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Department of Energy

Albuquerque Operations Office
P.O. Box 5400
Albuquerque, New Mexico 87185-5400

DEC 29 1997

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W., Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

Enclosed is the Los Alamos Initial Site Assessment Report which summarizes information developed from initial inspections and assessments of material containing uranium-233 at Los Alamos National Laboratory (LANL). The report represents the deliverable for Commitment 4 of the Department's Implementation Plan for addressing the Defense Nuclear Facilities Safety Board's Recommendation 97-1, concerning the safe storage of uranium-233 material.

The report describes the types of uranium-233 material in inventory, the facilities where the material is located, and the actions completed to date to determine any remediation efforts needed as we work toward consolidating the material in preparation for movement to a long-term storage location. We will continue to update this report as inspections and assessments progress, and plan to provide the final report to you in December 1998.

We have completed the actions identified under this milestone and propose closure of this commitment. If you have any questions, please contact me, or have your staff contact Steve Payne at (505) 845-6300.

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Sincerely,

for Bruce G. Twining
Manager

Enclosure

cc w/enclosure:
M. Whitaker, S-3.1, DOE HQ

LA-UR-97-4538

Title: **Los Alamos National Laboratory Site Assessment Report**

Uranium 233 Storage and Disposition

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Prepared for: **USDOE/DNFSB 97-1 Program**

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Revision 1

December 18, 1997

Los Alamos National Laboratory Site Assessment Report

Uranium 233 Storage and Disposition

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Prepared for the

U.S. Department of Energy

TABLE OF CONTENTS

1. Site Specific Description: Los Alamos National Laboratory

1.1. Inventory

The Los Alamos Uranium -233 inventory consists of 110 items (TABLE 1). The material is currently stored in the TA-55 vault, the Chemistry and Metallurgy Building (CMR) vault, and a the Hillside vault at TA-18 (Los Alamos Critical Experiment Facility, LACEF).

The inventory has been static during the past 5 years because there is no programmatic need or use for this material at this time. Our plans are to consolidate the material in preparation for movement to a final long term storage location.

1.2. Material forms

The total reportable inventory at Los Alamos is 7.2 kgs of uranium-233. The major physical forms are metal and oxides. There are small amounts of other forms which total less than 10% of the inventory by number of items. Table 1 summarizes the material forms by number of items. The variety of items at Los Alamos arises from the research atmosphere of the institution. In order to deal with the material currently on site we will attempt to stabilize the material to an oxide or metal form.

1.3. Facility Description

1.3.1. TA-55

The TA-55 complex began operating in 1978. This seismically-designed facility performs primarily state-of-the-art Pu processing, but also has some HEU inventory and handling operations. While TA-55 operations involve primarily Pu in liquid and solid forms, operations involving uranium and other actinides are also carried out inside the TA-55 facility. Facility activities include fabricating, testing, and disassembling of solid components, and various aqueous processes involving both uranium and plutonium.

1.3.2. Chemistry and Metullurgy Building (CMR)

The CMR Building is a large, reinforced concrete building with a basement, a first floor, and an attic. The facility is centered around a single main corridor with eight wings. An administration wing and seven laboratory wings extend from the corridor. The laboratory wings have change rooms and filter towers located at the end of each wing. In addition, a waste assay facility is located at the loading dock between Wings 1 and 4.

The CMR Building was completed in 1952 to house research and experimental facilities for analytical chemistry, Pu and uranium chemistry and metallurgy, and some engineering design and support functions. At the time it was built, the facility represented state-of-the-art instrumentation and engineered safety controls for a modern chemistry laboratory. The design of the facility is still considered a preferred configuration for a chemistry laboratory. However, it was built to Uniform Building Requirements and does not meet many of today's standards or requirements. In 1960, a 54,000-square-foot addition (Wing 9) was constructed to support Laboratory programs requiring hot cell facilities. The Wing 9 addition brought the total square footage of the CMR Building to approximately 555,000 square feet. Photograph A-10, taken over ten years ago, shows the CMR facility.

1.3.3. TA-18

TA-1 8 houses the LACEF and serves as the primary facility at LANL for critical experiments. TA-1 8 is remotely located at the Pajarito Site within canyons that can provide radiation shielding in the event of a local release. Critical experiments are conducted there at low-power levels for extended periods, and at high-power levels for burst operations. These experiments generate negligible fission product or activation product inventories, and need no special cooling. The experimental critical assemblies are situated in Laboratory buildings called Kivas, which also contain storage areas for SNM. An additional storage area exists at TA-18 in the hillside vault. This area is where the U-233 is stored at this location. The critical assemblies are the only assemblies currently authorized to operate using HEU. Safety analyses of these assemblies are well documented and have been reviewed by several organizations.

2. Observations

2.1. Material Characterization Data

Material characterization data for the U-233 inventory (form and quantity) can be found with our material accountability data. The majority information that currently exist are measurements performed by the institution that of the shipped the material to Los Alamos. Los Alamos currently is unable to complete NDA because no instrumentation or traceable standards exist to calibrate and certify NDA instrumentation. Of the items in inventory, 37% are currently listed at measurement based on weight alone. Another 16% have invalid measurement codes, 17% are considered difficult to measure items, 13% have values assigned by the shipper, and 17% have confirmatory measurements that are not quantified. Currently there are no items in the inventory with chemical analysis measurement codes. The characterization data or lack thereof needs to be addressed to fulfill the requirements of this program. Therefore, NDA measurements or chemical analysis of the material will be required to ship this material off site as part of this plan. Table 2 summarizes this information.

Measurement Code	# of items	% of Inventory
Balance Measurement	53	37
Difficult to Measure	25	17
Shippers Value	18	13
Confirmatory Measurement	24	17
Invalid Measurement Code	23	16
Total	143	100

2.2. Packaging

2.2.1. Visual Inspection

Over the past two years a complete visual inspections of the containers has taken place. During these inspection there was no visual evidence of degradation of the outer container.

Small amounts of U-233 have been stored in the Hillside Vault for more than 10 years. The U233 has not been repackaged because of high radiation levels (more than 2O R/hr at contact). Facility personnel believe that no plastic bags surround the U-233 samples. However, breaching of the packaging could occur as a result of a seismic event or if the container were dropped on the floor during the semiannual vault inventories. The exterior of the packages show no signs of decay. A recent radiography study also indicates that the contents are still intact and require no remedial action with respect to packaging.

2.2.2. Remediation

Based on the inspection conducted over the past two years, there seems to be no need for remedial action with respect to outer packages. However, the inner packaging is not well characterized and some remedial action may be required when the items are prepared for transport to the final storage location. There has been an example of a package of U-233 containing plastics in contact with a metal button. When this material was repackaged the plastic was found to be blackened and brittle from radiological damage. Because of this finding, it is likely that we may find other containers that have plastic packaging material. These items will have to be repackaged to remove all plastics and organics from the storage container.

The Hillside vault storage location at TA-18 was also identified as an inadequate storage location because of its proximity to a public access road and the lack of ventilation and HEPA filtration of the air handling system. The near term action to remedy this situation is to move the U-233 material from the Hillside vault to the CMR building floor hole storage area in wing 9.

In preparation for moving the TA-18 material a radiography study of the material was completed. The results of this study did not identify any critical safety concerns. However, it did provide information regarding the contents of each package. Many of the larger packages contain a variety of smaller containers. The smaller container were identified as being glass, plastic, and metal containers. This information will be used when opening the containers for repackaging. It is now known that these contain packaging material not suitable for storage of U-233.

A neutron streaming study was also complete on the floor hole storage array in the CMR building. This was done to verify that the material to be stored in the floor holes will be adequately contained to minimize radiation fields outside of the storage locations. It is also used to ensure that there is no interaction of radiation fields between each storage location. The results of this study confirmed that these location are suitable for storage of U-233. The radiation fields measurements on top of the storage location was only background. This indicates that there will be no transient personnel dose from storage of material in these locations. Hole to hole neutron measurements were taken at a variety of depths ranging from unshielded reading at top of hole to readings at the bottom of the hole. The readings observed were approximately 1 Mr/hr at top to 300 mR/hr at the bottom of the hole. Gamma radiation reading were only taken at floor level an no reading above background were observed. This also does not raise any concern for storage of U-233 in these locations.

2.3. Facility

2.3.1. TA-55

2.3.1.1. Safety Analysis

A DOE-approved SAR for TA-55 (DOE 5480.23) was approved in July 1996. Operational Safety Requirements (OSR) have been approved by DOE (1988, revised 1989), and a Basis for Interim Operation (BIO) for the processing facility was approved June 16, 1994. In the BIO, the consequences of a worst-case bounding and of an unmitigated accident are presented. Results for both scenarios are well below the DOE guideline for accidental releases of 25 rem whole-body committed effective dose equivalent at the site boundary.

Analysts who performed the preliminary hazards analysis (PHA) reviewed operations in all areas of TA-55. Approximately 850 scenarios were identified and were categorized based on the likelihood of occurrence and on the consequences likely to the public, workers, and the environment. The scenarios were grouped by likelihood and consequence to create a risk ranking. Those scenarios that were considered to be bounding were described in detail in the SAR, In the SAR accident analysis, U-233 was based on the materials current location. The analysis did not reveal any condition that would impact the safety envelop of the facility.

2.3.1.2. Facility Measurements

2.3.1.2.1. Ventilation and Off-gas Monitoring

Circulating air and makeup air (drawn from the outside into the building) are passed through high-efficiency particulate air (HEPA) filters. In-line air samplers are also located at various locations within the ventilation ducts to monitor for contamination. This protects workers from contamination that might originate from both inside and outside of the facility. The air in the laboratories is continuously replaced at approximately seven air changes per hour. The desired pressure differentials are monitored both automatically and visually in the Facility Operations Center. There is a 1 00-percent redundant system for standby to back up the ventilation system for the high-radiation areas (Zone 1).

Air that is being bled off to the outside of the facility passes through an additional two stage HEPA filter, and is released through continuously-monitored stacks.

2.3.1.2.2. Radiation Assessments

Uranium -233 is stored in the TA-55 main vault. Because of the locations the radiation fields can be greater than 100 mr/hr. This dose rate is not from the U-233 alone. The TA-55 vault store other material as well as the U-233.

2.3.1.3. Condition Assessments

Operations are controlled by the plan of the day and a daily work schedule. A morning meeting is used to review the work each day These methods are used to coordinate between the Operations Center and the distributed Laboratory activities. The Operations Center is used to monitor the ventilation systems, electrical systems, and safety systems of TA-55.

The Operations Center and the laboratories have written procedures for tasks. The processing areas use SOPS. The personnel are trained in the procedures.

Maintenance and minor construction are conducted by a resident subcontractor. Maintenance work is controlled by a work control process, which includes written procedures and job packages.

Safety-related equipment and systems are subject to surveillance requirements defined in the OSRs. The surveillance requirements-which include monitoring, testing, and calibrating-apply to ventilation systems, exhaust filtration, recirculation filtration, fire detection, fire suppression, emergency alarms, the facility control system, instrument compressed air, and uninterruptible power supply. Generally, the systems are designed to allow operations to continue during testing and maintenance.

A configuration manager is responsible for maintaining facility configuration. Thorough reviews are conducted before the installation of new equipment or processes. Before replacing equipment in gloveboxes, an unreviewed safety question (USQ) screening is conducted along with independent reviews, including criticality safety reviews.

The formality of operations and maintenance has increased since the DOE Mentor program began in early 1993. Under this program, subject matter experts have worked toward increasing formalization of operations involving management and organization, the safety envelope, environmental compliance, safety, and the conduct of operations. This was identified as a noteworthy practice during the Plutonium Vulnerability Assessment.

A predictive maintenance program is in place at TA-55. On a monthly basis, a subcontractor performs vibrational testing on various types of equipment. Data have indicated that the mean time between failure for equipment under the program has increased significantly. Discussions with site personnel revealed the following:

> In 1996, The backlog of corrective maintenance work orders is approximately 385. Completion of these work orders will require approximately 25,000 person hours to complete.
>
> The TA-55, Fiscal Year-1998 budget calls for $150 million in equipment upgrades. Typically only $2 million per year is devoted to equipment upgrades.
>
> One day in five is devoted to maintenance-related activities at TA-55.

2.3.2. CMR

2.3.2.1. Safety Analysis

An ISAR was prepared in 1992. This report focused on accident conditions and included a PHA of the facility. The purpose of the ISAR is to define the current safety envelope of the CMR Building (SM-29) and to identify additional upgrades that are necessary for continued safe operation of the facility.

The ISAR describes the facility and the processes performed, and evaluates the hazards and risks to the workers and the public from the operations. The focus is on accident scenarios and consequences. During normal operation, worker exposures are well below DOE limits, and public exposures are several orders of magnitude lower than DOE annual limits.

The facility is classified as posing a moderate hazard based on radiological considerations, and posing a moderate (Wings 2, 4, and 5) to low (Wing 3) hazard based on chemical hazards.

The PHA of the CMR identified the radiological material inventory at risk in each zone; 21 chemicals were also identified that would approach or exceed immediately dangerous to life or health values if spilled and allowed to evaporate in a laboratory. The hazards analysis also encompassed fires, explosions, spills, and seismic occurrences. Standard techniques were used to construct and evaluate fault and event trees and propagate uncertainties in the evaluation of accident scenarios and consequences. Accident scenarios included fires, explosions, external events (e.g., an earthquake and its consequences), and chemical spills. The CMR storage area, which contains the bulk of the HEU, is seismically qualified to meet DOE 6430. 1, and presumably would survive a DBE intact. The consequences of the postulated accidents showed that public health and safety would not be at risk as a result of chemical spills in the CMR Building (off-site concentrations would be less than ERPG-1 levels). The radiological consequences to the public from a seismic event would exceed the 25 rem site guideline. However, upgrades proposed for Phase 2 would result in a major reduction in consequences.

The FSAR, prepared in accordance with DOE Order 5480.23, has been prepared and is currently in its second revision and has been submitted to DOE. The Facility Management team is currently involved in writing a Basis for Interim operations until the SAR can be revised and approved.

A Justification for Continued Operations was prepared and approved in 1994.

2.3.2.2. Facility Measurements

2.3.2.2.1.Ventilation

The CMR Facility ventilation system moves air at a rate of nearly 100,000 cubic-feet-per-minute (cfm) through each laboratory wing. The average air change rate in a laboratory is approximately 15 air changes per hour, but this varies depending on the use of the laboratory.

Ventilation systems in the wings are independent. The HVAC systems supply 100% outside air to the laboratories, offices, attic spaces, and basement areas. Except for the Administration Wing, the systems operate in a single pass-through mode without recirculation. Drawing R7172, Sheets M59-M63 (in Attachment I at the end of this chapter) represents the supply and exhaust systems for Wings 2, 3, 4, 5, and 7 except for the type of filtering system used in the exhaust. The exhaust systems for Wings I and 9 and the Administration Wing are described separately. Descriptions of all the fan systems are included in "Los Alamos National Laboratory CMR Facility As Builts," SM-29, TA-3 and "Test, Adjusting, and Balancing Report," Phase I and Phase II (Energy Masters Corporation, 1991 and 1992).

The main vault was designed and constructed in 1986 to the requirements of DOE Order 6430. 1, General Design Criteria. The main vault is a reinforced concrete structure with three separate storage areas and an entry vestibule that is accessed from the basement corridor. Two Class V vault doors control access; the door to the vault is insulated to the equivalent of a 2-hour fire-resistive rating.

The HVAC system for the main vault is completely independent of the building ventilation systems. The main vault is supplied with 100% outside air to provide seven air changes per hour (about 1200 CFM). Supply air is filtered through a pre-filter, then through dual HEPA filters. Approximately 1300 cfm of air is exhausted above the CMR Building through an exhaust stack. Exhaust air is filtered through a pre-filter, then through dual HEPA filters. An alarm panel located outside the main vault near the entrance alarms when the filters are dirty or clogged or when either supply or exhaust fans fail.

The Ventilation system in Wing 9 is a stand alone system.

2.3.2.2.2.Off-gas Monitoring

A variety of radiation detection instrumentation is used at the CMR Facility to provide a comprehensive radiation protection and contamination control. This combination consists of constant air surveillance devices, a variety of radiation survey instruments for monitoring areas and equipment, and personnel monitors. Together, these instruments form an effective deterrent to radiation exposure and the spread of radioactive contamination.

Devices for detecting airborne contamination in the CMR Facility consist of CAMs and fixed air samplers (FASS) located in areas where there is a potential for airborne activity. CAMs constantly sample local air for contamination. Alarm scale and sensitivity are variable so a particular instrument can be set to alarm at low concentrations of plutonium, uranium, or other radionuclides. All CAMs provide a real-time alarm to the local area, signaling an immediate evacuation of the area. CAM instrumentation is located throughout the CMR Facility according to the potential for airborne contamination. The areas of highest potential receive the greatest degree of CAM coverage.

FASs are used as a critical part of the comprehensive contamination control and air monitoring system at the CMR Facility. They complement the CAM system, providing accurate measurements of actual conditions and airborne radioactivity in the laboratory wings. FASs are placed in strategic locations according to laboratory airflow, types of material handled and work conducted in the laboratory, locations of hoods, gloveboxes, and open-front boxes, and the location of personnel during normal working conditions. The ultimate goal in the placement of the FASs is to provide a "representative" sample of the air that workers breathe. FASs use air sampler vacuum pumps to pull samples of local air through a filter. The filter is removed once a week and analyzed for collected activity. This system does not provide real-time warning of contamination buildup or protection from potential accidents. The primary function of the FAS system is to provide a weekly check on normal operations.

FASs are also used for monitoring CMR Facility stack emissions, with one FAS per facility stack. These stack FASs are located near the sampling ports in the attic of the CMR Facility. Stack FAS filters are changed and analyzed weekly. The results are used to determine compliance with DOE and EPA limits on exposure to the public resulting from normal operations.

Personnel monitors located at the exit of each laboratory module and each exit of controlled areas form a barrier to the spread of contamination in the CMR Facility. Portable hand and foot monitors capable of detecting alpha activity are available at these locations in addition to portable monitors for scanning other body extremities. Use of these monitors is required for all personnel as part of normal passage from buffer areas and controlled areas

2.3.2.3. *Condition Assessments*

The CMR is currently undergoing upgrades to bring many of the systems into compliance with various requirements and codes. These include electrical and ventilation system changes.

The facility is currently in a "Stand-Down" to implement a variety of changes to facility operational procedures and controls. The facility is expected to be fully functional by January, 1998.

Upon resumption of the operations, the facility will be available to store, repackage and ship U-233 material. The facility has all of the necessary equipment and systems to safely handle this type of material.

2.3.3. TA-18

2.3.3.1. *Safety Analysis*

A DOE-approved *Safety Analysis Report for TA-18* (5480.23), dated May 1996 is in place and is the primary document forming the authorization basis for the facility. A basis for interim operations was issued in October 1993. Only Kiva 2 is considered to be a Category 2 (moderate) hazard facility; all other operations at TA-18 are considered to be Category 3 (low). Safety analyses and experiment plans are reviewed by the Laboratory Reactor Safety Committee and reviewed and approved by the NonProliferation and International Security Division Director's Office (NIS/DO).

The SAR accident analyses accounted for both typical mechanistic accidents (e.g., loss of normal AC power, uncontrolled insertion of one control element, inadvertent criticality during fuel loading or maintenance), and extreme, hypothetical events leading to maximum consequences. The accident analyses completed for TA-18 covers all buildings and nuclear material storage locations including the hillside vault. The hillside vault was analyzed to cover typical storage inventories of U-235, Pu-239, and U-233. None of the mechanistic accidents resulted in releases of radioactivity outside the operations boundary (defined as the area within 200 meters of the TA-18 site perimeter). However, local consequences could be severe, (including fatalities).

Hypothetical events (bounding accidents) were postulated to define an envelope of permissible experiments at LACEF by determining the maximum consequences, given the scope of operations that take place in the Kivas and storage areas. It should be noted that the physical mechanisms necessary to initiate these accidents require multiple, simultaneous failures, or catastrophic events. The consequences of this class of events results in significant calculated doses outside the TA-18 control boundary, but usually less than the radiological site guidelines of DOE 6430.1A (25 rem). The analyzed events included: a fire in the Hillside storage areas with the dispersal of the uranium and Pu inventories (the bounding accident with respect to consequences outside the facility) and the dispersal from a plutonium-fueled critical assembly in Kiva 2 due to a reactivity insertion.

2.3.3.2. *Facility Measurements*

2.3.3.2.1. Ventilation

There is no ventilation system in the Hillside vault where the U-233 material is currently stored. Radiation surveys are carried out on a regular basis as well as contamination surveys to maintain an uncontaminated vault. There is on portable continuous air monitor in the Hillside vault to measure for airborne contamination.

2.3.3.3. Condition Assessments

The Hillside vault is functioning, however, it does not meet the criteria for a storage location for nuclear materials. There is no ventilation system or HEPA filtration to minimize release of material outside of the vault.

3. Evaluation of Observations

The evaluation of the condition of U-233 material in the Los Alamos Inventory is consistent with the conclusions reached in the Highly Enriched Uranium Vulnerability Assessment. The material at TA-18 needs to be moved to a more suitable storage location while awaiting stabilization, repackaging and shipment. The other material is stored in adequate location until further action is taken to remove the material from inventory.

An issue also was identified concerning accountability measurement data on the U-233 materials. The measurement data is not adequate to verify quantities in each package. In many cases the measurements consist of balance readings only. It is obvious that during repackaging and preparation for shipment that this material needs to be measured either by destructive chemical analysis or by a certified NDA technique.

4. Assessment Conclusions

This assessment has identified that some of the U-233 material in the Los Alamos inventory is not stored in a practical or safe location. The material at TA-18 is in a vault without the proper ventilation system for a vault location. There is a plan in place to move the TA-18 material to the CMR Facility for interim storage and repackaging prior to shipment to its final storage location.

Material currently stored at TA-55 and The CMR is in locations suitable for storage of this typo of material. It is not necessary to take any action at this time with this material until the repackaging and shipment process begins. At that time the material will be move to the CMR for repackaging and stabilization prior to shipment to its final storage location.

TABLE 1. Los Alamos 97-1 inventory by item count.

IDES	DESCRIPTION	ITEM COUNT
C13P	Compound/carbide/plutonium 239	3
C211	Compound/dioxide/high purity	3
C217	Compound/dioxide/impure/no major contaminant	28
C21P	Compound/dioxide/plutonium 239	6
C527	Compound/nitrate/impure/no major contaminant	2
C807	Compound/tetrafluoride/impure/no major contaminant	1
C862	Compound/trioxide/multiple contaminants/see remark	3
C881	Compound/U3O8/high purity	2
C887	Compound/U3O8/impure/no major contaminant	3
C88H	Compound/U3O8/History/archival sample	1
K150	Combustible/cellulose rag(s)/non-specific	2
M011	Metal/high purity/high purity	4
M01E	Metal/high purity/encapsulated	1
M391	Metal/high purity turnings/high purity	1
M447	Metal/impure/impure/no major contaminant	27
M44P	Metal/impure/plutonium 239	2
M467	Metal/impure turnings/impure/no major contaminants	1
M46P	Metal/impure turnings/plutonium 239	1
M745	Metal/spec alloy/part	1
M74E	Metal/spec alloy/encapsulated	1
M74H	Metal/spec alloy/history/archival sample	7
N310	Non combustible/graphite/non specific	1
N550	Noncombustible/nonactinide/nonspecific	1
N67W	Non combustible/plastics/kim wipes/approved designated waste	1
R410	Process Residue/hydroxide precipitate/non-specific	2
R412	Process Residue/hydroxide precipitate/multi contaminant/remarks	1
R780	Process residue/sweepings/screenings/non-specific	3
R78P	Process residue/sweepings/screenings/plutonium 239	1