



The Secretary of Energy
Washington, DC 20585

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DNF SAFETY BOARD

August 17, 2005

The Honorable A. J. Eggenberger
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, D.C. 20004 - 2901

Dear Mr. Chairman:

We are pleased to forward the enclosed Implementation Plan (Plan) for the Defense Nuclear Facilities Safety Board's (Board) Recommendation 2005-1, *Nuclear Material Packaging*. This Plan provides the Department's approach to ensure safe storage and handling of nuclear material at our sites.

We appreciate the support provided by the Board and its staff during the development of this Plan. We will keep you informed of our progress in completing the Plan. I have assigned Mr. Richard M. Stark as the responsible manager for ensuring the Plan's successful completion. You may contact Mr. Stark at (301) 903-4407 to answer any questions that might arise regarding details of the Plan.

Sincerely,

A handwritten signature in black ink that reads "Samuel W. Bodman". The signature is written in a cursive style with a large, prominent "S" and "B".

Samuel W. Bodman

Enclosure

cc:
M. Whitaker, DR-1
J. Shaw, EH-1



U. S. Department of Energy

Implementation Plan To Improve Nuclear Material Packaging

*(In response to Defense Nuclear Facilities
Safety Board Recommendation 2005-1)*



Washington, D.C. 20585

August 2005

Executive Summary

On March 10, 2005, the Defense Nuclear Facilities Safety Board (Board), unanimously approved Recommendation 2005-1, *Nuclear Material Packaging*. This recommendation addresses issuance of a requirement that nuclear material packaging meet technically justified criteria for safe storage and handling outside of engineered contamination barriers.

This Implementation Plan (IP) describes how DOE will:

- Specify the nuclear materials to which new requirements will apply. This includes conducting a survey of the sites currently storing nuclear materials.
- Develop the technical criteria and requirements that must be satisfied to ensure safe storage and handling of these materials, including the requirements for surveillance of packaged materials when appropriate.
- Develop a prioritization methodology for implementing the above criteria and requirements based on the hazards and risks posed by the existing packaging configurations and conditions.

On May 6, 2005, the Secretary accepted Recommendation 2005-1, *Nuclear Material Packaging*. The Assistant Secretary for Environment, Safety and Health, Mr. John Spitaleri Shaw (EH-1), is cognizant Secretarial officer. Mr. Richard M. Stark is the responsible manager.

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1.0 BACKGROUND

On March 10, 2005, the Defense Nuclear Facilities Safety Board (DNFSB, or Board) issued a recommendation to the Secretary of Energy identifying issues for the Department of Energy (DOE, or Department) concerning interim packaging and storage of nuclear materials. The DNFSB recommendation acknowledged that the Department has made progress in the stabilization and storage of its excess nuclear materials. However, the DNFSB states that storage requirements for other categories of nuclear materials are not as well defined and controlled. Specifically, there is no explicit Department-wide interim storage requirement to ensure the safe packaging of nuclear materials.

The DNFSB recommendation cites two Department recent events pointing out the need for formal Department action. One event resulted in workers receiving significant inhalation doses during routine inspection activities requiring a Type B Accident Investigation. The other event involved the accidental drop of a package containing salt-bearing plutonium oxide.

Past experience in nuclear material handling and storage at Department facilities has demonstrated the risk to nuclear material handlers due to package breaching.

Nuclear material packaging provides the primary containment boundary to protect facility workers during storage and handling activities. The Board believes the development of technically justified criteria for packaging systems for nuclear materials is necessary on a Department-wide level. Therefore, the Board recommended that the Department:

1. Issue a requirement that nuclear material packaging meet technically justified criteria for safe storage and handling. Packaging should, in general, provide a robust barrier between facility workers and the stored nuclear materials once they are removed from an approved engineered contamination barrier. It may be appropriate to include this requirement in an updated nuclear materials management Order.
2. Identify which nuclear materials should be included in the scope of the above requirement and then determine the technically justified packaging criteria needed to ensure the safe storage and handling of those materials. The scope need not include waste materials, fully encapsulated forms, or de minimis quantities such as analytical laboratory samples. The criteria should account for the nuclear material form and properties, expected future use, and duration of storage. It may be appropriate for this information to be included in a packaging Manual.

The ISSC¹ may provide the beginning of a sound technical foundation for developing such criteria. Although some modifications may be necessary to make

¹ Interim Safe Storage Criteria were the subject of Deputy Secretary Curtis memorandum of January 25, 1996 titled "Criteria for Interim Safe Storage of Plutonium – Bearing Solid Materials"

the ISSC more applicable to short-term storage, the Board believes the basic ISSC principles – for example, the requirement for a minimum of two contamination boundaries for high-hazard materials such as plutonium, assurance that leak-tightness is maintained for materials requiring a sealed environment, ability of the containers to withstand maximum expected internal pressures, and protection against common insults such as drops – should be maintained. The criteria should also include provisions for surveillance programs to verify that the container and any limited-life components are performing in a manner consistent with the duration of storage.

3. Prioritize implementation of the improved nuclear material packaging requirement consistent with the hazards of the different material types and the risk posed by the existing package configurations and conditions.

2.0 UNDERLYING CAUSES

The end of the Cold War, and downsizing of the nuclear weapons production complex, changed the dynamics of nuclear materials management. Certain materials that once were considered valuable assets soon became liabilities. With little need to process those materials for recovery, processing capabilities have been lost, or have not been fully funded. As a result, some of these materials have been in storage for years, or even decades.

Because of the variability of nuclear materials inventories, processes, and equipment among sites, interim packaging has been determined by the individual site. Some sites have adopted site-specific best practices based on complex-wide experience, while other sites have adopted storage containers that meet some, or all, of the performance-based functional requirements of the Interim Safe Storage Criteria.

The long times and the various environments experienced in storage combined with material characteristics have led some packages to deteriorate from the effects of corrosion, radiation, pressure buildups and handling. The packages that are used for storage were not expected to continue to function for decades. Handling necessitated by Materials Control and Accountability (MC&A) surveillance requirements and deteriorating packages over long periods have increased the risk to workers.

3.0 BASELINE ASSUMPTIONS

The Department has developed implementation plans and taken actions to improve the storage of nuclear materials in response to previous DNFSB Recommendations 94-1, 97-1 and 2000-1. In general, the materials addressed in those implementation plans will not be addressed in this implementation plan.

The Department makes the following baseline assumptions regarding successful fulfillment of the 2005-1 Implementation Plan.

- Initial funding will be accommodated from existing budgets. The Department will vigorously pursue necessary funding for steady-state activities.
- This plan describes Department actions for nuclear facilities. For the purposes of interacting with the Board on this implementation plan, however, the deliverables are limited to those facilities within the Board's scope (i.e., defense nuclear facilities). The Department will consider the level of risk involved in prioritizing implementation.
- This plan deals with materials that are stored outside of an approved engineered contamination confinement barrier, such as a glovebox or packages meeting DOE-STD-3013 and/or DOE-STD-3028.
- This plan deals with solid and liquid nuclear materials in interim storage. Interim storage will be defined as a part of the requirements document to be issued in accordance with Section 5 of this IP.
- In the context of this plan, the criteria developed for packaging nuclear materials will be applicable only to onsite storage of nuclear materials. These packaging criteria are not intended to be applied to offsite transportation of nuclear materials, nor are they intended to conflict with or supersede accepted packaging criteria established in other applicable Department directives such as DOE-STD-3013-2004.
- In the context of this plan, the requirements for nuclear materials storage are limited to ensuring the storage container is compatible with the range of anticipated storage environments.
- Ongoing repackaging activities will continue at DOE sites. All sites will conform to the 2005-1 packaging requirements when the 2005-1 requirements are approved.

4.0 SUMMARY OF COMPLETED AND NEAR-TERM ACTIONS

The Department has established a dedicated team representing all Department organizations with nuclear materials to develop this implementation plan addressing nuclear material packaging and interim storage.

To date the team has met weekly to gather data, discuss the issues and to develop the implementation plan. On April 25, 2005 EH-1 formally requested that each Department line, field and site organization designate a point of contact and to develop a list of nuclear materials that exist at each site. The team will review the survey data and determine the remaining items to be surveyed. The team expects that the final survey request will be issued in September 2005.

The team will reconcile and integrate all existing DOE directives and guidance as a part of the new requirements development activity. 10 CFR 835, DOE Orders 420 and 5660.1B and associated guidance will be included in this activity.

In October and November the team will concurrently be (1) receiving survey data (2) finalizing the risk prioritization methodology (3) determining the document(s) needed to institutionalize the new packaging and storage criteria and the associated guidance being developed and (4) developing the technical requirements. The risk prioritization methodology will be issued in March 2006.

DOE will develop a risk-based methodology for prioritizing packaged nuclear materials so that the highest risk packages are addressed and repackaged or qualified preferentially. The methodology will likely include input parameters such as airborne release fractions, respirable fractions, reactivity factors, container type, the date that the materials were packaged, and package integrity considerations. The application of this methodology will allow DOE to focus resources on the highest risk materials and packages and will accelerate the reduction in risk to nuclear material handlers.

The initial draft of the new packaging and storage criteria, including specifically the nuclear material to which it will apply will be available in March 2006 after DOE completes a review by a technical review board. The team will brief the DNFSB in March and will solicit the DNFSB comments on the draft. The new nuclear materials packaging and storage criteria document will be issued using the Departments Directive Systems in June 2006, after which the affected sites will be required to develop their implementation plans.

Some Department sites have developed repackaging plans for stored nuclear materials that may ultimately meet all or part of the new packaging and storage criteria being developed in response to this implementation plan. These site actions will continue, consistent with the sites risk reduction programs until the new packaging and storage criteria are issued, and the sites have issued their respective implementation plans for complying with the new criteria. However, once the Department requirement document(s) is institutionalized all sites will adhere to the new 2005-1 requirement(s).

5.0 SAFETY ISSUE RESOLUTION

To fully address the concerns of the DNFSB, the Department will evaluate current nuclear materials and packaging configurations and their potential safety risk at the designated Department sites and then will complete the following activities.

- Specify the nuclear materials to which new criteria will apply. This effort will include conducting a survey of the sites currently storing nuclear materials.
- Specify threshold quantity levels for nuclear materials to which criteria will apply.
- Develop the technical criteria that must be satisfied to ensure safe storage and handling of these materials, including the requirements for surveillance of packaged materials commensurate with the safety risk. The requirements will be technically reviewed by a technical review board.

- Develop a prioritization methodology for implementing the above criteria based on the hazards and risks posed by the existing nuclear material. This methodology will be technically reviewed by a technical review board.
- Develop site specific implementation plans to address the new requirements. (The DOE 2005-1 responsible manager will then prepare and publish a DOE wide summary of the integrated site plans for all DNFSB reporting sites.)
- Implement the site plans.
- Institutionalize nuclear material packaging and by issuing a formal document that integrates existing requirements and incorporates new requirements in accordance with the Department Directives System. Note: No approved Directives for packaging are affected by this plan.

This section is organized around the following three main areas:

1. Improved Nuclear Material Packaging Requirements
2. Identifying Affected Nuclear Materials
3. Implementing Improved Nuclear Material Packaging Requirements

Within each of the above main areas, supporting discussion addresses specific issues, bases for the issues, resolution approaches, and commitments/deliverables/milestones to resolve the issues.

5.1 Issuing Improved Nuclear Material Packaging Requirements

Issue Description

Department-wide criteria need to be established for nuclear materials packaging and storage in order to provide adequate protection. The criteria that will be established in response to this implementation plan will provide a uniform, Department-wide set of criteria for developing adequate technical basis for packaging and storage of nuclear materials.

Board Recommendation

Issue a requirement that nuclear material packaging meet technically justified criteria for safe storage and handling. Packaging should, in general, provide a robust barrier between facility workers and the stored nuclear materials once they are removed from an approved engineered contamination barrier. It may be appropriate to include this requirement in an updated nuclear materials management Order.

The ISSC may provide the beginning of a sound technical foundation for developing such criteria. Although some modifications may be necessary to make the ISSC more applicable to short-term storage, the Board believes the basic ISSC principles—for example, the requirement for a minimum of two contamination boundaries for high-hazard materials such as plutonium, assurance that leak-tightness is maintained for materials requiring a sealed environment, ability of the containers to withstand maximum expected internal pressures, and protection against common insults such as drops—should be maintained. The criteria should also include provisions for surveillance programs to verify that the container and any limited-life components are performing in a manner consistent with the duration of storage.

Resolution Approach

The Department will use the results of the 2005-1 material survey and the information gained from its actions taken in response to Board Recommendations 94-1, 97-1 and 2000-1 to develop a robust set of packaging and storage criteria that address the material types, forms, and hazards for materials in interim storage at Department sites.

Isotopic threshold levels will be used to determine applicability of the new criteria. Specific exclusions, such as sealed sources, laboratory samples, spent nuclear fuel in otherwise approved packages or storage facilities, and waste materials will be specifically excluded in the scope section of the criteria document. Rather than establish one or two types of storage containers to be used by all sites for all material types, forms and hazards, the Department will identify the criteria that must be satisfied in order to establish an adequate technical basis for the storage of any nuclear material. This will allow each site to determine whether it is more feasible/economical to qualify containers previously or currently in use, or qualify a new container for its specific materials and conditions.

The criteria needed to establish an adequate surveillance program will also be included.

The new packaging and storage criteria document will consider the requirements previously identified in other directives, such as, 10 CFR 835 DOE Orders 420 and 5660.1B, in the ISSC, and be consistent with DOE-STD-3009-94 Change Notice 2 and the ISMS graded approach.

The packaging, storage and surveillance criteria for Recommendation 2005-1 will be proposed by a technical Working Group (WG). The WG will consist of Department and contractor technical representatives in the Department complex (see Appendix G). The proposed criteria will be reviewed by a technical review board. The technical review board individuals will consist of qualified individuals who are not involved in the working group. See the technical review board charter in Appendix H.

Deliverables/Milestones

This subsection includes the milestones and deliverables for sections 5.1 and 5.2.

- | | |
|---------------------|--|
| Deliverable: | Identify additional questions/data site survey. DOE will survey current packaging types, container types, and packaging configurations. The packaging approval status and surveillance conditions requirements will also be solicited in this survey. A formal data request will be issued to DOE sites. |
| Date: | September 30, 2005 |
| Milestone: | Establish technical review board |
| Date: | September 30, 2005 |
| Milestone: | Resolve document type and existing directives integration for new packaging and storage criteria. Provide the resolution to the special technical review board for their review. |
| Date: | November 30, 2005 |

- Milestone:** Technical review board to conduct review of document type and existing directives and provide comments to DOE 2005-1 responsible manager.
- Date:** December 15, 2005
- Milestone:** DOE working group to provide technical review board comment resolution for document type and directives integrations to DOE 2005-1 responsible manager.
- Date:** January 15, 2006
- Deliverable:** Provide letter identifying document resolution to DNFSB staff.
- Date:** January 30, 2006
- Milestone:** Provide first draft of packaging and storage criteria document to technical review board for review and comment.
- Date:** January 31, 2006
- Milestone:** Technical review board to conduct review of draft packaging and storage document and provide comments to DOE 2005-1 responsible manager.
- Date:** February 20, 2006
- Milestone:** DOE working group to provide technical review board comment resolution for packaging and storage document to DOE 2005-1 responsible manager.
- Date:** March 10, 2006
- Deliverable:** Provide first draft of packaging and storage criteria document to Board staff for review and comment.
- Date:** March 31, 2006
- Milestone:** Forward packaging and storage criteria document for final technical board review.
- Date:** April 30, 2006
- Milestone:** Technical review board to conduct review of final packaging and storage document and provide comments to DOE 2005-1 responsible manager.
- Date:** May 20, 2006

Milestone: DOE working group to provide technical review board comment resolution on final packaging document to DOE 2005-1 responsible manager.

Date: June 10, 2006

Deliverable: Submit packaging (and/or rulemaking) storage criteria document(s) into Department Directives Systems for DOE wide review and approval.

Date: June 30, 2006

Deliverable: Issue packaging and storage criteria directive intent in letter to all sites.

Date: June 30, 2006

5.2 Identifying Affected Nuclear Materials

Issue Description

Several actions have already been implemented to stabilize and improve the storage of nuclear materials in response to Recommendations 94-1, 97-1 and 2000-1. In addition, some other materials, such as sealed sources, laboratory samples, spent nuclear fuel, and wastes are not intended to be included in the scope of this implementation plan. The materials to which the new packaging and storage criteria will apply need to be identified.

Board Recommendation

Identify which nuclear materials should be included in the scope of the above requirement and then determine the technically justified packaging criteria needed to ensure the safe storage and handling of those materials. The scope need not include waste materials, fully encapsulated forms, or de minimis quantities such as analytical laboratory samples. The criteria should account for the nuclear material form and properties, expected future use, and duration of storage. It may be appropriate for this information to be included in a packaging Manual.

Resolution Approach

The Department will conduct a survey of nuclear materials that are currently being used or stored throughout the Department complex. The Department will determine which materials can be excluded from the new packaging requirements and will establish the threshold at which each isotope becomes subject to the new requirements.

Deliverables/Milestones

See Section 5.1.

5.3 Implementing Improved Nuclear Material Packaging Requirements

Issue Description

After the new packaging and storage criteria document(s) is(are) issued each affected Department site office will evaluate their stored materials and establish a resource loaded schedule and funding plan for implementing the document. These activities will include identifying materials whose packaging must either be qualified or replaced, deciding whether to qualify current packaging or replace it with already qualified packaging, conducting a packaging prioritization assessment to determine the correct order in which to repackage materials, as applicable, and establish and implement a surveillance plan consistent with the technical basis for each packaging scheme employed. Based on the Department nuclear material risk profile, the Department will ensure that the highest priority items, as determined by the complex-wide risk ranking methodology will be qualified or repackaged first at all sites.

Board Recommendation

Prioritize implementation of the improved nuclear material packaging requirement consistent with the hazards of the different material types and the risk posed by the existing package configurations and conditions.

Resolution Approach

The Department will establish a risk ranking nuclear materials packaging methodology which each site will use to develop a site specific implementation plan based on the requirements of the approved interim storage order/standard/manual. The site implementation plan will include a risk based priority system that is consistent with the hazards of the materials/packages being stored. The site's implementation plan shall include the following information:

1. Identify the material type(s) in storage
2. Identify the material matrix
3. Describe current packaging configuration(s) for each material type(s) and matrix(es)
4. Risk ranking of current nuclear materials in storage
5. Number of containers in storage by material type(s) and packaging configuration(s)
6. Schedule, with milestones, for the repackaging of materials into packages that meet the new requirements.
7. Schedule for development and implementation of surveillance for materials packaged to the new requirements.

Deliverables/Milestones

Milestone: Provide draft of repackaging risk prioritization methodology to the technical review board for review and comment.

Date: November 30, 2005

Milestone: Technical review board to conduct review of repackaging risk prioritization methodology and provide comments to DOE-2005-1 responsible manager.

Date: December 20, 2005

- Milestone:** DOE working group to provide technical review board comment resolution to DOE-2005-1 responsible manager.
- Date:** January 15, 2006
- Deliverable:** Provide draft of repackaging risk prioritization methodology to Board staff for review and comment.
- Date:** January 31, 2006
- Deliverable:** Issue repackaging risk prioritization methodology.
- Date:** March 30, 2006
- Deliverable to DOE HQ:** Resource loaded schedules and funding plans for implementing new packaging and storage criteria document for Sandia National Laboratory, Los Alamos National Laboratory, Pantex, Y-12, Savannah River Site, Idaho Cleanup Project, Lawrence Livermore National Laboratory, Hanford Site, Idaho National Laboratory, Oak Ridge National Laboratory, Nevada Test Site.
- Date:** 120 days after new packaging and storage criteria document(s) intent letter is issued
- Deliverable:** DOE 2005-1 responsible manager issues a DOE wide schedule for 2005-1 implementation.
- Date:** 180 days after new packaging and storage document(s) intent letter issued.

6.0 ORGANIZATION AND MANAGEMENT

On May 6, 2005, the Secretary accepted Recommendation 2005-1, *Nuclear Material Packaging*. The Assistant Secretary for Environment, Safety and Health, Mr. John Spitaleri Shaw, is the cognizant Secretarial officer. Mr. Richard M. Stark, is the responsible manager.

The deliverables identified in Section 5.0 of this IP will be tracked to completion using the Department's Safety Issues Management System (SIMS) in accordance with DOE M 140.1-1B. SIMS commitments are reviewed monthly. Monthly status reports are distributed to the Secretarial officers and to designated site personnel. In addition, the responsible manager, or his designee, will conduct periodic status review meetings to ensure that activities are progressing on schedule and problems are identified early and resolved promptly.

Because Recommendation 2005-1 impacts several programs and sites, a multidiscipline team was formed to prepare this IP. Since implementing this IP will also require support from multiple programs and sites, the affected Secretarial officers, office Managers and site Managers were requested by a letter from the Assistant Secretary for Environment, Safety and Health to designate a knowledgeable point of

contact (POC) from their respective organizations to support both the preparation and implementation phases of this IP. The POCs have been selected. Each POC is responsible for maintaining awareness of the 2005-1 activities to be/being performed by his/her organization, and for promptly notifying both the 2005-1 responsible manager and his/her management if problems arise.

New materials packaging document(s) will be prepared in response to Recommendation 2005-1. The document(s) will be processed using the Department's Directives Systems in accordance with DOE O 251.1A.

After the new materials packaging document(s) is issued, each affected site Manager will prepare a resource loaded schedule and a funding plan for implementing the document. The work required to satisfy the commitments contained in this IP will be considered to be complete when the affected office Managers and site Managers have issued their schedules and funding plans. Each site will then be responsible for tracking its own scheduled activities.

The packaging, storage and surveillance criteria for Recommendation 2005-1 will be proposed by a Technical Working Group (WG). The WG composition will consist of Department and contractor technical representatives in the DOE complex (see Appendix G). The product of the WG will be peer reviewed by a technical review board and approved by the Department Directives System.

6.1 Change Control

Complex, long-range plans require sufficient flexibility to accommodate changes in commitments, actions, or completion dates that may be necessary due to additional information, improvements, or changes in baseline assumptions. The Department's policy is to (1) provide prior, written notification to the Board on the status of any implementation plan deliverable that will not be completed by the planned deliverable date, (2) have the Secretary approve all revisions to the scope and schedule of plan deliverables, and (3) clearly identify and describe the revisions and basis for the revisions. Fundamental changes to the plan's strategy, scope, or deliverable schedule will be provided to the Board through formal revision and re-issuance of the implementation plan. Other changes to the scope or schedule of planned deliverables will be formally submitted in appropriate correspondence approved by the Secretary, along with the basis for the changes and appropriate corrective actions.

6.2 Reporting

To ensure that the various Departmental implementing elements and the Board remain informed of the status of plan implementation, the Department's policy is to provide periodic progress reports until implementation plan commitments are completed. For this plan, the Department will provide as necessary, briefings to the Board and/or its staff. After the site schedules are developed, the Department will provide the DNFSB with quarterly reports on the status of the site repackaging plans.

Appendix A & B – Acronyms, Abbreviations & Glossary

ALARA – As Low As Reasonably Achievable

CFR – Code of Federal Regulations

DNFSB – Defense Nuclear Facilities Safety Board

DOE – Department of Energy

DOT – Department of Transportation

DSA – Documented Safety Analysis

IAWG – Inactive Actinide Working Group

IP – Implementation Plan

ISMS – Integrated Safety Management Systems

ISSC – Interim Safe Storage Criteria

LANL – Los Alamos National Laboratory

LLNL – Lawrence Livermore National Laboratory

MC&A – Materials Control and Accountability

NE – DOE Nuclear Energy, Science and Technology

NNSA – National Nuclear Security Administration

POC – Point of Contact

SNL – Sandia National Laboratory

SIMS – DOE's Safety Issue Management System

SRS – Savannah River Site

STD – Standard

U.S.C. – United States Code

WG – Working Group

Appendix C – References

DOE Rule 10 CFR 835, Occupational Radiation Protection

DOE Orders 251.1A, Directives System; 420.1A, Facility Safety; 5660.1B, Management of Nuclear Materials

DOE Standards 3009-94, Preparation Guide for DOE Nuclear Facility Documented Safety Analysis; 3013-2004, Stabilization, Packaging and Storage of Plutonium Bearing Materials; 3028-2000 Criteria for Packaging & Storing U₂₃₃ Bearing Materials

DNFSB Recommendations 94-1, Remediation of Nuclear Materials; 97-1, Safe Storage of Uranium 233; 2000-1, Prioritization for Stabilizing Nuclear Materials

Appendix D – Summary of Commitments

No.	Commitment	Affected Facility	Deliverable	Due Date	Responsibility
5.1-1	Deliverable - Identify additional packaging questions/data requests to be included in survey.	N/A	Letter	9-30-05	R. Stark
5.1-2	Deliverable – Document resolution type for new packaging and storage criteria.	N/A	Letter	1-30-06	R. Stark
5.1-3	Deliverable – Provide first draft of packaging and storage criteria document to Board staff for review and comment	N/A	Document for review	03-31-06	R. Stark
5.1-4	Deliverable – Submit packaging and storage criteria document to DOE Directives System.	N/A	Document submitted via Department's Directive System	6-30-06	R. Stark
5.1.5	Deliverable – Issue packaging and storage criteria directive letter to sites	N/A	Letter	6-30-06	R. Stark
5.3-1	Deliverable – Provide draft of repackaging risk prioritization methodology to the Board staff for review and comment	N/A	Document for review	1-31-06	R. Stark
5.3-2	Deliverable – Issue repackaging risk prioritization methodology	N/A	Letter signed by EH-1	03-30-06	R. Stark
5.3-3	Deliverable to DOE HQ – Resource loaded schedule and funding plan	SNL	Schedule and funding plan	120 days after directive letter issued *	Sandia Site Office Manager
5.3-4	Deliverable to DOE HQ – Resource loaded schedule and funding plan	LANL	Schedule and funding plan	120 days after directive letter issued *	Los Alamos Site Office Manager
5.3-5	Deliverable to DOE HQ – Resource loaded schedule and funding plan	Pantex	Schedule and funding plan	120 days after directive letter issued *	Pantex Site Office Manager

No.	Commitment	Affected Facility	Deliverable	Due Date	Responsibility
5.3-6	Deliverable to DOE HQ – Resource loaded schedule and funding plan	Y-12	Schedule and funding plan	120 days after directive letter issued	Y-12 Site Office Manager
5.3-7	Deliverable – Resource loaded schedule and funding plan	SRS	Schedule and funding plan	120 days after directive letter issued *	SRS Site Office Manager
5.3-8	Deliverable – Resource loaded schedule and funding plan	Idaho Cleanup Project	Schedule and funding plan	120 days after directive letter issued *	Idaho Site Office Manager
5.3-8	Deliverable – Resource loaded schedule and funding plan	LLNL	Schedule and funding plan	120 days after directive letter issued *	Lawrence Livermore Site Office Manager
5.3-9	Deliverable – Resource loaded schedule and funding plan	Hanford	Schedule and funding plan	120 days after directive letter issued *	Richland Site Office Manager
5.3-10	Deliverable – Resource loaded schedule and funding plan	Nevada	Schedule and funding plan	120 days after directive letter issued *	Nevada Site Office Manager
5.3-11	Deliverable – Resource loaded schedule and funding plan	Idaho	Schedule and funding plan	120 days after directive letter issued *	Idaho Site Office Manager
5.3-12	Deliverable – Resource loaded schedule and funding plan	Oak Ridge	Schedule and funding plan	120 days after directive letter issued *	Oak Ridge Site Office Manager
5.3-13	Deliverable – DOE HQ issues DOE wide summary of 2005-1 implementation schedules		DOE wide schedule	180 days after directive letter issued *	R. Stark

* The new nuclear materials packaging and storage criteria document will be submitted to the Departments Directive Systems in June 2006, after which the affected sites will be required to develop their implementation plans subject to any changes resulting from the RevCom process. (See Commitment 5.1-4)

Appendix E - Board Recommendation 2005-1

[DNFSB LETTERHEAD]

March 10, 2005

The Honorable Samuel W. Bodman
Secretary of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Secretary Bodman:

On March 10, 2005, the Defense Nuclear Facilities Safety Board (Board), in accordance with 42 U.S.C. § 2286a(a)(5), unanimously approved Recommendation 2005-1, *Nuclear Material Packaging*, which is enclosed for your consideration. This recommendation addresses issuance of a requirement that nuclear material packaging meet technically justified criteria for safe storage and handling outside of engineered contamination barriers.

After your receipt of this recommendation and as required by 42 U.S.C. § 2286d(a), the Board will promptly make it available to the public. The Board believes that the recommendation contains no information that is classified or otherwise restricted. To the extent this recommendation does not include information restricted by the Department of Energy (DOE) under the Atomic Energy Act of 1954, 42 U.S.C. §§ 2161-68, as amended, please arrange to have it promptly placed on file in your regional public reading rooms. The Board will also publish this recommendation in the *Federal Register*. The Board will evaluate DOE's response to this recommendation in accordance with Board Policy Statement 1, *Criteria for Judging the Adequacy of DOE Responses and Implementation Plans for Board Recommendations*.

Sincerely,

John T. Conway
Chairman

Enclosure

c: Mr. Mark B. Whitaker, Jr.

RECOMMENDATION 2005-1 TO THE SECRETARY OF ENERGY Pursuant to 42 U.S.C. § 2286a(a)(5), Atomic Energy Act of 1954, As Amended

Dated: March 10, 2005

Background

In Recommendation 94-1, *Improved Schedule for Remediation in the Defense Nuclear Facilities Complex*, the Defense Nuclear Facilities Safety Board (Board) urged the Department of Energy (DOE) to improve the packaging and storage conditions of its large inventory of nuclear materials once used for weapons manufacture. In particular, the Board recommended that DOE place plutonium metals and oxides in storage configurations meeting DOE's standard for long-term storage (DOE-STD-3013-2004, *Stabilization, Packaging, and Storage of Plutonium-Bearing Materials*). Some sites applied Recommendation 94-1 to excess materials only. The Board has continued to evaluate whether other categories of nuclear materials are stored in a safe manner.

DOE has made progress in the stabilization and storage of its excess nuclear materials.

The storage requirements for other categories of nuclear materials, however, are not as well defined and controlled. Specifically, DOE Order 5660.1B, *Management of Nuclear Materials*, does not address safe storage requirements. Other than two narrowly focused standards—DOE-STD-3013-2004 and DOE-STD-3028-2000, *Criteria for Packaging and Storing Uranium-233-Bearing Materials*—there are no explicit DOE-wide requirement to ensure the safe storage of nuclear materials. Currently, the technical adequacy of packaging—the combination of containers and other components providing a contamination barrier—for nuclear materials, including liquids, is dependent on the safety bases of individual facilities. Typically, facilities have credited engineered features, such as the confinement structure and ventilation system, for protecting offsite individuals and collocated workers. For facility workers, however, the controls are generally administrative, such as continuous air monitors, personal protective equipment, periodic contamination surveys, and other aspects of the radiological control program, in conjunction with proper evacuation training. In accordance with DOE Standard 3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analysis* (DOE-STD-3009-94, Change Notice 02), accidents that pose the risk of significant radiological exposure to workers, such as a breached nuclear material storage package, should be prevented or mitigated using safety-significant controls. The preferred hierarchy of controls favors engineered, preventive features over administrative controls.

Establishing packaging requirements for nuclear materials within the DOE complex requires consideration of a diverse population of material types for storage for uncertain periods of time. From a safety standpoint, nuclear material packaging must protect against a number of challenges that could breach the container and release radioactive material. Many of the materials of concern generate gases that result in container pressurization and may be pyrophoric or highly reactive. The container design must take into account corrosion, oxidative expansion of stored metal, effects of radiolysis, diurnal pumping and damage due to impacts from drops and tooling during handling. The Board's recent review of nuclear material packaging at Lawrence Livermore National Laboratory (LLNL) revealed that

many of these insults had not been fully considered when packaging choices were made for nuclear materials not covered by Recommendation 94-1. In fact, many of these current packaging configurations are similar to the inadequate configurations addressed in Recommendation 94-1, and are documented as being susceptible to eventual failure in the report of the Recommendation 94-1 Materials Identification and Surveillance Working Group, entitled *Summary of Plutonium Oxide and Metal Storage Package Failures* (LA-UR-99-2896).

In general, the hazards posed by nuclear materials covered under DOE's Implementation Plan for Recommendation 94-1 are the same as those for nuclear materials not considered excess. When nonexcess materials are removed from glovebox confinement for interim storage, relocation to another work station, assay, or other purposes, the packages are susceptible to the same types of failures as those addressed in Recommendation 94-1. The longer the materials are stored, the greater are the chances that the packaging will fail, especially if the packaging has not been designed appropriately for the actual duration of storage. The Board found that approximately 15 percent of the nonexcess items at LLNL's Plutonium Facility are stored in packaging more than 5 years old. Some of the older items, previously declared excess, remain in their existing packaging while awaiting stabilization and packaging under DOE-STD-3013-2004. This situation emphasizes the need to establish a technical basis for packaging, such as designating the time period for which a particular container is confirmed to perform its function adequately, in conjunction with tracking the age of containers in use.

Two recent events serve as further reminders of the importance of using packaging that is properly designed for its function:

- An August 5, 2003, event at Los Alamos National Laboratory's (LANL) Plutonium Facility resulted in multiple workers receiving plutonium-238 uptakes as a result of the degradation of a package stored longer than planned. This event is documented in a DOE Type B investigation report (HQ-EH-2004-1). The release of material and the resulting contamination and worker uptakes were due, in large part, to the inadequate packaging of plutonium being stored and handled outside of a glovebox.
- An October 6, 2004, incident at LLNL involved the accidental drop of a package containing salt-bearing plutonium oxide. This event is documented in an Occurrence Reporting and Processing System report (OAK--LLNL-LLNL-2004-0046). Although no plutonium was released, this event highlights the need to specify robust packaging requirements for materials handled outside of a glovebox.

State of Nuclear Material Packaging

DOE-STD-3013-2004 sets forth requirements for a robust storage configuration for long-term storage of plutonium-bearing materials. The requirements ensure containment through a combination of material form, packaging design, and surveillance of containers. However, the robust, welded configurations in the standard may not be desirable when a short storage period is anticipated pending use of the material.

There are no equivalent requirements for interim storage. As part of its response to Recommendation 94-1, DOE finalized guidance for the storage of plutonium-bearing materials not packaged for long-term storage under DOE-STD-3013. This guidance, identified in a January 25, 1996, memorandum from

Deputy Secretary of Energy Curtis entitled *Criteria for Interim Safe Storage of Plutonium-Bearing Solid Materials*, provides a technically justified approach to safe packaging and storage of plutonium-bearing materials for a period of up to 20 years. Although these Interim Safe Storage Criteria (ISSC) were not intended to apply to materials in working inventory, much of the guidance remains germane to storage of all nuclear materials outside of approved engineered contamination barriers (e.g., gloveboxes or certified shipping containers).

The ISSC were only implemented for selected excess materials and were never formally issued as part of the DOE Directives System. In practice, the sites use a wide variety of packages, many of which do not meet the ISSC. According to the lessons learned from the DOE Type B investigation of the worker uptakes at LANL, packages containing radioactive material should be assumed unsafe until proven otherwise or the materials are repackaged to current standards. Yet sites continue to rely on container types that have been used historically, but have no technically justified safety or design basis. These container types are generally forms of packaging typically used in non-nuclear applications (e.g., paint cans, food pack cans). Thus, they are not designed to protect against the hazards of the nuclear materials they contain for the duration of storage.

Several commonly used containers and their potential inadequacies are briefly summarized in an attachment to this Recommendation. Many other containers are in use for specialized applications.

Remaining Problems

In response to the Board's May 20, 2002, correspondence on safety of nuclear materials storage, the National Nuclear Security Administration (NNSA) established the Inactive Actinide Working Group (IAWG), with the goal of developing a comprehensive approach to the characterization, packaging, and storage of a subset of nuclear materials. As presented in a February 7, 2003, letter from NNSA to the Board, the IAWG was to meet this goal through the development of three strategies for the following: acceptance and retention of nuclear materials, material characterization and storage adequacy, and disposition. The Board has been observing the IAWG's efforts and has made three observations.

First, a key product of the IAWG effort will be the strategy for material characterization and storage adequacy. Based on discussions with IAWG participants, the delivery of this strategy has been delayed, in large part because of disagreements among member sites on the requirements necessary for justifying adequate storage. The Board believes these requirements should provide for sufficient characterization based on an appropriate combination of analysis and process knowledge to determine the appropriate packaging. Characterization information should also be used to develop a surveillance program prioritized according to expected material and container risk (including, for example, material type, material form, and the age and type of container).

Second, in a June 2000 report entitled *A Strategic Approach to Integrating the Long-Term Management of Nuclear Materials*, DOE recognized the need to update the existing DOE Order on nuclear materials management. In particular, this report urged improvements to the nuclear materials management process. However, neither the current Order nor the report explicitly considers storage safety. The Board believes that DOE should require a technical basis for nuclear material packaging and storage safety. Efforts to meet this requirement should take advantage of the knowledge about storage adequacy being developed by the IAWG, as well as existing guidance, such as the ISSC.

Third, the IAWG strategy does not include other program offices in the defense nuclear complex, such as the Nuclear Energy, Science, and Technology (DOE-NE) facilities involved in defense nuclear activities. Currently, materials and activities in transition between the facilities of different program offices have the potential to be overlooked. For example, operators at the Savannah River Site have begun converting the neptunium-237 solutions covered under Recommendation 94-1 to oxide and placing the oxide in packaging intended for 1 year of storage at that site prior to offsite shipping. The long-term storage of large quantities of neptunium oxide has not been performed previously in the complex, and the technical basis for ensuring the safety of such storage is incomplete. Nonetheless, these materials will be transferred to DOE-NE for use, where they may continue to be stored in their existing packaging for a period of up to 20 years. In addition, the Board has learned that DOE-NE intends to assume more direct control of activities involving plutonium-238, which have to date been performed at NNSA sites.

The significant radiological hazards associated with this material necessitate appropriate storage containers for the expected storage period. The Board believes the requirement for a technical basis for nuclear material packaging and storage should encompass all program offices in the defense nuclear complex. DOE may wish to consider implementing this requirement for all program offices, including those outside of the defense nuclear complex.

The Board is encouraged by other efforts currently under way to improve nuclear material packaging. As a result of discussions between the Board's staff and LLNL, the Livermore Site Office, in a December 3, 2004, letter, directed LLNL to develop a technical basis for the adequacy of storage packages as part of a Special Nuclear Materials Storage Plan covering "all packaging activities". LLNL replied in a letter of January 31, 2005, outlining the required activities, milestones, and funding to develop and implement an approved packaging and storage program. Implementation of the plan is contingent upon the availability of key personnel and funding. Likewise, the proposed Documented Safety Analysis (DSA) for the LANL Plutonium Facility requires the use of a proposed facility packaging standard and designates material containers as a safety-related component. However, the new DSA has been awaiting NNSA approval. In general, these efforts represent an improvement, but they do not represent a comprehensive DOE-wide effort, and significant differences remain in the quality of the efforts at individual facilities.

Recommendation

Nuclear material packaging provides the primary containment boundary to protect facility workers during storage and handling activities. The Board believes the development of technically justified criteria for packaging systems for nuclear materials is necessary on a DOE-wide level. Therefore, the Board recommends that DOE:

- 1 Issue a requirement that nuclear material packaging meet technically justified criteria for safe storage and handling. Packaging should, in general, provide a robust barrier between facility workers and the stored nuclear materials once they are removed from an approved engineered contamination barrier. It may be appropriate to include this requirement in an updated nuclear materials management Order.
- 2 Identify which nuclear materials should be included in the scope of the above requirement and then determine the technically justified packaging criteria needed to ensure the safe storage and

handling of those materials. The scope need not include waste materials, fully encapsulated forms, or de minimus quantities such as analytical laboratory samples. The criteria should account for the nuclear material form and properties, expected future use, and duration of storage. It may be appropriate for this information to be included in a packaging Manual.

The ISSC may provide the beginning of a sound technical foundation for developing such criteria. Although some modifications may be necessary to make the ISSC more applicable to short-term storage, the Board believes the basic ISSC principles—for example, the requirement for a minimum of two contamination boundaries for high-hazard materials such as plutonium, assurance that leak-tightness is maintained for materials requiring a sealed environment, ability of the containers to withstand maximum expected internal pressures, and protection against common insults such as drops—should be maintained. The criteria should also include provisions for surveillance programs to verify that the container and any limited-life components are performing in a manner consistent with the duration of storage.

- 3 Prioritize implementation of the improved nuclear material packaging requirement consistent with the hazards of the different material types and the risk posed by the existing package configurations and conditions.

John T. Conway, Chairman

Attachment

ATTACHMENT [to Board Recommendation]

Selection of Commonly Used Nuclear Material Packaging

Food-Pack Cans

Food-pack cans are thin-walled tinned carbon steel containers used in the food industry. No additional manufacturing or structural requirements have been specified for application with nuclear materials. These cans typically rely on a double-crimped metal-to-metal closure with a thin layer of sealing compound to provide leak-tightness. Historically, many sites have reported failures of food-pack cans. Lawrence Livermore National Laboratory (LLNL) has reported anecdotal evidence suggesting that none of its food-pack cans have failed to the point of detectable contamination outside the container (UCRL-ID-11733). However, this same report states further that some degree of oxidation was observed in all of the examined food-pack cans containing plutonium metal, suggesting the lack of an airtight seal. Leakage of oxygen through nonairtight food-pack cans has been responsible for a number of container failures reported at other sites, due to oxidative expansion of plutonium metals (LA-UR-99-2896).

Improvements have been made to the technology, including better sealing equipment, as discussed in a May 1984 report entitled *The Effectiveness of Corrective Actions Taken to Preclude Events Involving Tin Cans and Plutonium* (RHO-HS-SA-59 P). Some evidence suggests, however, that these containers still may not be adequate for prolonged storage of nuclear materials. Approximately half of the sampled lot of food-pack cans sealed 10 to 14 years earlier at the Hanford Plutonium Finishing Plant using the improved methodology failed leak testing, and nearly all showed further indications of a potential lack of seal (LA-UR-99-3053).

Additional testing performed at Pacific Northwest National Laboratory confirmed that the performance of food-pack cans is highly dependent on the quality of the seal (PNL-5591). During these tests, 33 industry-standard food-pack cans were sealed according to federal specifications. The testing revealed leak rates ranging from less than 10^{-5} cubic centimeters per second (cc/sec) to more than 2 cc/sec. These findings should receive due consideration when food-pack cans are used for storage applications in which a hermetic seal is required. LLNL continues to use food-pack cans as inner and outer containers for the storage of plutonium metal and oxide, and other sites may be storing nuclear materials previously packaged in food-pack cans.

Paint Cans

Paint cans are thin-walled cans with a press-fit lid that are commonly used to store paint. They have been used as both inner and outer containers for the storage of some nuclear materials, including plutonium metal. The press-fit lid is typically placed by hand using a mallet, which results in a questionable seal lacking any evidence of quality control. According to a January 16, 1987, LLNL site report entitled *Incident Analysis/Plutonium Burn in Storage Can*, oxidation was found to be common for plutonium metal stored in paint cans (memorandum from R. H. Condit to K. Ernst). The report goes on to calculate that a 4 micron gap integrated across the seal area would be