150
1.6.12 Punch List Activities	\$33,759	\$---
1.6.13 DOE Approve Transition Plan	\$---	\$---
WBS 1.6 TOTAL	\$33,205,857	\$240,150

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 2)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO.
4. WBS ELEMENT CODE 1.7	5. WBS ELEMENT TITLE COMMISSIONING PHASE	
6. INDEX LINE NO. 69	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.7.1 Operations Training
- 1.7.2 Start Up Testing
- 1.7.3 Turnover and Start Up
- 1.7.4 Prepare Final SAR
- 1.7.5 Review Final SAR
- 1.7.6 SAR Approval
- 1.7.7 Operations Readiness Review

B. SCHEDULE CONTENT:

	START	FINISH
1.7.1 Operations Training	2/01/00	3/31/00
1.7.2 Start Up Testing	2/01/00	7/03/00
1.7.3 Turnover and Start Up	7/04/00	10/03/00
1.7.4 Prepare Final SAR	7/04/00	12/18/00
1.7.5 Review Final SAR	12/19/00	3/12/01
1.7.6 SAR Approval	8/29/01	10/09/01
1.7.7 Operations Readiness Review	7/26/00	8/28/01

C. COST CONTENT

	TEC	OPC
1.7.1 Operations Training	\$---	\$470,092
1.7.2 Start Up Testing	\$---	\$588,470
1.7.3 Turnover and Start Up	\$---	\$774,775
1.7.4 Prepare Final SAR	\$---	\$300,000
1.7.5 Review Final SAR	\$---	\$100,000
1.7.6 SAR Approval	\$---	\$50,000
1.7.7 Operations Readiness Review	\$---	\$1,278,817

**U.S. DEPARTMENT OF ENERGY
WORK BREAKDOWN STRUCTURE DICTIONARY (OPTION 2)
PART II - ELEMENT DEFINITION**

1. PROJECT TITLE/PARTICIPANT NMSF RENOVATION LOS ALAMOS NATIONAL LABORATORY	2. DATE 06/21/95	3. IDENTIFICATION NO.
4. WBS ELEMENT CODE 1.7 (continued)	5. WBS ELEMENT TITLE COMMISSIONING PHASE	
6. INDEX LINE NO. 69	7. REV. NO & AUTH 0	8. DATE 06/21/95
9. APPROVED CHANGES NONE		
10. SYSTEM DESIGN DESCRIPTION:		11. BUDGET & REPORTING NUMBER

ELEMENT TASK DESCRIPTION

A. TECHNICAL CONTENT:

- 1.7.8 DOE and LANL Approval
- 1.7.9 Move In
- 1.7.10 Key Decision 4 (KD-4)
- 1.7.11 Occupy Facility

B. SCHEDULE CONTENT:

	START	FINISH
1.7.8 DOE and LANL Approval	10/10/01	10/23/01
1.7.9 Move In	10/24/01	11/20/01
1.7.10 Key Decision 4 (KD-4)	11/20/01	11/20/01
1.7.11 Occupy Facility	11/20/01	11/20/01

C. COST CONTENT

	TEC	OPC
1.7.8 DOE and LANL Approval	\$---	\$33,838
1.7.9 Move In	\$---	\$58,257
1.7.10 Key Decision 4 (KD-4)	\$---	\$---
1.7.11 Occupy Facility	\$---	\$---
WBS 1.7 TOTAL	\$0	\$3,654,249

NMSF RENOVATION - PROPOSED SCHEDULE FOR DESIGN/BUILD ACQUISITION STRATEGY

Critical Progress Summary
 Noncritical Milestone Rolled Up

ICF KAISER ENGINEERS, INC.

NMSF RENOVATION - PROPOSED SCHEDULE FOR DESIGN/BUILD ACQUISITION STRATEGY

Critical Progress Summary
 Noncritical Milestone Rolled Up

ICF KAISER ENGINEERS, INC.

NMSF RENOVATION - PROPOSED SCHEDULE FOR DESIGN/BUILD ACQUISITION STRATEGY

Critical Progress Summary
 Noncritical Milestone Rolled Up

ICF KAISER ENGINEERS, INC.

NMSF RENOVATION - PROPOSED SCHEDULE FOR DESIGN/BUILD ACQUISITION STRATEGY

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ICF KAISER ENGINEERS, INC.

NMSF RENOVATION - PROPOSED SCHEDULE

DESIGN/BUILD ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
1	1 LANL PROJ. MGMT. & OVERSIGHT	2190d	6/21/93 8:00am	11/13/01 5:00pm
2	1.1 PROJECT MANAGER	438w	6/21/93 8:00am	11/13/01 5:00pm
3	1.2 PROJECT LEADER	438w	6/21/93 8:00am	11/13/01 5:00pm
4	1.3 USER REPRESENTATIVE	438w	6/21/93 8:00am	11/13/01 5:00pm
5	1.4 PROJECT CONTROLLER	150w	10/28/97 8:00am	9/11/00 5:00pm
6	1.5 ADMINISTRATIVE SUPPORT	438w	6/21/93 8:00am	11/13/01 5:00pm
7	1.6 HEALTH AND SAFETY ENGINEERING	345w	2/15/95 8:00am	9/25/01 5:00pm
8	1.7 QUALITY ASSURANCE ENGINEERING	210w	10/1/96 8:00am	10/9/00 5:00pm
9				
10	2 CONCEPTUAL DESIGN PHASE	550d	6/20/93 8:00am	8/1/95 5:00pm
11	2.1 KEY DECISION 0 (KD-0)	0w	6/20/93 8:00am	6/20/93 8:00am
12	2.2 CONCEPTUAL DESIGN REPORT NO. 1	32.8w	6/21/93 8:00am	2/7/94 5:00pm
13	2.3 PROJECT DEFINITION (DRAFT F & OR)	38.5w	6/21/93 8:00am	3/18/94 12:00pm
14	2.4 REVIEW NEPA DOCUMENTATION	52w	6/21/93 8:00am	6/21/94 5:00pm
15	2.5 PRELIMINARY HAZARDS ASSESSMENT - CDR NO. 1	11.8w	10/15/93 8:00am	1/4/94 5:00pm
16	2.6 PREPARE PHA - CDR NO. 1	13w	1/4/94 8:00am	4/4/94 5:00pm
17	2.7 SUBMIT DRAFT CDR NO. 1	1d	2/7/94 8:00am	2/7/94 5:00pm
18	2.8 CDR NO. 1 (DRAFT) - REVIEW	65d	2/8/94 8:00am	5/8/94 5:00pm
19	2.9 CDR NO. 1 (DRAFT) - COMMENT RESPONSE	61d	5/7/94 8:00am	8/1/94 5:00pm
20	2.10 ADVANCED VALUE ENGINEERING STUDY	93d	6/15/94 8:00am	10/21/94 5:00pm
21	2.11 PREPARE CDR NO. 2	105d	10/22/94 8:00am	3/17/95 5:00pm
22	2.12 REVISE PHA	66d	1/18/95 8:00am	4/17/95 5:00pm
23	2.13 SUBMIT CDR NO.2 (90% DRAFT)	0w	3/17/95 5:00pm	3/17/95 5:00pm
24	2.14 LANL TECHNICAL REVIEW	15d	3/20/95 8:00am	4/7/95 5:00pm
25	2.15 ICR (DAME AND MOORE)	21d	3/20/95 8:00am	4/17/95 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE
DESIGN/BUILD ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
26	2.16 VULNERABILITY ASSESSMENT	21d	3/20/95 8:00am	4/17/95 5:00pm
27	2.17 DOE TECHNICAL REVIEW (ALBQ & HQ)	30d	3/20/95 8:00am	4/28/95 5:00pm
28	2.18 DOE REVIEW (STONE AND WEBSTER)	30d	3/20/95 8:00am	4/28/95 5:00pm
29	2.19 INCORPORATE COMMENTS	21d	5/1/95 8:00am	5/29/95 5:00pm
30	2.20 REPRODUCE AND SUBMIT 100% DRAFT	2d	5/30/95 8:00am	5/31/95 5:00pm
31	2.21 ISSUE 100% DRAFT CDR NO. 2	1d	6/1/95 8:00am	6/1/95 5:00pm
32	2.22 DOE CONCURRENCE WITH CDR NO. 2	20d	6/2/95 8:00am	6/29/95 5:00pm
33	2.23 ISSUE FINAL CDR NO. 2	1d	6/30/95 8:00am	6/30/95 5:00pm
34	2.24 PREPARE PROJECT EXECUTION PLAN	9w	5/1/95 8:00am	6/30/95 5:00pm
35	2.25 DOE VALIDATION	21d	7/3/95 8:00am	7/31/95 5:00pm
36	2.26 KEY DECISION 1 (KD-1) - BEGIN DESIGN	0d	8/1/95 5:00pm	8/1/95 5:00pm
37				
38	3 PRE-DESIGN PHASE	304d	8/2/95 8:00am	9/30/96 5:00pm
39	3.1 PREPARE DESIGN CRITERIA	10w	8/2/95 8:00am	10/10/95 5:00pm
40	3.2 FINAL NEPA DISPOSITION	38w	12/20/95 8:00am	9/10/96 5:00pm
41	3.3 SOLICITATION, NEGOTIATIONS, AND AWARD	50.8w	10/11/95 8:00am	9/30/96 5:00pm
42	3.4 KEY DECISION NO. 2 (KD-2)	0d	9/30/96 5:00pm	9/30/96 5:00pm
43	3.5 CONTINUE FACILITY/SFE R&D	58.8w	8/2/95 8:00am	9/16/96 5:00pm
44				
45	4 FACILITY AND SFE DESIGN PHASE	370d	10/1/96 8:00am	3/2/98 5:00pm
46	4.1 FACILITY AND SFE DESIGN	280d	10/1/96 8:00am	10/27/97 5:00pm
47	4.2 DESIGN REVIEW	90d	10/28/97 8:00am	3/2/98 5:00pm
48	4.3 PREPARE DRAFT PSAR	50w	10/1/96 8:00am	9/15/97 5:00pm
49	4.4 REVIEW DRAFT PSAR	30d	9/16/97 8:00am	10/27/97 5:00pm
50	4.5 APPROVE PSAR	0d	10/27/97 5:00pm	10/27/97 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE
DESIGN/BUILD ACQUISITION STRATEGY

ID	Name	Duration	Scheduled Start	Scheduled Finish
51	4.6 PERMITS	45d	12/30/97 8:00am	3/2/98 5:00pm
52	4.7 KEY DECISION NO. 3 (KD-3) - DOE APPROVAL	0w	3/2/98 5:00pm	3/2/98 5:00pm
53				
54	5 TITLE III - CONSTRUCTION INSPECTION & ENGINEERING	650d	3/3/98 8:00am	8/28/00 5:00pm
55	5.1 CONSTRUCTION ENGINEERING	130w	3/3/98 8:00am	8/28/00 5:00pm
56	5.2 CONSTRUCTION INSPECTION	130w	3/3/98 8:00am	8/28/00 5:00pm
57	5.3 SAFETY INSPECTION	130w	3/3/98 8:00am	8/28/00 5:00pm
58				
59	6 FACILITY AND SFE CONSTRUCTION PHASE	590d	10/28/97 8:00am	1/31/00 5:00pm
60	6.1 SEGREGATE SITE (SECURITY)	60d	10/28/97 8:00am	1/19/98 5:00pm
61	6.2 SPEC. FACIL. EQUIP. FABRICATION & INSTALLATION	500d	3/3/98 8:00am	1/31/00 5:00pm
62	6.3 SITEWORK AND MISCELLANEOUS DEMOLITION	60d	3/3/98 8:00am	5/25/98 5:00pm
63	6.4 BUILDING DEMOLITION AND MODIFICATIONS	300d	3/3/98 8:00am	4/26/99 5:00pm
64	6.5 MECHANICAL EQUIPMENT FABRICATION & INSTALLATION	300d	7/7/98 8:00am	8/30/99 5:00pm
65	6.6 ELECTRICAL EQUIPMENT & CONSTRUCTION	300d	5/5/98 8:00am	6/28/99 5:00pm
66	6.7 FIRE PROTECTION	120d	7/7/98 8:00am	12/21/98 5:00pm
67	6.8 EQUIPMENT TIE INS/INSTALLATION AND CONTROLS	60d	8/31/99 8:00am	11/22/99 5:00pm
68	6.9 EQUIPMENT CHECKOUT	45d	11/23/99 8:00am	1/24/00 5:00pm
69	6.10 PREPARE TRANSITION PLAN	240d	3/3/98 8:00am	2/1/99 5:00pm
70	6.11 TEST PLAN	300d	3/3/98 8:00am	4/26/99 5:00pm
71	6.12 PUNCH LIST ACTIVITIES	90d	9/28/99 8:00am	1/31/00 5:00pm
72	6.13 DOE APPROVE TRANSITION PLAN	0w	1/31/00 5:00pm	1/31/00 5:00pm
73				
74	7 COMMISSIONING PHASE	471d	2/1/00 8:00am	11/20/01 5:00pm
75	7.1 OPERATIONS TRAINING	44d	2/1/00 8:00am	3/31/00 5:00pm

NMSF RENOVATION - PROPOSED SCHEDULE**DESIGN/BUILD ACQUISITION STRATEGY**

ID	Name	Duration	Scheduled Start	Scheduled Finish
76	7.2 START UP TESTING	110d	2/1/00 8:00am	7/3/00 5:00pm
77	7.3 TURNOVER AND START UP	66d	7/4/00 8:00am	10/3/00 5:00pm
78	7.4 PREPARE FINAL SAR	120d	7/4/00 8:00am	12/18/00 5:00pm
79	7.5 REVIEW FINAL SAR	60d	12/19/00 8:00am	3/12/01 5:00pm
80	7.6 SAR APPROVAL	30d	8/29/01 8:00am	10/9/01 5:00pm
81	7.7 OPERATIONS AND READINESS REVIEW	285d	7/26/00 8:00am	8/28/01 5:00pm
82	7.8 DOE AND LANL APPROVAL	2w	10/10/01 8:00am	10/23/01 5:00pm
83	7.9 MOVE IN	20d	10/24/01 8:00am	11/20/01 5:00pm
84	7.10 KEY DECISION 4 (KD-4)	0d	11/20/01 5:00pm	11/20/01 5:00pm
85	7.11 OCCUPY FACILITY	0d	11/20/01 5:00pm	11/20/01 5:00pm

- DOE Title II review and KD-3 approval will be completed within six weeks of Title II design summary distribution.
- DOE will endorse the use of a Readiness Review prior to KD-4 approval as specified in DOE Order 5480.31 and its associated standard.

5. METHOD OF ACCOMPLISHMENT

Facilities engineering, design, and inspection (ED&I) will be performed through a fixed-price AE contract. LANL will provide design and cost estimating oversight as well as project management and construction inspection. The Title I and II design summaries will integrate both the SFE and Facility Design information.

Facilities construction will be performed by a fixed-price construction contract.

Standard equipment other than office furnishings will be procured and installed by the construction contractor. Office furnishings will be procured and installed by the LANL support services subcontractor. Project management and technical liaison with the AE will be provided by the FSS-6 Project Leader.

6. BUDGET AND RESOURCE ALLOCATION

Included in this section is a funding profile for each of the two acquisition strategies. The burdened funding profile for the other project costs (OPC) and the burdened-funding profile for the line-item funds assume the project will be approved as an FY97 new start. The funding profiles were generated from the resource-loaded schedule.

7. VALUE ENGINEERING

A value engineering study was performed that identified alternatives that can be further evaluated for feasibility during Title I design. Value engineering based on the 100% Draft CDR will be performed following Title I design, as specified by DOE Order 4010.1Ab. This effort will identify possible areas of cost savings before the start of detailed design.

NMSF

CONVENTIONAL ACQUISITION (OPTION 1) FUNDING PROFILES (\$K)

EXPENSE (Burdened)

| FISCAL YEAR | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | Total
FY93-03 |
|---------------|-----|-------|-------|-------|-----|-----|-----|-----|-------|-------|-----|------------------|
| EXPENSE FUNDS | 897 | 2,044 | 2,405 | 1,708 | 300 | 300 | 300 | 300 | 1,795 | 1,012 | 300 | \$11,361 |

LINE ITEM (Burdened)

| FISCAL YEAR | APPROPRIATION
(LINE ITEM FUNDS) | OBLIGATION
(LINE ITEM FUNDS) |
|-------------|------------------------------------|---------------------------------|
| 1997 | 4,000 | 3,380 |
| 1998 | 9,200 | 7,495 |
| 1999 | 15,200 | 13,767 |
| 2000 | 12,150 | 13,767 |
| 2001 | 4,742 | 6,883 |
| TOTAL | \$45,292 | \$45,292 |

NMSF

DESIGN/BUILD ACQUISITION (OPTION 2) FUNDING PROFILE (\$K)

EXPENSE (Burdened)

| FISCAL YEAR | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 00 | 01 | Total
FY93-01 |
|---------------|-----|-------|-------|-------|-----|-----|-----|-------|-----|------------------|
| EXPENSE FUNDS | 897 | 2,044 | 2,405 | 1,707 | 300 | 300 | 300 | 2,172 | 765 | \$10,890 |

LINE ITEM (Burdened)

| FISCAL YEAR | APPROPRIATION
(LINE ITEM FUNDS) | OBLIGATION
(LINE ITEM FUNDS) |
|-------------|------------------------------------|---------------------------------|
| 1997 | 3,600 | 2,954 |
| 1998 | 21,700 | 18,083 |
| 1999 | 14,400 | 15,905 |
| 2000 | 2,545 | 5,303 |
| TOTAL | \$42,245 | \$42,245 |

C. PROJECT CONTROLS AND REPORTING SYSTEMS

1. PERFORMANCE AND CONFIGURATION CONTROL

The FSS-6 Project Leader will use the Engineering Project Controls System to measure and report project progress using the WBS reporting system required by DOE Order 4700.1. The use of contingency funds will be monitored closely, and the status of these funds will be reported to key project participants so that the project will not be jeopardized by a cost overrun. A CCB will be established to provide change control and to accomplish management of the project baselines.

The NMT Facility Project Leader will monitor the technical progress of the project, evaluating progress against programmatic needs. Whenever technical changes are anticipated or proposed, he will evaluate all ramifications and fully document the conclusions. Working closely with the FSS-6 Project Leader, the NMT Facility Project Leader will monitor and evaluate schedule, cost, and interrelated construction and technical work variance to assess programmatic impacts. Should a baseline change be required, the FSS-6 Project Leader will initiate a LANL CCB action to propose a baseline revision. All changes will be controlled by the procedures contained in the LAAO Baseline Change Control Process. This process includes field office CCBs and a contractor change control procedure, as well as change authority for the FSS-6 Project Leader. The baseline and thresholds for these change control levels will be delineated in the Project Plan and the Project Management Plan.

2. PROGRAM AND TECHNICAL REVIEWS

LANL and DOE will conduct technical reviews of the design criteria and of the Title I and II design packages. The Title I and II design packages will integrate the Facility and SFE designs into a comprehensive Design Summary document. DOE approval of these Design Summaries is required prior to KD-2 and KD-3. All review comments will be coordinated by the FSS-6 Project Leader.

3. PROJECT AND PROGRESS REVIEWS

Meetings to review progress and performance during design and construction will be as directed by the FSS-6 Project Leader. These meetings include quarterly construction reviews as well as design reviews with DOE.

4. SUBCONTRACT CONTROL

The AE and SFE contractors will be selected using LANL selection procedures. Work will be performed under a negotiated fixed-price contract or through established task-order contracts with specific DOE approval. Items affecting work, schedules, and cost will be set during contract negotiations.

Construction contracts will be formally advertised and awarded to either fixed-price contractors or negotiated cost-plus-fixed-fee contractors. Construction completion milestones will be specified in

each contract. Changes required during the contract period will be established and approved through contract change orders.

Schedules for the major WBS work elements are presented in the project schedule. The schedule will be revised as needed and reviewed again during preparation of the project's design criteria. The schedule will be reviewed by the AE during negotiations and again during Title I design. The construction schedule will be included in the bid documents and may be changed as a result of contract modifications.

5. DOCUMENTATION

This project will be designed, administered, and controlled in accordance with the following documents:

- DOE Order 4700.1
- DOE Order 6430.1A
- LANL Program Management Plan for Construction

In general, project documentation will conform to the requirements of DOE AL 4700.1. The FSS-6 Project Leader is responsible for generating the applicable O&M contractor documentation listed in Attachment 1-1 of the Order.

In addition to the CDR, the following documents will be prepared to request and provide project authorization at various stages of the project:

- Construction Project Data Sheet
- Design Criteria
- Project Management Plan
- DOE Environmental Checklist
- Project Plan
- Request for Project Authorization

Additional records for control purposes during design and construction will be specified in a formal Quality Assurance Project Plan.

6. REPORTING REQUIREMENTS

Project reporting will be accomplished in accordance with DOE Order AL 4700.1, Chapter IX.

Reporting the status of the project to interested DOE and LANL parties is the responsibility of the PM in the DOE organization and the FSS-6 Project Leader in the LANL organization. LANL will use its Engineering Project Controls System to support this activity. At a minimum, the following reports will be produced:

- Monthly design status
- Weekly inspection of construction
- Monthly project progress
- Quarterly construction management review
- Required quarterly updates

D. SPECIAL PLANS

1. QUALITY ASSURANCE PLAN

LANL recognizes the significance of the quality-related goals as defined by DOE Order 5700.6C, Quality Assurance; DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities; and the project management-related goals of DOE Order 4700.1, as demonstrated by issuance of Director's Policy 110. Refer to **Part I - Design Concept**, Section F, for QA requirements.

2. HEALTH AND SAFETY PROGRAM

The LANL Health and Safety Program requires that a preliminary assessment of the risks posed by NMSF operations be completed in accordance with DOE Order 5481.1b to establish the initial hazard categorization for the facility. The program also calls for an appropriate level of safety analysis to be performed to establish the safe operating envelope within which the facility must be constructed and operated.

A preliminary Hazard Classification has been determined for this project. The facility has been classified as a Performance Category 3 facility (seismic) and a Hazard Category 2. This hazard classification requires preparation and approval of a SAR to establish the safety envelope that would bound the facility operations. A fire hazard analysis will be performed per DOE 5480.7A, Fire Protection. The PHA safety documentation has been initiated during conceptual design, and the preliminary SAR requires approval prior to development of Title II design. The final SAR must be completed before occupancy.

3. ENVIRONMENTAL PROGRAM

Environmental compliance activities required during NMSF project development, design, construction, and operations are delineated in the LANL Environmental Program Plan. All required NEPA documentation has been approved and is in place.

4. OPERATIONS AND MAINTENANCE PLAN

The project team will be responsible for writing an O&M plan. This large source document, which will contain SOPs and maintenance procedures, will be the basic document used and maintained by the NMSF staff while operating the facility. It will be developed in parallel with the design so that it is integrally tied to the systems integration process. The O&M Plan and SOPs must be completed prior to completion of the integrated test plan.

Maintenance procedures and plans will be generated during the design effort to ensure that adequate space is provided for equipment maintenance and that reliable designs are established.

NMSF operating personnel will be trained using the SOP document. NMSF maintenance personnel will be trained using the SOPs as well as the equipment maintenance plan generated during detailed design.

5. INTEGRATED TEST PLAN

The SFE design and the O&M plan will be the basis for development of the integrated test plan. This plan must be developed for initiating the start-up testing, and reviewed and approved by the startup team prior to beginning the test and evaluation of the completed project.

6. OPERATIONAL READINESS REVIEW PLAN

The startup of the NMSF facility will be accomplished through the Operational Readiness Review (ORR) process. An ORR Plan will be prepared and submitted to DOE for concurrence. Following ORR Plan approval, the acceptance testing and startup activities will be completed in accordance with the procedures and criteria set forth in the plan. An ORR report will be generated following completion of the readiness review, and any report findings will be resolved prior to occupancy.

The project execution philosophy is to maintain continuity of the project/program team from project initiation through licensing so that fully informed and trained user staff take over an operational facility at the close of the project. The project design team will be responsible for the generation of test procedures and the Operations Readiness Team Plan, which will be treated as a design deliverable.

A conceptual set of systems test procedures and a conceptual Operations Readiness Test Plan will be prepared as part of the title design summary report. Test procedures ranging from shop tests and receiving tests, to individual installed component tests, to individual system performance tests, and finally to integrated systems tests, including off-normal incident response tests, will be listed and summarized in descriptive narrative form.

7. SECURITY PLANS

Refer to **Part I - Design Concept** for security requirements. Material stored in this facility will be subject to strict MC&A and security requirements. Plans are currently under development.

8. CONFIGURATION MANAGEMENT PLANS

Configuration Management Plans will be initiated at Title I design. Draft plans will be completed by the Operational Readiness Review and modified as needed, but issued in final form prior to occupancy. These plans will assist the facility managers in establishing documented operational procedures.