# The Secretary of Energy
**Washington, D.C. 20585**

October 24, 2007

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

Dear Mr. Chairman:

Enclosed is the Department of Energy's (DOE) Implementation Plan (Plan) for the Defense Nuclear Facilities Safety Board's (Board) Recommendation 2007-1, *Safety-related In Situ Nondestructive Assay of Radioactive Materials*.

This Plan provides the Department's approach for addressing holdup measurements of fissionable material in installed process equipment, ancillary equipment, and supporting facility infrastructure using *in situ* Nondestructive Assay. The methodology applied to this Plan permits the Department to address the Board's Recommendation with the proper priority on safety. The program improvements that will result from addressing *in situ* Nondestructive Assay of fissionable materials will also benefit our ability to measure holdup of other radioisotopes.

DOE appreciates the support provided by the Board and its staff during the development of this Plan. We will keep you and your staff informed of our progress in completing the Plan.

I have assigned Mr. Richard Lagdon, Chief of Nuclear Safety, Office of the Under Secretary of Energy, as the Department's responsible manager for ensuring the Plan's successful completion. Mr. Lagdon can be reached at (202) 586-9471.

Sincerely,

Samuel W. Bodman

Enclosure

# U. S. Department of Energy

## Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2007-1

## *Safety-Related In Situ Nondestructive Assay of Radioactive Materials*

**Washington, D.C. 20585**

**October 24, 2007**

## Executive Summary

The Defense Nuclear Facilities Safety Board stated in Recommendation 2007-1 that there are many situations in which the quantity and composition of radioactive material must be determined *in situ*. In some instances, access to the material is impossible or undesirable, and consequently, weighing, laboratory analysis, and calorimetry are not viable options. In these cases, *in situ* nondestructive assay (NDA), based on the measurement of signature emissions from a specific isotope of interest, is used to provide an estimate of the type and quantity of radioactive material present. However, large uncertainties and imprecision have occurred in estimating the type and quantity of radioactive material using *in situ* NDA. These uncertainties and imprecision include incorrect assumptions about shielding and the spatial distribution of radioactive material, as well as improper measurement techniques. Measurement errors, in turn, can lead to potential criticality accident conditions, unexpected radiation exposure to workers, and underestimation of radioactive material available for release in accident scenarios.

In most nuclear safety areas, the Department has captured required elements for robust site programs through its Directives system. These elements include requirements necessary for proper functioning of the program, training and qualification standards for personnel, assessment criteria to ensure proper implementation of requirements, and feedback mechanisms for lessons learned and continuous improvement. However, DOE has not established programmatic requirements for *in situ* NDA, even though this method is heavily relied upon for nuclear safety throughout the complex and is key to many DOE activities including the capability to perform accurate measurements and use the results to determine compliance with nuclear safety limits.

The Department recognizes that continuous improvement in *in situ* NDA is warranted to support nuclear safety in various activities carried out at Department defense nuclear facilities and, therefore, accepted Recommendation 2007-1. The holdup of fissionable material, in quantities greater than the single parameter sub-critical fissionable mass limits specified in ANSI/ANS-8.1-1998; R2007, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, at defense nuclear facilities presents a criticality risk to the Department that can be effectively managed via improvements in the protocols, methodologies, calculations, and assumptions applicable to NDA holdup measurements performed at DOE sites. Using the following approach, the Department has developed this Implementation Plan that is consistent with Integrated Safety Management System principles:

- Evaluate the condition of *in situ* NDA programs against evaluation criteria, which will be developed;
- Identify good practices, both commercial as well as within the Department, in training and qualification, design requirements for new facilities and equipment, standards for conducting *in situ* NDA, implementation of standards, and oversight;
- Identify relevant ongoing research and development activities;
- Identify what is needed and resulting gaps in personnel capabilities and training, equipment capabilities, policy and directives, quality assurance, and oversight;
- Establish requirements, programs, and guidance, as needed; and

- Develop a prioritized plan for implementing the above criteria and requirements and verify their effectiveness.

To assist in the Implementation Plan an NDA Technical Support Group of subject matter experts (SME's) will be established. This support group will consist of Federal employees from Headquarters and Field Elements and DOE management and operating contractors who have expertise in NDA holdup measurement. The support group will assist the Department in the specific areas of concern highlighted in Recommendation 2007-1.

- Assistance, as requested, to support management's efforts in accomplishing this IP;
- Programmatic input regarding the development and implementation of an effective NDA holdup measurement program;
- SMEs to assist in conducting periodic assessments to ensure that NDA holdup measurement programs are using appropriate technology, standards and process;
- A mechanism to identify and address major NDA holdup measurement issues that have crosscutting impacts across the DOE complex;
- A forum for sharing lessons-learned, ideas and proven processes or programs to both DOE and contractor management; and
- A forum for ensuring that advances in DOE and consensus standards are made when appropriate.

To facilitate continuous improvement in NDA holdup measurement practices and technology, the Department will identify a process for clearly communicating lessons learned, new technology, and innovative techniques that are related to NDA holdup measurement. This communication will include both Federal and contractor personnel who perform or use NDA holdup measurements, and may utilize existing systems within DOE or a separate website dedicated to NDA holdup measurement. The NDA Technical Support Group will assist with this effort.

# TABLE OF CONTENTS

1.0 BACKGROUND ..... 6

2.0 UNDERLYING CAUSES ..... 7

3.0 BASELINE ASSUMPTIONS ..... 8

4.0 SUMMARY OF COMPLETED NEAR-TERM ACTIONS ..... 11

5.0 SAFETY ISSUE RESOLUTION ..... 13

5.1 Evaluation of Extent of Condition ..... 13

5.2 Identification of State of the Practice ..... 16

5.3 Identification of DOE *in situ* Nondestructive Assay Needs ..... 21

5.4 Requirements, Programs and Guidance to Address Gaps ..... 24

5.5 Continuous Improvement ..... 27

6.0 ORGANIZATION AND MANAGEMENT ..... 30

6.1 Roles and Responsibilities ..... 30

6.2 Change Control ..... 30

6.3 Reporting ..... 31

LIST OF TABLES

Table 1. Overview of DOE Implementation Plan for DNFSB Recommendation 2007-1 ..... 10

Table 2. Summary of Implementation Plan Commitments and Deliverables/Milestones ..... 32

APPENDICES

Appendix A: List of Acronyms ..... 39

Appendix B: Glossary ..... 40

Appendix C: Cross-Walk to Recommendations ..... 41

Appendix D: DNFSB Recommendation 2007-1 ..... 48

Appendix E: Department's Recommendation 2007-1 Acceptance Letter ..... 54

## 1.0 BACKGROUND

The Defense Nuclear Facilities Safety Board (Board or DNFSB) issued Recommendation 2007-1 on April 25, 2007 (Appendix D). The Department of Energy (DOE or Department) accepted the Board's Recommendation on June 28, 2007 (Appendix E).

The Board stated in Recommendation 2007-1 that there are many situations in which the quantity and composition of radioactive material must be determined *in situ*. In some instances, access to the material is impossible or undesirable, and consequently, weighing, laboratory analysis, and calorimetry are not viable options. In these cases, *in situ* nondestructive assay (NDA), based on the measurement of signature emissions from a specific isotope of interest, is used to provide an estimate of the type and quantity of radioactive material present. However, large uncertainties and imprecision have occurred in estimating the type and quantity of radioactive material using *in situ* NDA. These uncertainties and imprecision include incorrect assumptions about shielding and the spatial distribution of radioactive material, as well as improper measurement techniques. Measurement errors, in turn, can lead to potential criticality accident conditions, unexpected radiation exposure to workers, and underestimation of radioactive material available for release in accident scenarios.

In most nuclear safety areas, the Department has captured required elements for robust site programs through its Directives system. These elements include requirements necessary for proper functioning of the program, training and qualification standards for personnel, assessment criteria to ensure proper implementation of requirements, and feedback mechanisms for lessons learned and continuous improvement. However, DOE has not established programmatic requirements for *in situ* NDA, even though this method is heavily relied upon for nuclear safety throughout the complex and is key to many DOE activities including the capability to perform accurate measurements and use the results to determine compliance with nuclear safety limits.

Research and development efforts for *in situ* NDA have historically focused on the areas of material control and accountability and nuclear material safeguards; advances in these areas have peripherally benefited *in situ* NDA measurement capabilities. Current research and development efforts appear to hold little promise for addressing needed improvements for in-process and static nuclear material holdup NDA measurements. For example, development of instrumentation and measurement techniques is needed to reduce overall measurement uncertainties that are relied upon to ensure compliance with nuclear safety limits.

The Department recognizes that continuous improvement in *in situ* NDA is warranted to support nuclear safety in various activities carried out at Department defense nuclear facilities and, therefore, accepted Recommendation 2007- 1. Using the following approach, the Department has developed this Implementation Plan that is consistent with Integrated Safety Management System principles:

- Evaluate the condition of *in situ* NDA programs against evaluation criteria, which will be developed;

- Identify good practices, both commercial as well as within the Department, in training and qualification, design requirements for new facilities and equipment, standards for conducting *in situ* NDA, implementation of standards, and oversight;
- Identify relevant ongoing research and development activities;
- Identify what is needed and resulting gaps in personnel capabilities and training, equipment capabilities, policy and directives, quality assurance, and oversight;
- Establish requirements, programs, and guidance, as needed; and
- Develop a prioritized plan for implementing the above criteria and requirements and verify their effectiveness.

## 2.0 UNDERLYING CAUSES

Three main issues dominate the current technical and regulatory landscape regarding *in situ* NDA measurements: (1) lack of standardized requirements for performing measurements, (2) lack of design requirements for new facilities that would facilitate accurate holdup measurement, and (3) lack of research and development activities for new instrumentation and/or measurement techniques. Each of these issues is discussed below.

Lack of Standardization - DOE has not established requirements or guidance for performing *in situ* measurements in its Directives system. While the Board recognized that measurement techniques can be highly location-specific, a requirement to follow methods outlined in national consensus standards when performing *in situ* NDA measurements could reduce the errors and uncertainty of results. Commercial guidance for NDA is available in a series of standards published by ASTM International. This series addresses good practices for performing NDA measurements, methods for performing specific types of NDA measurements (for example, ASTM C-1133-03, *NDA of Low-Density Scrap and Waste by Segmented Passive Gamma Ray Scanning),* and training and qualification of NDA personnel. While this guidance has been used informally at some sites, DOE has not required its use for NDA measurements.

Lack of Design Requirements for New Facilities - Many of the problems that require *in situ* NDA to determine radioactive material holdup arose because facilities were designed and built before the need for NDA technology was evident. As a result, no consistent attempt was made to design facility systems to minimize holdup or facilitate holdup measurement. This historical trend should not be repeated in new facilities. The necessity of monitoring radioactive material holdup must be considered in the design of new facilities. For example, locations for monitoring can be selected during the design phase on the basis of the most likely locations for holdup to occur. Calibrations and characterizations can then be performed at these locations *before* the facility begins operations to provide a baseline for future NDA measurements. Facilities can also be designed to minimize holdup in areas where it may be of concern.

Lack of Research and Development Activities - Los Alamos National Laboratory (LANL) conducted NDA research for more than 20 years. LANL developed most of the NDA techniques in current use, and conducts associated training programs. However, it is not clear that any significant

research and development for *in situ* NDA measurements is currently being conducted within DOE to address concerns with material holdup.

Research and development activities are focused in other areas, such as nuclear material safeguards and homeland security, but these efforts have different objectives and may not yield results that are beneficial for measurements using *in situ* NDA.

## 3.0 BASELINE ASSUMPTIONS

The Department made the following baseline assumptions regarding the development and successful fulfillment of the Recommendation 2007-1 Implementation Plan (IP):

- This IP will be executed using the approach in Table 1, and based on target-level funding approved by Congress in an atmosphere of stable mission requirements.

- This IP does not commit to any changes to the DEAR clauses or Directives, except to the extent specifically described in the IP.

- This IP does not create new requirements for the reliance upon *in-situ* NDA beyond those documented in DOE approved documented safety analyses, criticality safety program description documents compliant with DOE Order 420.1B, *Facility Safety*, or other Department directives.

- A graded approach will be used for all reviews undertaken as part of this IP. Credit may be taken for documented pre-existing assessments results and/or other documented activities performed by DOE Line Management.

- Actions identified in this IP are intended to address concerns identified in Board Recommendation 2007-1. This IP applies to Environmental Management (EM) and National Nuclear Security Administration (NNSA) defense nuclear facilities containing fissionable material in quantities greater than the single parameter sub-critical fissionable mass limits specified in ANSI/ANS-8.1-1998; R2007, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors.*

- The Department recognizes that complex, high-hazard defense nuclear facilities could be identified that rely upon *in situ* NDA measurements to meet non-fissionable inventory control requirements. If such facilities are identified, Chief of Nuclear Safety/Chief of Defense Nuclear Safety will evaluate the safety significance and actions necessary to ensure that the Department's safety policies and requirements are adequately implemented.

- This IP addresses holdup measurements of fissionable material in installed process equipment, ancillary equipment and supporting facility infrastructure using *in situ* NDA for the purpose of ensuring compliance with nuclear safety limits. This IP focuses on to the holdup of fissionable material. The holdup of fissionable material presents a criticality accident risk to the Department. For the purposes of this IP, the Department prioritizes criticality accident risk

based on form (e.g., solution or powder) and quantity (actual/potential) of fissionable material holdup.

- For the purposes of this IP, the term "nuclear safety limits" means limits on fissionable material to comply with values or limits established by criticality safety evaluations conforming to the expectations of DOE O 420.1B.

- The extent of condition evaluation will identify defense nuclear facilities that have a criticality safety program and rely upon *in situ* NDA measurements of fissionable material.

- The improvements in the protocols, methodologies, calculations, and assumptions that result from this IP are expected to be applied to other NDA holdup measurements performed at DOE sites.

- The Department will leverage research and development and consensus standards to the greatest degree appropriate.

- The Guiding Principles of Integrated Safety Management apply to all aspects of this IP and of NDA holdup measurement programs and activities.

- IP activities for "State of the Practice" and "Identification of NDA Needs" may be performed in parallel, assuming sufficient resources are available including assistance for the NDA Technical Support Group. Cross-fertilization in these activities is essential.

- Identification of any "Interim Actions" or "Compensatory Measures" during the "Identification of DOE NDA Needs" must be given priority. Evaluation of areas where "standardization" may be appropriate (e.g., specific processes) will occur during the gap analysis phase.

**Table 1: Overview of DOE Implementation Plan for DNFSB Recommendation 2007-1 Approach for Major Activities**

| Phase 1 | | | | | | Phase 2 |
|---|---|---|---|---|---|---|
| **Evaluate Extent of Condition** | **Identify State of the Practice and Good Practices** | **Identify NDA Needs** | **Gap Analysis** | **Priorities** | **Actions** | **Follow-up Actions** |
| • Develop selection criteria to identify DOE facilities<br>• Identify facilities that meet criteria<br>• Prioritize facilities based upon criticality accident risk | • Training & Qualification<br>• Design requirements for new facilities and equipment<br>• Standards for conducting NDA<br>• Implementation of standards<br>• R&D<br>• QA<br>• Oversight | • Identify Personnel capabilities and training, equipment capabilities, Directives, R&D, QA and Oversight Needs<br>• Identify any interim actions | • Conduct Gap Analysis using Extent of Condition, State of the Practice, and NDA holdup measurement needs as the basis.<br>• Define Requirements, Programs, and Guidance to Address Gaps | • Prioritize Needs to be addressed from Gap Analysis based on Risk | • Develop and Implement Action Plans to Address Phase 1 Priorities<br>• Identification of continuous improvement<br>• Feedback as appropriate | • Develop and Implement Action Plans to Address Phase 2 Priorities<br>• Feedback as appropriate<br>• Verify effectiveness of actions |

Assumptions:

1. Phase 1 activities for identifying "State of the Practice" and "NDA Needs" may be performed in parallel, assuming sufficient resources are available including assistance for the NDA Technical Support Group. Cross-fertilization in these activities is essential.
2. Evaluation of areas (e.g., specific processes) where "standardization" may be appropriate will occur during the gap analysis phase.

## 4.0 SUMMARY OF COMPLETED NEAR-TERM ACTIONS

The Department has been aware of the need for improvements in holdup measurements at facilities such as Hanford's Plutonium Finishing Plant (PFP) and the K-25/K-27 Decontamination and Decommissioning (D&D) Project as well as those at the Y-12 National Security Complex.

In 2002, the Rocky Flats field office initiated an independent assessment of the NDA program in response to holdup measurement issues and ineffective communications between measurement staff and other programs such as criticality safety and material control and accountability (MC&A). The assessment identified 10 recommendations dealing with:

- Ways to pre-identify suspect measurements
- Holdup measurement staffing issues
- Assumptions in the criticality safety evaluations

Corrective actions were completed and significantly contributed to the closure of the Rocky Flats site.

At the PFP, assessment revealed that the Portable NDA Program and its associated infrastructure including such aspects as staffing, equipment availability, training programs, organization, and some specific measurement methods and techniques were not adequate to support the planned D&D activities. Problems identified included: (1) training for Portable NDA operators did not meet procedural requirements or provide a complete understanding of the physics of holdup measurements; (2) measurement uncertainties were not minimized and accurately estimated at the 95% confidence level; (3) a stand-alone Portable NDA program did not exist; (4) there was no responsible senior scientist supporting portable NDA measurement; (5) periodic assessments were not performed; and (6) the NDA staff was isolated from the broader measurements community. A multi-year corrective action plan was initiated and significant improvements resulted.

In June 2005, a routine bimonthly measurement of a High Efficiency Particulate Air filter at the Y-12 National Security Complex was performed as part of the Uranium Holdup Survey Program (UHSP). The measurement was analyzed using the traditional Generalized Geometry Holdup approach with an area calibration and self-attenuation corrected with an empirical correction factor. The modeled result of 172g $^{235}$U was reported. The actual quantity of $^{235}$U in the filter was later determined to be approximately 1700g. Two factors contributed to the low reported value: detector placement that caused the filter to not fill the field of view of the detector (lack of correction); and modeling the filter as an area source rather than as a volume. Corrective actions for this case include moving the detector placement to the side of the filter (rather than the face) and changes in the modeling methods to account for the volume source and resulting self-attenuation of the uranium loading in the filter. In addition to the process-specific responses, the UHSP has been improved through increased staffing, issuance of a plant-level procedure to govern the UHSP and improved survey equipment, the implementation of meaningful performance metrics, issuance of technical guidance documents, and requirements for periodic trending analysis. The Department continues to review UHSP and identify improvements.

In April 2006, NDA measurements of a casting vacuum filter housing at the Y-12 National Security Complex performed as part of the UHSP indicated the possible presence of a buildup of uranium mass significantly in excess of the nominal cleanout threshold. The reported values were a result of NDA technicians performing comprehensive measurements on the filter housing in response to survey readings that exceeded the UHSP action limit. The Nuclear Criticality Safety (NCS) program at the time of this incident relied upon holdup measurements to detect accumulations of fissile material in the filter housing. The primary indicator of changes in accumulation was established eight years prior, when NDA measurements at that time indicated the most significant accumulation in the filter housing was at the first impingement point in the filter, near the top of the housing. Increases in survey readings at the indicator point were intended to trigger more detailed measurements of the entire housing and filter. Routine measurement points have also been added to these housings to provide representative data for the entire filter housings.

Prior to Recommendation 2007-1, the Office of Environmental Management had initiated some site-specific actions toward addressing the *in situ* NDA measurement of radioactive material holdup at the K-25/K-27 Project. In July 2006, the Oak Ridge Operations Office (ORO) directed the contractor managing this project to implement its NDA program independent of the line organization.

In November 2006, ORO conducted an assist visit at the K-25/K-27 D&D Project. The objective of this review was to determine whether the contractor had established the necessary NDA equipment, data, and procedures to support the required criticality safety and waste management needs of the Project. The review identified significant programmatic deficiencies, including training. A follow-up formal assessment was conducted in April 2007, finding improvements in contractor NDA programmatic structure, including training.

In each of these instances, the Department initiated site-specific corrective actions based on the specific problem encountered. Lessons learned, including actions to prevent inadequate and inconsistent application of standards pertaining to *in situ* NDA measurements were not effectively shared within the DOE complex. This IP has been developed to ensure continuous improvement in the area of NDA holdup measurement, department-wide.

## 5.0 SAFETY ISSUE RESOLUTION

This section is organized around the following five main areas:

- Evaluation of Extent of Condition
- Identification of State of the Practice
- Identification of DOE *in situ* Nondestructive Assay Needs
- Requirements, Programs and Guidance to Address Gaps
- Continuous Improvement

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 Evaluation of Extent of Condition

Issue

Evaluate the extent of condition of imprecise *in situ* NDA programs within the Department by identifying those defense nuclear facilities for which a criticality safety program (CSP) is required and relies upon *in situ* NDA.

Basis

The Department has not evaluated the extent of condition regarding imprecise *in-situ* NDA programs within the DOE. This effort should involve the identification of all cases within the defense nuclear complex in which *in situ* NDA results are used to ensure compliance with nuclear criticality safety limits.

Resolution Approach

The basis of DNFSB Recommendation 2007-1 is focused on the use of imprecise measurements and correction factors for material geometry assumptions or failure to perform measurements at locations where fissionable material was accumulating. Three instances of *in situ* NDA measurement of fissionable material hold-up were cited as examples. This IP has been developed to address holdup measurements of fissionable material in installed process equipment, ancillary equipment and supporting facility infrastructure using *in situ* NDA for the purpose of ensuring compliance with nuclear criticality safety limits.

To evaluate the extent of condition within DOE, this IP applies to defense nuclear facilities: (1) containing fissionable material in quantities greater than the single parameter sub-critical fissionable mass limits (ANSI/ANS-8.1-1998; R2007, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors* and ANSI/ANS-8.15-1981; R2005, *Nuclear Criticality Control of Special Actinide Elements)* and, (2) that rely upon *in situ* NDA measurements. This will establish the scope of the extent of condition evaluation.

The technical justification for the extent of condition evaluation is based upon the following:

- DOE Order 420.1B specifically addresses fissionable material holdup and requires that "Facilities that conduct operations using fissionable material in a form that could inadvertently accumulate in significant quantities must include a program and procedures for detecting and characterizing accumulations."

- DOE Order 420.1B requires CSPs for those "… nuclear facilities and activities that involve, or potentially involve, nuclides in quantities that are equal to or greater than the single parameter limits for fissionable materials listed in ANSI/ANS-8.1 and 8.15."

- DOE Order 420.1B requires that the CSP "…description document must describe how the contractor will implement the requirements in the contractor requirements document (CRD) including the standards invoked by this Chapter. The CSP description document must be approved by DOE and implemented as approved."

Deliverables/Milestones

**Commitment 5.1.1: Identify EM defense nuclear facilities for which a criticality safety program is required (per DOE O 420.1B) and relies upon *in situ* NDA.**

Lead Responsibility: EM-3 (Site Office Managers of applicable EM sites).

Deliverable: List of EM defense nuclear facilities for which a criticality safety program is required per DOE O 420.1B and relies upon in situ NDA.

Due Date: January 2008.

**Commitment 5.1.2: Identify NNSA defense nuclear facilities for which a criticality safety program is required (per DOE O 420.1B) and relies upon *in situ* NDA.**

Lead Responsibility: NA-10 (Site Office Managers of applicable NNSA sites).

Deliverable: List of NNSA defense nuclear facilities for which a criticality safety program is required per DOE O 420.1B and relies upon in situ NDA.

Due Date: January 2008.

**Commitment 5.1.3: Prioritize EM defense nuclear facilities based upon criticality accident risk for those facilities identified in Commitment 5.1.1.**

Lead Responsibility: EM-61.

Deliverable: Prioritized list of EM defense nuclear facilities based upon criticality accident risk.

Due Date: 30-days after completion after Commitment 5.1.1.

**Commitment 5.1.4: Prioritize NNSA defense nuclear facilities based upon criticality accident risk for those facilities identified in Commitment 5.1.2.**

Lead Responsibility: NA-17.

Deliverable: Prioritized list of NNSA defense nuclear facilities based upon criticality accident risk.

Due Date: 30-days after completion of Commitment 5.1.2.

## 5.2 Identification of State of the Practice

Issue

Identify the state of the practice and good practices with respect to training and qualification, design requirements for new facilities and equipment, standards for conducting NDA holdup measurements, implementation standards, research and development, quality assurance, and oversight.

Basis

DOE has not established requirements or guidance for performing *in situ* NDA measurements in its Directives system. Many of the problems that require *in situ* NDA to determine fissionable material holdup arose because facilities were designed and built before the need for NDA technology was evident. As a result, no consistent attempts were made to design facility systems to minimize holdup or facilitate its measurement.

Los Alamos National Laboratory (LANL) conducted NDA research for more than 20 years. LANL developed most of the NDA techniques in current use, and conducts associated training programs. However, it is not clear that any significant research and development for *in situ* NDA measurements is currently being conducted within DOE to address serious concerns with material holdup.

Resolution Approach

The Department will conduct reviews where appropriate, either in office or on-site, to:

- Determine whether the protocols, methodologies, calculations, and assumptions used in practice to obtain NDA results are technically defensible and adequate for their intended purpose. This review should take into consideration lessons learned from recent events.

- Identify domestic and international (to the extent practicable) good practices with respect to training and qualification, design requirements for new facilities and equipment, standards for conducting NDA holdup measurements, implementation of standards, research and development, quality assurance, and oversight.

Some DOE sites have made progress in establishing *in situ* NDA programs. Further commercial guidance for NDA is available in a series of standards published by ASTM International. The Department will draw on the experience of the NDA Technical Support Group described in Section 5.5 and DOE sites and commercial experience in determining good practices.

Deliverables/Milestones

**Commitment 5.2.1: Establish criteria for conducting state of the practice reviews of: a) training and qualification; b) design requirements for new facilities and equipment; c) standards for conducting NDA holdup measurements; d) implementation of standards; e) research and development; f) quality assurance; and g) oversight.**

Lead Responsibility: EM-3 with input from the NDA Technical Support Group.

Deliverable: Review criteria for training and qualification; design requirements for new facilities and equipment; standards for conducting NDA holdup measurements; implementation of standards; research and development; quality assurance; and oversight.

Due Date: 6-months after completion of Commitment 5.5.1.

**Commitment 5.2.2: Establish schedule to conduct state of the practice reviews (to be completed within one year) of EM facilities identified in Commitment 5.1.3.**

Lead Responsibility: EM-3 (Site Office Managers of applicable EM sites) with input from the NDA Technical Support Group.

Deliverable: Schedule of reviews.

Due Date: 30-days after completion of Commitment 5.2.1.

**Commitment 5.2.3: Establish schedule to conduct state of the practice reviews (to be completed within one year) of NNSA facilities identified in Commitment 5.1.4.**

Lead Responsibility: NA-10 (Site Office Managers of applicable NNSA sites) with input from the NDA Technical Support Group.

Deliverable: Schedule of reviews.

Due Date: 30-days after completion of Commitment 5.2.1.

**Commitment 5.2.4: Conduct EM state of the practice reviews per the schedule established in Commitment 5.2.2 with the assistance of the NDA Technical Support Group.**

Lead Responsibility: EM Site Office Managers with assistance from the NDA Technical Support Group.

Deliverable: Reports to the PSO indicating the results of the reviews, any concerns and the actions necessary to address the concerns.

Due Date: Per established schedule.

**Commitment 5.2.5: Conduct NNSA state of the practice reviews per the schedule established in Commitment 5.2.3 with the assistance of the NDA Technical Support Group.**

Lead Responsibility: NA-10 (Site Office Managers of applicable NNSA sites) with assistance from the NDA Technical Support Group.

Deliverable: Reports to the PSO indicating the results of the reviews, any concerns and the actions necessary to address the concerns.

Due Date: Per established schedule.

**Commitment 5.2.6: Identify good practices discovered during the state of the practice reviews with respect to training and qualification, design requirements for new facilities and equipment, standards for conducting *in situ* NDA holdup measurements, implementation standards, research and development, quality assurance, and oversight.**

Lead Responsibility: Chief of Nuclear Safety (CNS).

Deliverable: Report identifying good practices with respect to training and qualification, design requirements for new facilities and equipment, standards for conducting *in situ* NDA holdup measurements, implementation standards, research and development, and oversight.

Due Date: 30 days after completion of Commitments 5.2.6.1 through 5.2.6.7.

**Commitment 5.2.6.1: Identify good practices, for both commercial and within the Department, for *in situ* NDA training and qualification.**

Lead Responsibility: EM-3 with input from the NDA Technical Support Group.

Deliverable: Report identifying good practices for NDA training and qualification.

Due Date: 30-days after completion commitments 5.2.4 and 5.2.5.

**Commitment 5.2.6.2: Identify good practices for both commercial and within the Department, for *in situ* NDA design requirements for new facilities and equipment.**

Lead Responsibility: CNS with input from the NDA Technical Support Group.

Deliverable: Report identifying good practices for NDA design requirements for new facilities and equipment.

Due Date: 30-days after completion of commitments 5.2.4 and 5.2.5.

**Commitment 5.2.6.3: Identify good practices for both commercial and within the Department, for standards for conducting *in situ* NDA.**

Lead Responsibility: EM-3 with input from the NDA Technical Support Group.

Deliverable: Report identifying good practices for NDA for standards for conducting *in situ* NDA.

Due Date: 30-days after completion of commitments 5.2.4 and 5.2.5.

**Commitment 5.2.6.4: Identify good practices for both commercial and within the Department, for implementation of *in situ* NDA standards.**

Lead Responsibility: EM-3 with input from the NDA Technical Support Group.

Deliverable: Report identifying good practices for implementation of NDA standards.

Due Date: 30-days after completion of commitments 5.2.4 and 5.2.5.

**Commitment 5.2.6.5: Identify recent and ongoing research and development applicable to *in situ* NDA, and identify commercially available (domestic and international) instrumentation/methods.**

Lead Responsibility: NA-11 / HSS HS-82 with input from the NDA Technical Support Group.

Deliverable: Report identifying ongoing R&D in the US/international laboratories and commercially available instrumentation that would, if implemented, reduce the uncertainties associated with *in situ* NDA.

Due Date: 30-days after completion of commitments 5.2.4 and 5.2.5.

**Commitment 5.2.6.6: Identify good practices for both commercial and within the Department, for implementation of *in situ* NDA quality assurance.**

Lead Responsibility: CNS with input from the NDA Technical Support Group.

Deliverable: Report identifying good practices for implementation of NDA quality assurance.

Due Date: 30-days after completion of commitments 5.2.4 and 5.2.5.

**Commitment 5.2.6.7: Identify good practices for both commercial and within the Department, for implementation of *in situ* NDA oversight.**

| | |
|---|---|
| Lead Responsibility: | EM-3/NA-10 with input from the NDA Technical Support Group. |
| Deliverable: | Report identifying good practices for implementation of NDA oversight. |
| Due Date: | 30-days after completion of commitments 5.2.4 and 5.2.5. |

## 5.3 Identification of DOE *in situ* Nondestructive Assay Needs

Issue

Identify DOE NDA holdup measurement needs, including identifying personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions.

Basis

DOE has not established programmatic requirements for NDA, even though this method is heavily relied upon for nuclear safety throughout the complex and is key to many DOE activities. The capability to perform accurate measurements and use the results to determine compliance with nuclear safety limits is absolutely essential.

Research and development efforts for NDA have historically focused on the areas of material control and accountability, and nuclear material safeguards; advances in these areas have peripherally benefited *in situ* NDA measurement capabilities. Current research and development efforts appear to hold little promise for addressing potential needed improvements for *in situ* NDA measurement. For example, development of instrumentation and measurement techniques may be needed to reduce overall measurement uncertainties.

Resolution Approach

The Department will identify NDA holdup measurement needs, including identifying personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions. The Department will draw on DOE sites and commercial experience in determining NDA holdup measurement program needs.

Deliverables/Milestones

**Commitment 5.3.1: Identify DOE NDA holdup measurement needs and technical bases for personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions.**

| | |
|---|---|
| Lead Responsibility: | CNS. |
| Deliverable: | Report identifying DOE NDA holdup measurement needs with technical bases for personnel training and qualification; equipment capabilities; directives; research and development, quality assurance, oversight needs, and any interim actions. |
| Due Date: | 30 days after completion of Commitments 5.3.1.1 through 5.3.1.6. |

**Commitment 5.3.1.1: Identify *in situ* NDA personnel training and qualification needs and any interim actions.**

Lead Responsibility: EM-3 with input from the NDA Technical Support Group.

Deliverable: Report identifying NDA personnel training and qualification needs.

Due Date: 60 days after completion Commitment 5.2.6.

**Commitment 5.3.1.2: Identify *in situ* NDA equipment capabilities and needs and any interim actions.**

Lead Responsibility: CNS with input from the NDA Technical Support Group.

Deliverable: Report identifying NDA equipment capabilities and needs.

Due Date: 60 days after completion Commitment 5.2.6.

**Commitment 5.3.1.3: Identify *in situ* NDA directive needs and any interim actions.**

Lead Responsibility: HS-71 with input from the NDA Technical Support Group.

Deliverable: Report identifying *in situ* NDA directive needs.

Due Date: 60 days after completion Commitment 5.2.6.

**Commitment 5.3.1.4: Identify and incorporate the needs for *in situ* research and development (R&D) through the Planning, Programming, Budgeting, and Execution process of nuclear safety R&D.**

Lead Responsibility: NA-11/HS-82 with input from the NDA Technical Support Group.

Deliverable: Report identifying the R&D projects for which funding is requested.

Due Date: 120 days after completion Commitment 5.2.6.

**Commitment 5.3.1.5: Identify quality assurance needs to ensure effective implementation of NDA holdup measurement activities and any interim actions.**

Lead Responsibility: CNS with input from the NDA Technical Support Group.

Deliverable: Report identifying NDA quality assurance needs.

Due Date: 120 days after completion Commitment 5.2.6.

**Commitment 5.3.1.6: Identify oversight needs consistent with DOE O 226.1 to ensure effective implementation of NDA holdup measurement activities and any interim actions.**

Lead Responsibility: EM-62/NA-10 with input from the NDA Technical Support Group.

Deliverable: Report identifying NDA oversight needs.

Due Date: 120 days after completion Commitment 5.2.6.

## 5.4 Requirements, Programs and Guidance to Address Gaps

Issue

Develop a prioritized plan for implementing requirements, programs and guidance to address the results of the gap analysis performed using extent of condition, state of the practice, and NDA holdup measurement needs as the basis.

Basis

DOE has not established programmatic requirements for NDA, even though this method is heavily relied upon for nuclear safety throughout the complex and is key to many DOE activities. The capability to perform precise measurements and use the results to determine compliance with nuclear safety limits is essential.

The requirements and guidance should focus on *in situ* NDA programs that are used to demonstrate compliance with nuclear safety limits. Particular issues addressed should include:

- Training and qualification standards for personnel involved in performing NDA measurements, interpreting and reviewing results, and managing site programs.
- Application of standard protocols and methodologies, such as those given in the national consensus series issued by ASTM International, for performing NDA measurements.
- Standardization of methods to determine appropriate correction factors for common situations (geometry and self-attenuation factors), where appropriate and consistent application of well determined uncertainty values.
- Reinforcement of the use of formal lessons-learned mechanisms in the application of NDA programs so that information can be shared easily among affected DOE sites.
- Incorporation of features in the design of new facilities to minimize radioactive material holdup and facilitate accurate NDA holdup measurements.
- Periodic assessments of the need for new NDA technology and the status of ongoing NDA-related research and development programs.
- Periodic assessments to ensure that NDA programs are using the best available technology.
- Incorporation of appropriate quality assurance elements into *in situ* NDA measurements when used for *compliance* with nuclear safety limits as required by 10 CFR Part 830, *Nuclear Safety Management*.

Resolution Approach

The Department will conduct a gap analysis using the outcomes of the extent of condition, state of the practice and DOE NDA holdup measurement needs reviews as the basis for developing a plan that is prioritized to address identified gaps in personnel training and qualification; equipment capabilities; policy, directives and standards; research and development; quality assurance and oversight.

Actions will then be taken to address the identified needs and to close gaps between current NDA holdup measurement practices and state of the practice. This may require either introducing commercial practices and/or equipment into the DOE complex, or research and development for new equipment and/or practices. Potential gap-filling actions will be risk and cost prioritized

To ensure that Federal personnel with significant NDA responsibilities have the necessary technical capabilities to carry out their duties, technical qualification requirements will be identified and specified in the appropriate Technical Qualification Standards as needed. This process will be coordinated with the Federal Technical Capability Panel in accordance with the requirements of the DOE M 426.1, *Federal Technical Capability Manual*.

The approach will be to establish general requirements in DOE directives, describe protocols and methodologies in consensus standards, and use DOE directives to require that protocols and methodologies described in applicable consensus standards be followed unless another approach is approved by DOE. Additional information may be provided as needed in DOE guides. Additional information could include lists of applicable standards or sections thereof, as well as other information related to best practices for performing NDA holdup measurements and designing facilities.

The rationale for a standards-based approach is that: (1) the expertise for performing *in situ* NDA measurements rests with personnel at the Department's national laboratories, its operating facilities, and commercial vendors; and (2) it provides a process to develop consistent correction factors for commonly encountered equipment.

Deliverables/Milestones

**Commitment 5.4.1: Perform gap analysis and identify areas for improvement in training and qualification; equipment capabilities; directives; research and development; quality assurance; and oversight.**

| | |
|---|---|
| Lead Responsibility: | CNS with input from the NDA Technical Support Group. |
| Deliverable: | Gap analysis report identifying areas for improvement in training and qualification; equipment capabilities; directives; research and development; quality assurance and oversight. |
| Due Date: | 90 days after completion of commitment 5.3.1. |

**Commitment 5.4.2: Define and prioritize requirements, programs, and guidance to address gaps in training and qualification; equipment capabilities; directives; research and development; quality assurance; and oversight.**

| | |
|---|---|
| Lead Responsibility: | CNS with input from the NDA Technical Support Group. |

| | |
|---|---|
| Deliverable: | Prioritized action plan with schedule and milestones to address the gap analysis results. |
| Due Date: | 120 days after completion of commitment 5.4.1. |

## 5.5 Continuous Improvement

Issue

In addition to establishing the infrastructure for an NDA holdup measurement program, it is prudent that the Department ensure that these programs and processes are maintained and keep pace with evolving industry practices. This involves establishing an internal communications network within the Department and a network outside of the Department. Additionally, there is no consolidated and coordinated "body of knowledge" within the Department to keep pace with industry practices or to provide input to management regarding program changes.

Basis

In each of the three examples cited in the Recommendation, site-specific corrective actions were taken based on the specific problem encountered. Lessons learned from these events do not appear to have been shared within the DOE complex. Complex-wide corrective actions have not been identified to minimize the occurrence of similar events at other sites. As a result, the Board has expressed concerns that undiscovered problems exist at other facilities within the DOE complex.

Resolution Approach

To ensure continuous improvement in the area of NDA holdup measurement, several elements are required. The Department must ensure that it stays current with industry and Federal agency standards and practices related to NDA holdup measurement. To accomplish this, a more formalized and coordinated effort will be taken to interface with other agencies, industries, and organizations with expertise in NDA holdup measurement. It should be noted that various organizations across the Department are undertaking significant NDA holdup measurement efforts, but these efforts are not always coordinated or shared.

It is desirable to establish an NDA Technical Support Group of subject matter experts (SMEs). This support group will consist of Federal employee representatives from Headquarters and Field Elements and DOE management and operating contractors who have expertise in NDA holdup measurement. The support group will assist the Department in the specific areas of concern highlighted in Recommendation 2007-1. The support group will provide the following:

- Assistance, as requested, to support management's efforts in accomplishing this IP;
- Programmatic input regarding the development and implementation of an effective NDA holdup measurement program;
- SMEs to assist in conducting periodic assessments to ensure that NDA holdup measurement programs are using appropriate technology, standards and process;
- A mechanism to identify and address major NDA holdup measurement issues that have cross-cutting impacts across the DOE complex;
- A forum for sharing lessons-learned, ideas and proven processes or programs to both DOE and contractor management; and

- A forum for ensuring that advances in DOE and consensus standards are made when appropriate.

To facilitate continuous improvement in NDA holdup measurement and technology, the Department will identify a process for clearly communicating lessons learned, new technology, and innovative techniques that are related to NDA holdup measurement. This communication will include both Federal and contractor personnel who perform or use NDA holdup measurements, and may utilize existing systems within DOE or a separate website dedicated to NDA holdup measurement. The NDA Technical Support Group will assist with this effort.

Deliverables/Milestones

**Commitment 5.5.1: Establish the NDA Technical Support Group that is responsible and accountable for the identification and resolution of NDA holdup measurement issues and communicating lessons learned.**

| | |
|---|---|
| Lead Responsibility: | EM-3. |
| Deliverable: | NDA Technical Support Group established with approved Charter. |
| Due Date: | 30 days after funding is available. |

**Commitment 5.5.2: Identify methods for capturing and clearly communicating NDA holdup measurement lessons learned, new technology, innovative techniques, and areas in which research and development is needed.**

| | |
|---|---|
| Lead Responsibility: | EM-3 with input from the NDA Technical Support Group. |
| Deliverable: | "Information sharing" mechanism functioning for NDA. |
| Due Date: | 6 months after completion of commitment 5.5.1. |

**Commitment 5.5.3: Conduct triennial reviews of the need for new NDA holdup measurement technology and the status of ongoing NDA-related research and development programs.**

| | |
|---|---|
| Lead Responsibility: | EM-3 with input from the NDA Technical Support Group. |
| Deliverable: | Report to NA-17 on the need for new NDA holdup measurement technology and the status of ongoing NDA-related research and development programs. |
| Due Date: | 3-years after completion of the Gap Analysis in Section 5.4. |

**Commitment 5.5.4: Conduct periodic reviews to ensure that NDA holdup measurement programs are using technology adequate for their intended purpose.**

| | |
|---|---|
| Lead Responsibility: | EM-62/NA-10 with input from the NDA Technical Support Group. |
| Deliverable: | Schedule of periodic reviews (either incorporated with existing review schedule or as a stand alone review). |
| Due Date: | 30 days after completion of commitments 5.4.1 and 5.4.2. |

## 6.0 Organization and Management

Overall execution of this IP is the responsibility of the Chief of Nuclear Safety, Office of the Under Secretary of Energy. A Responsible Manager will be assigned to ensure individuals responsible for deliverables and commitments identified within this IP complete their actions. However, responsibility for implementing NDA holdup measurement rests with line managers who are responsible for many of the deliverables associated with commitments made within this IP. This includes ensuring that the necessary resources are provided. The various lead responsible organizations identified within the IP are accountable for the completion of deliverables.

## 6.1 Roles and Responsibilities

The 2007-1 Implementation Plan Core Team has the following responsibilities:

- Coordinate overall implementation of the Department's 2007-1 implementation plan.
- Complete assigned commitments, working with affected organizations and obtaining necessary concurrences from affected program offices.
- Monitor plan commitments and provide assistance and feedback to keep plan commitments on schedule and consistent with the planned objectives.
- Review all 2007-1 implementation plan deliverables for completeness and consistency, and provide input and recommendations to the responsible commitment managers.
- Communicate regularly with affected headquarters and site offices regarding the status of plan activities and expectations for near-term activities in support of plan implementation.
- Identify and resolve cross-cutting issues affecting plan implementation.
- Keep the executive leadership informed of overall plan performance and any issues that need senior management attention and direction.

## 6.2 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 IP commitment that will not be completed by the planned milestone date; (2) have the Secretary approve all revisions to the scope and schedule of IP commitments; and (3) clearly identify and describe the revisions and bases for the revisions. Fundamental changes to the IP's strategy, scope, or schedule will be provided to the Board through formal revision and re-issuance of the IP. Other changes to the scope or schedule of planned commitments will be formally submitted in appropriate correspondence approved by the Secretary, along with the basis for the changes and appropriate corrective actions.

## 6.3 Reporting

To ensure the various Department implementing elements and the Board remain informed of the status of plan implementation, the Department's policy is to provide progress reports to the Board and/or Board staff. The Department will provide briefings to the Board and/or Board staff approximately every 4 months.

**Commitment 6.3.1: The Department will provide briefings to the Board and Board Staff. These briefings will include updates on the status of completing actions identified in the various reviews indicated in this IP.**

Lead Responsibility: CNS.

Deliverable: Briefings.

Due Date: January 2008, and approximately every four months thereafter.

**Table 2: Summary of Implementation Plan Commitments and Deliverables/Milestones**

| Number | Commitment | Deliverable | Due Date | Responsibility |
|---|---|---|---|---|
| 5.1.1 | Identify EM defense nuclear facilities for which a criticality safety program is required (per DOE O 420.1B) and relies upon in situ NDA. | List of EM defense nuclear facilities for which a criticality safety program is required per DOE O 420.1B and relies upon in situ NDA. | January 2008 | EM-3 (Site Office Managers of applicable EM sites) |
| 5.1.2 | Identify NNSA defense nuclear facilities for which a criticality safety program is required (per DOE O 420.1B) and relies upon in situ NDA. | List of NNSA defense nuclear facilities for which a criticality safety program is required per DOE O 420.1B and relies upon in situ NDA. | January 2008 | NNSA NA-10 (Site Office Managers of applicable NNSA sites) |
| 5.1.3 | Prioritize EM defense nuclear facilities based upon criticality accident risk for those facilities identified in Commitment 5.1.1. | Prioritized list of EM defense nuclear facilities based upon criticality accident risk. | 30-days after completion after Commitment 5.1.1 | EM-61 |
| 5.1.4 | Prioritize NNSA defense nuclear facilities based upon criticality accident risk for those facilities identified in Commitment 5.1.2. | Prioritized list of NNSA defense nuclear facilities based upon criticality accident risk. | 30-days after completion after Commitment 5.1.2 | NNSA NA-17 |
| | | | | |

| Number | Commitment | Deliverable | Due Date | Responsibility |
|---|---|---|---|---|
| 5.2.1 | Establish criteria for conducting state of the practice reviews of; a) training and qualification; b) design requirements for new facilities and equipment; c) standards for conducting NDA holdup measurements; d) implementation of standards; e) research and development; f) quality assurance; and g) oversight. | Review criteria for training and qualification; design requirements for new facilities and equipment; standards for conducting NDA holdup measurements; implementation of standards; research and development; quality assurance; and oversight. | 6-months after completion of Commitment 5.5.1 | EM-3 with input from the NDA Technical Support Group |
| 5.2.2 | Establish schedule to conduct state of the practice reviews (to be completed within one year) of EM facilities identified in Commitment 5.1.3. | Schedule of reviews | 30-days after completion of Commitment 5.2.1 | EM-3 (Site Office Managers of applicable EM sites) with input from the NDA Technical Support Group |
| 5.2.3 | Establish schedule to state of the practice reviews (to be completed within one year) of NNSA facilities identified in Commitment 5.1.4. | Schedule of reviews | 30-days after completion of Commitment 5.2.1 | NA-10 (Site Office Managers of applicable NNSA sites) with input from the NDA Technical Support Group |
| 5.2.4 | Conduct EM state of the practice reviews per the schedule established in Commitment 5.2.2 with the assistance of the NDA Technical Support Group. | Reports to the PSO indicating the results of the reviews, any concerns and the actions necessary to address the concerns. | Per established schedule | EM-3 (Site Office Managers of applicable EM sites) with assistance from the NDA Technical Support Group |
| 5.2.5 | Conduct NNSA state of the practice reviews per the schedule established in Commitment 5.2.3 with the assistance of the NDA Technical Support Group. | Reports to the PSO indicating the results of the reviews, any concerns and the actions necessary to address the concerns. | Per established schedule | NA-10 (Site Office Managers of applicable NNSA sites) with assistance from the NDA Technical Support Group |

| Number | Commitment | Deliverable | Due Date | Responsibility |
|---|---|---|---|---|
| 5.2.6 | Identify good practices discovered during the state of the practice reviews with respect to training and qualification, design requirements for new facilities and equipment, standards for conducting in situ NDA holdup measurements, implementation standards, research and development, quality assurance, and oversight. | Report identifying good practices with respect to training and qualification, design requirements for new facilities and equipment, standards for conducting *in situ* NDA holdup measurements, implementation standards, research and development, and oversight. | 60-days after completion of Commitments 5.2.6.1 through 5.2.6.7 | Chief of Nuclear Safety (CNS) |
| 5.2.6.1 | Identify good practices, for both commercial and within the Department, for NDA training and qualification. | Report identifying good practices for NDA training and qualification. | 30-days after completion of commitments 5.2.4 and 5.2.5 | EM-3 with input from the NDA Technical Support Group |
| 5.2.6.2 | Identify good practices for both commercial and within the Department, for NDA design requirements for new facilities and equipment. | Report identifying good practices for NDA design requirements for new facilities and equipment. | 30-days after completion of commitments 5.2.4 and 5.2.5 | CNS with input from the NDA Technical Support Group |
| 5.2.6.3 | Identify good practices, for both commercial and within the Department, for standards for conducting *in situ* NDA. | Report identifying good practices for NDA for standards for conducting *in situ* NDA | 30-days after completion of commitments 5.2.4 and 5.2.5 | EM-3 with input from the NDA Technical Support Group |
| 5.2.6.4 | Identify good practices, for both commercial and within the Department, for implementation of NDA standards. | Report identifying good practices for implementation of NDA standards. | 30-days after completion of commitments 5.2.4 and 5.2.5 | EM-3 with input from the NDA Technical Support Group |

| Number | Commitment | Deliverable | Due Date | Responsibility |
|---|---|---|---|---|
| 5.2.6.5 | Identify recent and ongoing research and development applicable to in situ NDA, and identify commercially available (domestic and international) instrumentation/methods. | Report identifying ongoing R&D in the US/international laboratories and commercially available instrumentation that would, if implemented, reduce the uncertainties associated with *in situ* NDA. | 30-days after completion of commitments 5.2.4 and 5.2.5 | NNSA NA-11 / HSS HS-82 with input from the NDA Technical Support Group |
| 5.2.6.6 | Identify good practices, for both commercial and within the Department, for implementation of NDA quality assurance. | Report identifying good practices for implementation of NDA quality assurance. | 30-days after completion of commitments 5.2.4 and 5.2.5 | CNS with input from the NDA Technical Support Group |
| 5.2.6.7 | Identify good practices, for both commercial and within the Department, for implementation of NDA oversight. | Report identifying good practices for implementation of NDA oversight. | 30-days after completion of commitments 5.2.4 and 5.2.5 | EM-3 /NA-10 with input from the NDA Technical Support Group |
| | | | | |
| 5.3.1 | Identify DOE NDA holdup measurement needs and technical bases for personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions. | Report identifying DOE NDA holdup measurement needs with technical bases for personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions. | 30 days after completion of Commitments 5.3.1.1 through 5.3.1.6 | CNS |
| 5.3.1.1 | Identify NDA personnel training and qualification needs and any interim actions. | Report identifying NDA personnel training and qualification needs. | 60 days after completion Commitment 5.2.6 | EM-3 with input from the NDA Technical Support Group |

| Number | Commitment | Deliverable | Due Date | Responsibility |
|---|---|---|---|---|
| 5.3.1.2 | Identify NDA equipment capabilities and needs and any interim actions. | Report identifying NDA equipment capabilities and needs. | 60 days after completion Commitment 5.2.6 | CNS with input from the NDA Technical Support Group |
| 5.3.1.3 | Identify *in situ* NDA directive needs and any interim actions. | Report identifying *in situ* NDA directive needs. | 60 days after completion Commitment 5.2.6 | HSS HS-71 with input from the NDA Technical Support Group |
| 5.3.1.4 | Identify and incorporate the needs for R&D through the Planning, Programming, Budgeting, and Execution process of nuclear safety R&D. | Report identifying the R&D projects for which funding is requested. | 120 days after completion Commitment 5.2.6 | NNSA NA-11 / HSS HS-82 with input from the NDA Technical Support Group |
| 5.3.1.5 | Identify quality assurance needs to ensure effective implementation of NDA activities and any interim actions. | Report identifying NDA quality assurance needs. | 120 days after completion Commitment 5.2.6 | CNS with input from the NDA Technical Support Group |
| 5.3.1.6 | Identify oversight needs consistent with DOE O 226.1 to ensure effective implementation of NDA activities. | Report identifying NDA oversight needs. | 120 days after completion Commitment 5.2.6 | EM-62/NA-10 with input from the NDA Technical Support Group |
| | | | | |
| 5.4.1 | Perform gap analysis and identify areas for improvement in training and qualification; equipment capabilities; directives; research and development; quality assurance; and oversight. | Gap analysis report identifying areas for improvement in training and qualification; equipment capabilities; directives; research and development; and oversight. | 90 days after completion of commitment 5.3.1 | CNS with input from the NDA Technical Support Group |

| Number | Commitment | Deliverable | Due Date | Responsibility |
|---|---|---|---|---|
| 5.4.2 | Define and prioritize requirements, programs, and guidance to address gaps in training and qualification; equipment capabilities; directives; research and development; quality assurance; and oversight. | Prioritized action plan with schedule and milestones to address the gap analysis results. | 30 days after completion of commitment 5.4.1 | CNS with input from the NDA Technical Support Group |
| | | | | |
| 5.5.1 | Establish the NDA Technical Support Group that is responsible and accountable for the identification and resolution of NDA issues and communicating NDA lessons learned. | NDA Technical Support Group established with approved Charter. | 30 days after funding is available | EM-3 |
| 5.5.2 | Identify methods for capturing and clearly communicating NDA lessons learned, new technology, innovative techniques, and areas in NDA in which research and development is needed. | "Information sharing" mechanism functioning for NDA. | 6 months after completion of commitment 5.5.1 | EM-3 with input from the NDA Technical Support Group |
| 5.5.3 | Conduct triennial reviews of the need for new NDA holdup measurement technology and the status of ongoing NDA-related research and development programs. | Report to NA-17 on the need for new NDA holdup measurement technology and the status of ongoing NDA-related research and development programs. | 3-years after completion of the Gap Analysis in Section 5.4 | EM-3 with input from the NDA Technical Support Group |
| 5.5.4 | Conduct periodic reviews to ensure that NDA holdup measurement programs are using technology adequate for their intended purpose. | Schedule of periodic reviews (either incorporated with existing review schedule or as a stand alone review). | 30 days after completion of commitments 5.4.1 and 5.4.2 | EM-62/NA-10 with input from the NDA Technical Support Group |
| | | | | |

| Number | Commitment | Deliverable | Due Date | Responsibility |
|---|---|---|---|---|
| 6.3.1 | The Department will provide briefings to the Board and Board Staff. These briefings will include updates on the status of completing actions identified in the various reviews indicated in this IP. | Briefings | January 2008, and approximately every four months thereafter | CNS |

# Appendix A: List of Acronyms

ANSI – American National Standards Institute

ASTM International – Formally American Society for Testing and Materials

CDNS – Chief Defense Nuclear Safety

CNS – Chief Nuclear Safety

CSP – Criticality Safety Program

D&D – Decontamination and Decommissioning

DEAR – Department of Energy Acquisition Regulations

DOE – Department of Energy

EM – Environmental Management

LANL - Los Alamos National Laboratory

MC&A – Material Control and Accountability

NCS – Nuclear Criticality Safety

NDA – Nondestructive Assay

NNSA – National Nuclear Security Administration

ORO – Oak Ridge Operations Office

PFP - Plutonium Finishing Plant

PSO – Program Secretarial Officer

QA – Quality Assurance

R&D – Research and Development

UHSP - Uranium Holdup Survey Program

# Appendix B: Glossary

**Decommissioning -** Those actions taking place after deactivation of a nuclear facility to retire it from service and includes surveillance and maintenance, decontamination, and dismantlement. [10 CFR 830]

**Decontamination -** The removal or reduction of residual radioactive and other hazardous materials by mechanical, chemical, or other techniques to achieve a stated objective or end condition. [10 CFR 830]

**Extent of Condition** - The determination whether the same problem/condition exists elsewhere and whether the same root or underlying causes of the problem/condition may be affecting performance in other applications.

**Fissionable materials -** A nuclide capable of sustaining a neutron- induced chain reaction (e.g., uranium-233, uranium-235, plutonium-238, plutonium-239, plutonium-241, neptumium-237, americium-241, and curium-244). [10 CFR 830]

**Good Practice** – A sound or valid way to perform some activity or operation associated with a specific technique that is known or believed to influence the quality of the activity or operation.

**Holdup** - The amount of nuclear material remaining in process equipment and facilities after the in process material, stored materials and product are removed. [ASTM C1592-04]

***in situ* Nondestructive Assay** – The measurement of fissionable material holdup in installed process equipment, ancillary equipment and supporting facility infrastructure.

**Nuclear Facility –** A reactor or a nonreactor nuclear facility where an activity is conducted for or on behalf of DOE and includes any related area, structure, facility, or activity to the extent necessary to ensure proper implementation of the requirements established by 10 CFR 830.

**Risk -** The quantitative or qualitative expression of possible loss that considers both the probability that an event will occur and the consequences of that event.

**State of the Practice** – A holistic evaluation of the adequacy (relative to developed review criteria) of *in situ* NDA programs across the DOE complex based on a compilation of information garnered from site-specific reviews.

# Appendix C
# Cross-Walk to Recommendations

| Board Recommendation 2007-1 (April 25, 2007) | Secretary's Response Letter (June 28, 2007) | Department's 2007-1 Implementation Plan |
|---|---|---|
| The Board, therefore, recommends that DOE:<br>1. Evaluate the extent of condition regarding imprecise in situ NDA programs within DOE. This effort should involve at least two actions: | Using the following approach, the Department will develop an Implementation Plan consistent with Integrated Safety Management System principles: | |
| A. Identifying all cases within the defense nuclear complex in which in situ NDA results are used to ensure compliance with nuclear safety limits. | • Evaluate the condition of *in situ* NDA programs against evaluation criteria, which will be developed; | **Commitment 5.1.1:** Identify EM defense nuclear facilities for which a criticality safety program is required (per DOE O 420.1B) and relies upon in situ NDA.<br><br>**Commitment 5.1.2:** Identify defense nuclear facilities for which a criticality safety program is required (per DOE O 420.1B) NNSA and relies upon in situ NDA.<br><br>**Commitment 5.1.3:** Prioritize EM defense nuclear facilities based upon criticality accident risk for those facilities identified in Commitment 5.1.1.<br><br>**Commitment 5.1.4:** Prioritize NNSA defense nuclear facilities based upon criticality accident risk for those facilities identified in Commitment 5.1.2. |
| B. Reviewing the cases identified in step 1. A to validate that the protocols, methodologies, calculations, and assumptions used to | • Identify state of the practice, both commercial as well as within the Department, in training and qualification, design requirements for new | **Commitment 5.2.6:** Identify good practices discovered during the state of the practice reviews with respect to training and qualification, design requirements for new facilities and equipment, |

| Board Recommendation 2007-1 (April 25, 2007) | Secretary's Response Letter (June 28, 2007) | Department's 2007-1 Implementation Plan |
|---|---|---|
| obtain NDA results are sufficiently conservative. This review should take into consideration lessons learned from recent events. | facilities and equipment, standards for conducting *in situ* NDA, implementation of standards, and oversight; | standards for conducting in situ NDA holdup measurements, implementation standards, research and development, quality assurance, and oversight. |
| 2. Establish requirements and guidance in a DOE directive or directives. The requirements and guidance should focus on in situ NDA programs that are used to demonstrate compliance with nuclear safety limits. Particular issues to be addressed should include: | • Identify what is needed and any resulting gaps in personnel capabilities and training, equipment capabilities, policy and directives, and oversight;<br><br>• Establish requirements, programs, and guidance, as needed;<br><br>• Develop a prioritized plan for implementing the above criteria and requirements. | **Commitment 5.3.1:** Identify DOE NDA holdup measurement needs and technical bases for personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions.<br><br>**Commitment 5.4.1:** Perform gap analysis and identify areas for improvement in training and qualification; equipment capabilities; directives; research and development; quality assurance; and oversight.<br><br>**Commitment 5.4.2:** Define and prioritize requirements, programs, and guidance to address gaps in training and qualification; equipment capabilities; directives; research and development; quality assurance; and oversight. |
| A. Training and qualification standards for personnel involved in performing NDA measurements, interpreting and reviewing results, and managing site programs. | | **Commitment 5.2.6:** Identify good practices discovered during the state of the practice reviews with respect to training and qualification, design requirements for new facilities and equipment, |

| Board Recommendation 2007-1 (April 25, 2007) | Secretary's Response Letter (June 28, 2007) | Department's 2007-1 Implementation Plan |
|---|---|---|
| | | standards for conducting in situ NDA holdup measurements, implementation standards, research and development, quality assurance, and oversight.<br><br>**Commitment 5.3.1:** Identify DOE NDA holdup measurement needs and technical bases for personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions. |
| B. Application of standard protocols and methodologies, such as those given in the national consensus series issued by ASTM, for performing NDA measurements. | | **Commitment 5.2.6:** Identify good practices discovered during the state of the practice reviews with respect to training and qualification, design requirements for new facilities and equipment, standards for conducting in situ NDA holdup measurements, implementation standards, research and development, quality assurance, and oversight.<br><br>**Commitment 5.3.1:** Identify DOE NDA holdup measurement needs and technical bases for personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions. |

| Board Recommendation 2007-1 (April 25, 2007) | Secretary's Response Letter (June 28, 2007) | Department's 2007-1 Implementation Plan |
|---|---|---|
| | | |
| C. Standardization of correction factors for common situations (geometry and self-attenuation factors) and consistent application of uncertainty values. | | **Commitment 5.2.6:** Identify good practices discovered during the state of the practice reviews with respect to training and qualification, design requirements for new facilities and equipment, standards for conducting in situ NDA holdup measurements, implementation standards, research and development, quality assurance, and oversight.<br><br>**Commitment 5.3.1:** Identify DOE NDA holdup measurement needs and technical bases for personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions. |
| D. Reinforcement of the use of formal lessons-learned mechanisms in the application of NDA programs so that information can be shared easily among affected DOE sites. | | **Commitment 5.5.1:** Establish the NDA Technical Support Group that is responsible and accountable for the identification and resolution of NDA issues and communicating NDA lessons learned.<br><br>**Commitment 5.5.2:** Identify methods for capturing and clearly communicating NDA lessons learned, new technology, innovative techniques, and areas in NDA in which research and development is needed. |

| Board Recommendation 2007-1 (April 25, 2007) | Secretary's Response Letter (June 28, 2007) | Department's 2007-1 Implementation Plan |
|---|---|---|
| E. Incorporation of features in the design of new facilities to minimize radioactive material holdup and facilitate accurate NDA holdup measurements. | | **Commitment 5.2.6:** Identify good practices discovered during the state of the practice reviews with respect to training and qualification, design requirements for new facilities and equipment, standards for conducting in situ NDA holdup measurements, implementation standards, research and development, quality assurance, and oversight.<br><br>**Commitment 5.3.1:** Identify DOE NDA holdup measurement needs and technical bases for personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions. |
| F. Periodic assessments of the need for new NDA technology and the status of ongoing NDA-related research and development programs. | • Identify any relevant ongoing research and development activities; | **Commitment 5.5.3:** Conduct triennial reviews of the need for new NDA holdup measurement technology and the status of ongoing NDA-related research and development programs. |
| G. Periodic assessments to ensure that NDA programs are using the best available technology. | | **Commitment 5.5.4:** Conduct periodic reviews to ensure that NDA holdup measurement programs are using technology adequate for their intended purpose. |
| H. Incorporation of appropriate quality assurance elements into *in situ* NDA | | **Commitment 5.2.6:** Identify good practices discovered during the state of the practice reviews with respect to |

| Board Recommendation 2007-1 (April 25, 2007) | Secretary's Response Letter (June 28, 2007) | Department's 2007-1 Implementation Plan |
|---|---|---|
| measurements when used for *compliance* with nuclear safety limits as required by 10 Code of Federal Regulations Part 830. | | training and qualification, design requirements for new facilities and equipment, standards for conducting in situ NDA holdup measurements, implementation standards, research and development, quality assurance, and oversight.<br><br>**Commitment 5.3.1:** Identify DOE NDA holdup measurement needs and technical bases for personnel training and qualification; equipment capabilities; directives; research and development; quality assurance; oversight; and any interim actions. |

Note: The Department's 2007-1 Implementation Plan commitments listed above includes the high level or rollup commitments and do not include the various sub-commitments that support them.

# Appendix D

# Defense Nuclear Facilities Safety Board Recommendation 2007-1

**[DNFSB LETTERHEAD]**

April 25, 2007

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

Dear Secretary Bodman:

On April 25, 2007, the Defense Nuclear Facilities Safety Board (Board), in accordance with 42 U.S.C. § 2286a(a)(5), unanimously approved Recommendation 2007-1, *Safety-Related In Situ Nondestructive Assay of Radioactive Materials*, which is enclosed for your consideration. This Recommendation addresses the measuring of radioactive material holdup at defense nuclear facilities in the Department of Energy (DOE) complex.

After you have received 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 this Recommendation contains no information that is classified or otherwise restricted. To the extent that this Recommendation does not include information restricted by DOE under the Atomic Energy Act of 1954, 42 U.S.C. §§ 2161-68, as amended, please arrange to have it placed promptly 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 the Board's Policy Statement 1, *Criteria for Judging the Adequacy of DOE Responses and Implementation Plans for DNFSB Recommendations*.

Sincerely,

***A. J. Eggenberger***
***Chairman***

c: Mr. Mark B. Whitaker, Jr.

Enclosure

**RECOMMENDATION 2007-1 TO THE SECRETARY OF ENERGY**
***Safety-Related In Situ Nondestructive Assay of Radioactive Materials***
**Pursuant to 42 U.S.C. § 2286(a)(5)**
**Atomic Energy Act of 1954, As Amended**

Dated: April 25, 2007

**Overview**

There are many situations in which the quantity and composition of radioactive material must be determined. In some instances, access to the material is impossible or undesirable, and consequently, weighing, laboratory analysis, and calorimetry are not viable options. In these cases, in situ nondestructive assay (NDA), based on the measurement of signature emissions from a specific isotope of interest, is used to provide an estimate of the type and quantity of radioactive material present. However, large uncertainties and imprecisions have occurred in estimating the type and quantity of radioactive material using in situ NDA. These uncertainties and imprecisions include incorrect assumptions about shielding and the spatial distribution of radioactive material, as well as poor measurement techniques. Measurement errors, in turn, lead to potential criticality accident conditions, unexpected radiation exposure to workers, and underestimation of radioactive material available for release in accident scenarios.

In most nuclear safety areas, the Department of Energy (DOE) has captured required elements for robust site programs through its Directives system. These elements include requirements necessary for proper functioning of the program, training and qualification standards for personnel, assessment criteria to ensure proper implementation of requirements, and feedback mechanisms for lessons learned and continuous improvement. However, DOE has not established programmatic requirements for NDA, even though this method is heavily relied upon for nuclear safety throughout the complex and is key to many DOE activities. The capability to perform accurate measurements and use the results to determine compliance with nuclear safety limits is absolutely essential.

Research and development efforts for NDA have historically focused on the areas of material control and accountability and nuclear material safeguards; advances in these areas have peripherally benefited *in situ* NDA measurement capabilities. Current research and development efforts appear to hold little promise for addressing needed improvements for *in situ* NDA measurement. For example, development of instrumentation and measurement techniques is needed to reduce overall measurement uncertainties.

**Examples**

Three notable instances of recent errors associated with *in situ* NDA measurement of radioactive material holdup are discussed below. These errors resulted from the use of inaccurate correction factors regarding material geometry assumptions or failure to perform measurements at locations where the material was accumulating. In each of these cases, the amount of radioactive material was initially underestimated, resulting in a smaller-than-expected safety margin and violations of criticality safety limits.

- Material holdup in 6-inch diameter vacuum system pipe at the Hanford Site's Plutonium Finishing Plant was assumed to be in the form of a 0.25 inch layer at the bottom of the pipe. Using a correction factor for this geometry, the initial estimate of material was about 1 kg. When workers then proceeded to remove the piping, it was found to be filled with a solid plug of material, and the actual amount of material present was nearly twice as high as the initial estimate.

- Measurement of an exhaust filter at the Y-12 National Security Complex assumed that fissionable material was loaded only on the face of the filter. An estimate of a few hundred grams of material was obtained using correction factors for this geometry. Subsequent investigation showed that material was loaded throughout the filter, and not just on the face. The actual amount of fissionable material present was several times the initial estimate.

- A second exhaust filter at the Y-12 National Security Complex was measured periodically using NDA, but the measurement point was not where the fissionable material was accumulating. Once this error was discovered, follow-up measurements showed significant material accumulation.

In each of these instances, site-specific corrective actions were taken based on the specific problem encountered. Lessons learned from these events do not appear to have been shared within the DOE complex. Complex-wide corrective actions have not been identified to minimize the occurrence of similar events at other sites. The Board is concerned that undiscovered problems currently exist at other facilities within the DOE complex. It is incumbent upon DOE and its contractors to review current *in situ* NDA measurements to determine whether the assumptions used to derive results are sufficiently conservative to ensure compliance with nuclear safety limits.

**Issues**

Three main issues dominate the current technical and regulatory landscape regarding *in situ* NDA measurements: (1) lack of standardized requirements for performing measurements, (2) lack of design requirements for new facilities that would facilitate accurate holdup measurement, and (3) lack of research and development activities for new instrumentation and/or measurement techniques. Each of these issues is discussed below.

*Lack of Standardization* - DOE has not established requirements or guidance for performing in situ measurements in its Directives system. While the Board recognizes that measurement techniques can be highly location specific, a requirement to follow methods outlined in national consensus standards when performing *in situ* NDA measurements would reduce the errors and uncertainty of results. Commercial guidance for NDA is available in a series of standards published by the American Society for Testing and Materials (ASTM). This series addresses good practices for performing NDA measurements, methods for performing specific types of NDA measurements (for example, ASTM C-1133-03, *NDA of low-Density Scrap and Waste by Segmented Passive Gamma Ray Scanning*), and training and qualification of NDA personnel. While this guidance has been used informally at some sites, DOE has not required its use for NDA measurements

*Lack of Design Requirements for New Facilities*—Many of the problems that require *in situ* NDA to determine radioactive material holdup arose because facilities were designed and built before the need for NDA technology was evident. As a result, no consistent attempt was made to design facility systems to minimize holdup or facilitate its measurement. This historical trend should not be repeated in new facilities. The necessity of monitoring radioactive material holdup must be considered in the design of new facilities. For example, locations for monitoring can be selected during the design phase on the basis of the most likely locations for holdup to occur. Calibrations can then be performed at these locations *before* the facility begins operations to provide a baseline for future NDA measurements. Facilities can also be designed to minimize holdup in areas where it may be of concern.

*Lack of Research and Development Activities*—Los Alamos National Laboratory (LANL) conducted NDA research for more than 20 years. LANL developed most of the NDA techniques in current use, and conducts associated training programs. However, it is not clear that any significant research and development for *in situ* NDA measurements is currently being conducted within DOE to address serious concerns with material holdup. Research and development activities are focused in other areas, such as nuclear material safeguards and homeland security, but these efforts have different objectives and may not yield results that are beneficial for measurements using *in situ* NDA.

**Recommendation**

The Board, therefore, recommends that DOE:

1. Evaluate the extent of condition regarding inaccurate in situ NDA programs within DOE. This effort should involve at least two actions:

   A. Identifying all cases within the defense nuclear complex in which in situ NDA results are used to ensure compliance with nuclear safety limits.

   B. Reviewing the cases identified in step 1. A to validate that the protocols, methodologies, calculations, and assumptions used to obtain NDA results are sufficiently conservative. This review should take into consideration lessons learned from recent events.

2. Establish requirements and guidance in a DOE directive or directives. The requirements and guidance should focus on in situ NDA programs that are used to demonstrate compliance with nuclear safety limits. Particular issues to be addressed should include:

   A. Training and qualification standards for personnel involved in performing NDA measurements, interpreting and reviewing results, and managing site programs.

   B. Application of standard protocols and methodologies, such as those given in the national consensus series issued by ASTM, for performing NDA measurements.

   C. Standardization of correction factors for common situations (geometry and self-attenuation factors) and consistent application of uncertainty values.

   D. Reinforcement of the use of formal lessons-learned mechanisms in the application of NDA programs so that information can be shared easily among affected DOE sites.

   E. Incorporation of features in the design of new facilities to minimize radioactive material holdup and facilitate accurate NDA holdup measurements.

   F. Periodic assessments of the need for new NDA technology and the status of ongoing NDA-related research and development programs.

   G. Periodic assessments to ensure that NDA programs are using the best available technology.

   H. Incorporation of appropriate quality assurance elements into *in situ* NDA measurements when used for *compliance* with nuclear safety limits as required by 10 Code of Federal Regulations Part 830.

***A. J. Eggenberger, Chairman***

# Appendix E
# Department's Recommendation 2007-1
# Acceptance Letter

**[SOE LETTERHEAD]**

June 28, 2007

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

Dear Mr. Chairman:

The Department of Energy acknowledges receipt of the Defense Nuclear Facilities Safety Board's Recommendation 2007-1, *Safety-Related In Situ Nondestructive Assay of Radioactive Materials*, issued on April 25, 2007.

The Department recognizes that continuous improvement in *in situ* nondestructive assay (NDA) is warranted to support nuclear safety in various activities carried out at Department defense nuclear facilities and, therefore, accepts Recommendation 2007-1.
Using the following approach, the Department will develop an Implementation Plan consistent with Integrated Safety Management System principles:

- Evaluate the condition of *in situ* NDA programs against evaluation criteria, which will be developed;
- Identify state of the practice, both commercial as well as within the Department, in training and qualification, design requirements for new facilities and equipment, standards for conducting *in situ* NDA, implementation of standards, and oversight;
- Identify any relevant ongoing research and development activities;
- Identify what is needed and any resulting gaps in personnel capabilities and training, equipment capabilities, policy and directives, and oversight;
- Establish requirements, programs, and guidance, as needed; and
- Develop a prioritized plan for implementing the above criteria and requirements.

I have assigned Mr. Richard Lagdon, Chief of Nuclear Safety, Office of the Under Secretary of Energy, as the Department's responsible manager for developing the Implementation Plan. He can be reached at (202) 586-9471.

Sincerely,

***Samuel W. Bodman***