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U.S. DEPARTMENT OF ENERGY
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REPORT ON INSPECTION OF
ALLEGED DESIGN AND CONSTRUCTION DEFICIENCIES IN THE
NUCLEAR MATERIALS STORAGE FACILITY AT THE
LOS ALAMOS NATIONAL LABORATORY

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INSPECTION OF ALLEGED DESIGN AND CONSTRUCTION
DEFICIENCIES IN THE NUCLEAR MATERIALS STORAGE FACILITY
AT THE LOS ALAMOS NATIONAL LABORATORY

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U.S. DEPARTMENT OF ENERGY
OFFICE OF INSPECTOR GENERAL
OFFICE OF INSPECTIONS

INSPECTION OF ALLEGED DESIGN AND CONSTRUCTION
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I. INTRODUCTION AND PURPOSE

On June 8, 1994, the Office of Inspections, Office of Inspector General (OIG), Department of Energy (DOE), received a letter dated May 31, 1994, from a complainant concerning the Nuclear Materials Storage Facility (NMSF) at the Los Alamos National Laboratory. The complainant alleged that the NMSF, completed in 1987, was so poorly designed and constructed that it was never usable and that DOE proposed to gut the entire facility and sandblast the walls. According to the complainant, "these errors are so gross as to constitute professional malpractice in a commercial design setting." The complainant further stated that "DOE proposes to renovate this facility to store large amounts of plutonium (as much as 30 metric tons, by some accounts), and it is imperative that the public receive some assurance that this waste will not recur and that the facility will be made safe."

The purpose of our inspection was to determine if the allegations regarding the design and construction of the NMSF were accurate, and if so, to determine if the Government could recover damages from the Architect/Engineer and/or the construction contractor. We also reviewed the Department's proposed actions to renovate the NMSF.

II. SCOPE AND METHODOLOGY

In conducting the inspection, we interviewed appropriate DOE and contractor officials and reviewed pertinent documentation. We also reviewed renovation plans for the NMSF project and visually inspected the existing facility. The field work portion of the inspection was conducted at the Albuquerque Operations Office (AL) and included a site visit to the Los Alamos National Laboratory (LANL).

This inspection was conducted in accordance with the Quality Standards for Inspections issued by the President's Council on Integrity and Efficiency.

III. SUMMARY RESULTS OF INSPECTION

We concluded that the complainant's allegations concerning the design and construction of the NMSF were accurate. We learned that deficiencies in the facility were so serious that they

rendered the facility unusable for its intended purpose. We found that AL officials were planning extensive renovations to bring the facility into compliance with current Departmental environmental, safety, and security standards. However, we also found that deficiencies identified by the complainant were similar to deficiencies already identified by the Department and the contractor.

We also do not believe there is sufficient basis for the Government to recover damages from any of the contractors on the project. A Root Cause Analysis Report, prepared by the DOE Los Alamos Area Office (LAAO), stated that Departmental officials and the Management and Operating (M&O) contractor were responsible for inadequate design requirements for the facility. The report also stated that there was inadequate management on the part of DOE, LANL, the Construction Manager, the Architect/ Engineer (A/E) and the construction contractor. As a result, AL officials concluded that there was no basis for recovering damages from the A/E or the construction contractor.

At the time of our inspection, we found that AL's planning for the NMSF Renovation Project to correct deficiencies in the existing facility was in progress. The project's objective is to provide a complete and usable facility that can be operated safely. However, we believe that additional actions should be taken to ensure that the facility is successfully renovated.

We made several recommendations for corrective actions that we believe should be taken by management to ensure the facility is successfully renovated. Management generally concurred with our recommendations.

IV. BACKGROUND

The NMSF was a DOE Office of Defense Programs (DP) FY 1984 Research, Development, and Testing project that had never become operational. The primary purpose of the NMSF was to provide mid to long term storage of LANL's nuclear materials using state-of-the-art nuclear material accountability techniques while mitigating potential environmental, safety, and health (criticality/exposure) impacts. The facility was intended to provide a consolidated repository for special nuclear material.

The total estimated cost of construction was \$19.3 million. The NMSF was planned to be a 30,000 square foot storage facility intended to meet applicable Federal and Departmental security, safety, fire protection, environmental, safeguards, and operational requirements. The facility was designed with the following four major operating areas: (1) a material access area (MAA); (2) a safe secure trailer (SST) garage and dock; (3) a material transfer tunnel to the Plutonium Processing Facility (PF-4); and (4) an administration area. The MAA included a nuclear material storage vault and other storage locations, a non-destructive assay area, a packaging/unpacking area, and a staging area. The administration area included a mechanical equipment room, a security inspection station, offices, and change rooms.

The NMSF was located within Technical Area 55 (TA-55), which was one of the security areas at LANL.

Department officials at LAAO managed and directed the design and construction contracts for the NMSF. LANL provided technical support to the LAAO project manager under its M&O contract; and DOE signed an agreement with another Federal agency to provide construction management services for the project.

V. RESULTS OF INSPECTION

A. Original NMSF Construction Project

We found that the NMSF, which was originally completed in 1987, was so poorly designed and constructed that it was never usable and that DOE officials were proposing to renovate the entire facility. Departmental and contractor officials discovered numerous design, construction and operational deficiencies after the facility was occupied in February 1987. These deficiencies included: (1) the inability to control and balance the heating, ventilation and air conditioning (HVAC) system to maintain acceptable negative pressures within the facility; (2) the inability to dissipate the heat generated by radioactive decay of the materials to be stored; (3) the inability to limit personnel radiation exposures to "as low as reasonably achievable;" (4) a peeling of the "Placite" decontamination epoxy coating throughout the facility; and (5) the inability to open and secure the Safe Secure Trailer (SST) doors due to the inadequate width of the garage once the SSTs were parked in the garage.

We determined that deficiencies alleged by the complainant were similar to deficiencies discussed above, which had been identified by the Department and the contractor. The complainant alleged that: (1) the garage for the plutonium transporter was too narrow to allow the transporter's doors to be opened and secured; (2) plutonium had to be carried through the office area after it was removed from its shipping container; (3) radiation shielding was not installed as required; (4) special paint designed to facilitate decontamination was improperly installed and was peeling throughout the facility; (5) ventilation ducts receiving air from the plutonium storage area were improperly located in the office area; (6) the decontamination shower and sink were improperly located within the facility; and (7) two natural-gas fired boilers were located in the facility (a fire/explosive hazard).

We confirmed the existence of these deficiencies through our visual inspection of the NMSF on July 26, 1994, and a review of the following documents:

- o "The Renovation Report for the Nuclear Materials Storage Facility, Los Alamos National Laboratory," issued by the NMSF Task Group on June 22, 1992.
- o Briefing Charts, "Nuclear Materials Storage Facility Renovation," "HQ KD#0 Presentation," dated June 1993, prepared for a briefing for the DP Principal Deputy

Assistant Secretary for Facilities.

- o "The Draft 100% Conceptual Design Report, NMSF Renovation," issued by Merrick Engineers & Architects on January 24, 1994. (The Final Conceptual Design Review document was scheduled to be completed in May/June 1995.)
- o "The Capital Assets Management Process (CAMP) Report for FY 1996."
- o "Report of the Root Cause Analysis and Corrective Actions for the NMSF," issued by DOE LAAO and LANL on April 12, 1993.
- o "NMSF Legal Review, Technical Evaluation," dated March 16, 1993, and Legal Opinion issued by LAAO's Counsel on April 5, 1993, which provides a legal review for contractor liability.

According to the opinion of LAAO's legal counsel, there was no basis for claims against the A/E and construction contractor, because the primary cause for NMSF problems was due to inadequate design criteria, poor coordination among participants, and a need for better project and construction management.

B. Causes of NMSF Deficiencies

In March 1992, AL's Manager directed the formation of a Task Group to investigate and evaluate renovation options that were available to make the NMSF operational. The Task Group was also requested to review requirements contained in the National Environmental Policy Act and Safety Analysis Report to determine if any design changes were needed in the renovation project. The Task Group's findings were incorporated in their report titled, "Renovation Report for the Nuclear Materials Storage Facility, Los Alamos National Laboratory," which was issued on June 22, 1992. The Task Group provided a lessons learned section in the report which stated:

"The leading cause of the deficiencies was the lack of a well defined technical baseline at the beginning of the design phase. The Conceptual Design Report (CDR) and the Design Criteria were very generic, thus specific user design requirements were not identified early in the design stages. There was also a minimal amount of quality assurance involved with the design even though a QA system was in place. Several issues raised during the design phase do not appear to have been fully resolved. Among these issues are the decay heat load, the location of the HEPA filters, operation of the ventilation system, shielding of the vault area, and the placement of the "Placite" decontamination coating. Communications between the DOE, LANL, A/E and the Construction Manager appear to have been limited."

The report also stated:

"One lesson learned from this project is that

construction of nuclear facilities must be closely monitored by the DOE and the Management and Operating (M&O) Contractor. Another lesson learned is that the technical baseline must be complete and reviewed by all DOE and M&O organizations involved with the project. Methods for communicating and resolving problems were not fully developed, or utilized, and consequently several issues were not fully and satisfactorily resolved."

Specific causes of the storage facility's design and construction problems are identified in LAAO's "Report of the Root Cause Analysis and Corrective Actions for the NMSF," dated April 12, 1993. They are as follows:

"I. Los Alamos National Laboratory

- "A. LANL did not adequately develop a technical baseline for the facility.
- "B. LANL organizations did not cooperate during the design and construction of the facility because of a lack of accountability.
- "C. The LANL Construction Project Manager did not adequately use the expertise of Laboratory nuclear facility experts.
- "D. LANL did not incorporate Design Review comments into design documents.

"II. Department of Energy

- "A. DOE Project Management Branch Chief did not adequately manage the project.

"III. Architect/Engineer

- "A. The Architect/Engineer did not provide an acceptable Quality Assurance Program in a timely manner.
- "B. The Architect/Engineer did not adequately program and determine the design needs of the facility.

"IV. Construction Management

- "A. The [Construction Manager] did not adequately manage the construction contractor.
- "B. The [Construction Manager] did not consider the needs of the customer."

C. The Proposed NMSF Renovation Project

At the time of our inspection, we found that actions were being taken to address the deficiencies in the NMSF. For example, project planning and conceptual design work was progressing for the

NMSF renovation project. Also, an initial management team had been formed with a project manager, program liaison representative and user liaison representative identified as critical personnel. Further, the draft design criteria and a draft 100 percent Conceptual Design Report had been developed and coordinated to correct deficiencies plaguing the original building. In a "Status Project Review" document issued on July 19, 1994, it was stated that the latest safety, security, environmental and energy conservation orders would be implemented in the renovation of the facility. A Fiscal Year 1996 construction project with a current working estimate of \$34.5 million had also been developed and was planned for validation.

D. Proposed Actions to Improve Project Management

We reviewed current and future plans for managing the renovation project, and determined that there may be additional areas where further risk reduction in the planned renovation project could be initiated. For example, we believe:

1. AL's Manager should confirm that: (a) laboratory personnel assigned to the project are the best available; and (b) they are allocated in the best possible way to ensure project success since there is an urgent need, according to LANL program managers, for the storage of nuclear materials by the late 1990s. We believe that, if this project is to be successful, it must be managed in an exemplary manner with the most highly qualified personnel LANL has to offer, since many of the problems associated with the original construction were due, in part, to errors by technical personnel. We did, however, note at the time of our on-site inspection in July 1994, that several members of a more capable management team had been selected for positions on the renovation project (i.e., project management, program liaison and user liaison).
2. It may be beneficial to certify contractor project managers in addition to DOE project managers. However, recognizing the current budget reductions in training and travel, we believe that an alternative would be to identify such personnel as "Key Personnel" in M&O contracts.

A Secretary of Energy memorandum to the Office of Procurement Assistance and Program Management, dated May 23, 1991, described the Financial and Project Management Improvement Program, which was designed to establish a sound business management culture and proactively resolve financial and project management problems. The fourth initiative of the program tasked the Director, Office of Procurement Assistance and Program Management, to "Improve the Department's training courses for [Departmental] project managers and add a certification program so that all project managers are qualified at an identifiable skill level." We learned that DOE Order 4700.4, "Project Manager Certification," dated January 27, 1993, implemented such a program for DOE project managers. We also noted that a similar certification program for DOE contractor project managers is not required by the Department or DOE Order 4700.4. From our review of project-

related documents, we learned that the original project's difficulties were largely due to inadequate Federal and contractor project management and technical support.

3. Departmental officials should ensure that an effective Quality Assurance and Quality Control Program is planned and implemented for the NMSF renovation project in accordance with Departmental requirements. Although a legal review by LAAO of the previous A/E's work (related to the NMSF) did not establish a legal basis for claims against the A/E, there were several "serious" concerns noted in various project documents we reviewed. For example, the A/E did not provide an acceptable Quality Assurance Program in a timely manner. This was indicated in comments provided by LANL quality assurance officials on the A/E's Quality Assurance Program in June 1984 and September 1984. Also, the deficiency had not been satisfactorily resolved as of April 30, 1985. Another example concerns a Quality Assurance Surveillance Report, issued on May 28, 1985, which highlighted items with corrective actions (required under the terms of the A/E contract) that were long overdue. In addition to these examples, we learned that: (a) LANL officials had not performed quality assurance audits that should have been performed on the A/E, and (b) the Quality Assurance Program was never fully implemented or approved. As a result, many of the facility's deficiencies, which we identified above, surfaced during the construction phase and prevented the NMSF from becoming operational.

DOE Order 5700.6C, "Quality Assurance," dated August 21, 1991, and ALms implementing order, ASME NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities," require that an independent and aggressive Quality Assurance and Quality Control Program be planned and implemented during all phases of the design and construction efforts of a project. LANL officials advised us that the A/E contractor will be contractually required to provide a Quality Assurance Plan on schedule or a portion of the A/E's contract funds will be withheld.

4. Contract language is needed in the future A/E contract for the renovation project that will provide increased accountability and liability for the A/E and reduce the Government's risk of loss due to A/E design errors or other deficiencies. According to LAAO's "Report of the Root Cause Analysis and Corrective Actions for the Nuclear Materials Storage Facility," issued on April 12, 1993, the A/E did not adequately program and determine the design needs of the facility. For example, the report cites:

- o improper setup of an operations room;
- o improper placement of the HEPA filters for maintenance;
- o improper installation of an HVAC system so that proper manual/operator intervention was not possible;
- o improper routing of material through office areas; and

- o improper radiation protection in the area of the Stack/Retriever.

5. Clarification is needed of DOE policy in the Department's Acquisition Regulation (DEAR) and DOE Order 4700.1, "Project Management System," regarding the liability of A/Es for design errors and deficiencies. Federal Acquisition Regulation (FAR) 36.609-2(b) states that: "The contracting officer shall insert FAR Clause 52.236-23, Responsibility of the Architect-Engineer Contractor, in fixed-price architect-engineer contracts." The FAR does not state whether this clause should or should not be included in cost-type A/E contracts. We determined that DEAR 970.7104-28 is ambiguous concerning application of the FAR clause for cost-type or fixed-price A/E contracts. We also determined that DOE Order 4700.1 does not appear to provide policy or procedures for holding A/Es accountable and liable for design errors and deficiencies.

6. A full-time highly qualified construction management team is needed, instead of an individual consultant, to perform such vital functions as: design reviews relative to constructability; monitoring and inspecting for conformance to design requirements; the formulation of current cost and progress as the work proceeds; the preparation of Government cost estimates; and the LANL construction-related services. We also believe that the construction management firm should have a proven record for successfully accomplishing projects similar to the NMSF. We learned that construction management for the existing NMSF was provided by another Federal organization. We also learned that this organization apparently had little successful nuclear construction experience within DOE. For example, the organization had difficulties with construction management of the Device Assembly Facility at the Nevada Test Site as cited in our May 1992 report, DOE/IG-0310, "General Management Inspection, Department of Energy Nevada Field Office." We also noted that existing problems, associated with the NMSF, were primarily due to poor design criteria and inadequate construction and project management.

At the time of our field visit, a LANL project manager stated that a non-Federal consultant would be hired to perform construction management services for the NMSF renovation project. We were also told, by a LANL project manager, that Title III inspectors from LANL would be used on a part-time basis.

VI. CONCLUSIONS AND RECOMMENDATIONS

We concluded that the complainant's allegations concerning the design and construction of the NMSF were accurate. Deficiencies in the facility were so serious that they rendered the facility unusable for its intended purpose. We found that AL officials were planning extensive renovations to bring the facility into compliance with current Departmental environmental, safety, and security standards. However, we also found that deficiencies identified by

the complainant were similar to deficiencies already identified by the Department and the contractor.

We also do not believe there is sufficient basis for the Government to recover damages from any of the contractors on the project. A Root Cause Analysis Report, prepared by LAAO, stated that Departmental officials and the M&O contractor were responsible for inadequate design requirements for the facility. The report also stated that there was inadequate construction management on the part of the Department and its contractors. As a result, AL officials concluded that there was no basis for recovering damages from the A/E and construction contractor.

At the time of our inspection, we found that AL's planning for the NMSF Renovation Project to correct deficiencies in the existing facility was in progress. The project's objective is to provide a complete and usable facility that can be operated safely. However, we believe that additional actions should be taken to ensure that the facility is successfully renovated.

Therefore, we recommend that the Manager, Albuquerque Operations Office:

1. Verify that the project manager, program liaison representative, and user liaison representative are qualified at a level which will help to ensure successful renovation of the Nuclear Material Storage Facility.
2. Consider incorporating in the Title I and Title II A/E contracts for the renovation of the NMSF, the Federal Acquisition Regulation Clause 52.236-23, "Responsibility of the Architect-Engineer Contractor," or one similar to it, to ensure the A/E is held financially responsible for design errors and omissions.
3. Ensure that an independent, aggressive, and effective Quality Assurance and Quality Control Program is developed and implemented for the duration of the design and construction of the NMSF Renovation Project, as required by DOE Order 5700.6C. This program should be supplemented by project specific quality assurance oversight for the renovation project.
4. Ensure that the construction management organization hired to manage the NMSF Renovation Project has the necessary resources to manage the project and a proven record for successfully accomplishing projects similar to the NMSF.

We also recommend that the Director, Office of Infrastructure Acquisition Services:

5. As a minimum, have contractor project managers performing design and construction work be identified as "Key Personnel" in M&O contracts or formulate a certification program for such personnel.

[Note: Subsequent to the issuance of our initial draft report, the Office of Infrastructure Acquisition Services was renamed as the

Office of Project and Fixed Asset Management.]

Further, we recommend that the Deputy Assistant Secretary for Procurement and Assistance Management, in coordination with the Director, Office of Infrastructure Acquisition Services:

6. Review the use of appropriate language regarding the liability of A/Es for design errors and deficiencies in cost-type architect/engineer contracts and provide clarification/guidance to contracting officers and project managers, as necessary.

VII. MANAGEMENT COMMENTS

By memorandum dated September 22, 1995, the Director, Project and Facilities Management Division, Albuquerque Operations Office, provided comments on our draft report. He concurred with Recommendations 1 through 4 and provided the following comments.

With respect to Recommendation 1, the Director stated that:

"LANL will review the qualifications of candidates and submit recommendations and supporting documentation to DOE. A DOE panel consisting of representatives from PMD, WQD and LAAO will review recommendations and provide comments and concurrence or nonconcurrence with LANL recommended personnel. If DOE nonconcurs, LANL will have to provide supplementary information to support the original proposed personnel or recommend new personnel.

"Following DOE concurrence of key LANL personnel, these individuals will be identified in the Project Management Plan. Any changes will have to be formally documented using the same process used for selection of the original personnel.

"The DOE project manager will be appointed by the Manager, AL, in accordance with the requirements of DOE Order 4700.4, Project Manager Certification."

We consider management's actions to be responsive; therefore, Recommendation 1 may be closed.

With respect to Recommendation 2, the Director stated that AL's Contracts and Procurement Division verified that FAR Clause 52.236-23 is included in the General Provisions section of the standard boilerplate for all A/E contracts at the Los Alamos National Laboratory.

We believe Recommendation 2 should remain open until the A/E contract for the renovation of the NMSF is signed and the OIG is provided a copy of the contract containing the FAR clause.

With respect to Recommendation 3, the Director stated:

". . . Based on direction from DOE/LAAO, LANL is presently developing and implementing an aggressive overall Quality

Program. This program will serve as a model for implementation on a graded approach. LANL Facilities, Safeguards and Security Division is also developing a Quality Program to be applied to all projects, including the NMSF project. The basis for the program is 10 CFR 830.120, and DOE Order 5700.6C. An overview of the Quality Program's approach and philosophy was briefed to the Defense Nuclear Facilities Safety Board with favorable response.

"Additional activities in this area include the formation of a Technical Review Team by the Weapons Quality Division, AL. This team is chartered to perform independent technical oversight and review of the project during the Conceptual Design stage, and their charter may be extended through Title I and Title II Design. The function of external peer review has been built into the project since initiation of Conceptual Design efforts. A separate external Peer Review was conducted on the draft CDR in April 1994.

"Finally, the overall Quality Program developed and implemented for the NMSF Renovation project will be consistent, integrated, and complimentary to the existing programs in place at TA-55. The Quality Program will also be defined in, and implemented through, the Project Management Plan."

We consider management's actions to be responsive; therefore, Recommendation 3 may be closed.

With respect to Recommendation 4, the Director stated:

"LANL will function as the construction manager for the NMSF project and as such, will ensure that necessary resources are available to manage the project. In addition, a Project Oversight Committee will be appointed to ensure successful accomplishment of the NMSF project goals for a complete usable facility.

"The Project Oversight Committee will regularly review the overall status, progress and direction of the NMSF project. Membership of this Steering Committee may include the:

Director, Project Management Division, AL
Director, Weapons Quality Division, AL
Area Manager, LAAO
DP/HQ Defense Programs/Project Representatives
Director, Nuclear Materials and Reconfiguration
Technologies, LANL
Director, Facilities, Safeguards and Security Division,
LANL.

"On December 20, 1994, an Independent Technical Review Committee that was established by AL's WQD, met to review the complete development of the CDR and the overall systems and programs that are in place to ensure successful accomplishment of project objectives. A final report was prepared and issued in June 1995."

We consider management's actions to be responsive; therefore, Recommendation 4 may be closed.

By memorandum dated November 28, 1995, the Director, Office of Infrastructure Acquisition Services, provided comments on our draft report. He concurred with Recommendation 5 and stated:

". . . it is important to recognize that our preference is to ensure that key personnel on managing [sic] and operating contracts are identified and fully qualified project managers rather than implement a costly contractor project manager certification program."

Also, by memorandum dated January 18, 1995, the Director, Office of Procurement Assistance and Property, provided comments on our draft report. He stated regarding Recommendation 5 that:

"Procurement would be pleased to work with the Office of Infrastructure Acquisition Services regarding a contractor certification program to ensure such requirements are reflected in contracts as appropriate."

We believe Recommendation 5 should remain open until a contractor certification program has been established or a policy change initiated to have contractor project managers identified as "Key Personnel" in the M&O contracts.

In an October 31, 1995, meeting with Office of Inspections officials, the Director, Office of Procurement Assistance and Property, provided verbal concurrence with Recommendation 6. He also stated that:

"We will be meeting with representatives from the Office of the Deputy Assistant Secretary for Procurement and Assistance Management to determine the necessary details to clarify to contracting officers the architect/engineer contractors general responsibilities for design errors/deficiencies to address your Recommendation 6."

We believe Recommendation 6 should remain open until guidance regarding A/E contractors' responsibilities has been issued.

IG Report No. INS-O-97-01

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