Department of Energy
Washington, DC 20585

September 20, 2010

The Honorable Peter S. Winokur
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue NW, Suite 700
Washington, DC 20004-2901

Dear Mr. Chairman:

This letter is to inform you of the completion of Commitment 5.4.1 in the Department of Energy (DOE) *Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2007-01,* dated October 24, 2007. Commitment 5.4.1 identifies areas for improvement in training and qualification; equipment capabilities; directives; research and development; quality assurance; and oversight. A report documenting the areas for improvement is attached.

If you have any questions or need further information, please contact me at (301) 903-4218.

Sincerely,

Richard H. Lagdon, Jr.
Chief of Nuclear Safety
Office of the Under Secretary
U.S. Department of Energy

Attachment

cc:

K. Johnson, S-3
J. Poppiti, EM-21
R. McMorland, HS-1.1
S. Petras, HS-1.1

Nondestructive Assay (NDA) Holdup Gap Analysis

The Department of Energy (DOE) NDA Technical Support Group (TSG) established to assist in resolving Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2007-1, *Safety-Related* In Situ *Nondestructive Assay of Radioactive Materials,* has conducted a gap analysis using the outcomes of the extent-of-condition, state-of-the-practice, and NDA holdup measurement needs reviews of sites within the scope of the Recommendation. The purpose of this report is to identify areas for improvement in training and qualification, equipment capabilities, directives, research and development (R&D), quality assurance, and oversight. The gaps are organized into subsections consistent with Commitment 5.4.1. Each gap has been assigned an alphanumeric identifier for reference.

The goal of the analysis was to identify the gap between optimized *in situ* holdup measurement programs (i.e., optimized in terms of best practices) and the state of the practice across the complex. The identified gaps provide insight into areas that could be improved. The gap analysis was performed based on responses to the lines of inquiry used during the site visits for the state-of-the-practice reviews. Only lines of inquiry that were identified as best and good practices were included. This report meets the deliverable requirement for Commitment 5.4.1 in the Implementation Plan for Recommendation 2007-1.

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.

5.4.1(a) Training and Qualification Gaps

The training and qualification gaps are:

a1. Lack of standardized, formal qualification programs for NDA measurement personnel, including rigorous periodic requalification and on-the-job training; and

a2. Lack of formal NDA measurement training programs, including infrastructure support (budget, instructors, and nuclear material standards) for updating and developing advanced course offerings and content.

The state-of-the-practice reviews have shown that, in general, a lack of experienced NDA personnel exists, and NDA personnel perform tasks for which they have not been adequately trained. Qualification requirements for each NDA holdup position should be formally defined and take into consideration the authorities, duties, and responsibilities of each position. Qualifications should be evaluated and documented using formal testing and skill demonstrations. Periodic renewal of qualifications should be considered for complex tasks, and the frequency and required performance demonstration should be defined and documented. Records should be maintained on training participation and qualifications held.

A standardized, formal training and qualification program is needed to build up and maintain technical expertise. A centralized, formal training program promotes standardization of holdup

measurement methodologies and measurement uncertainty determination throughout the complex. A formal training program, located at an existing NDA measurement center of excellence such as Los Alamos National Laboratory or Oak Ridge National Laboratory, provides a means for NDA professionals of various levels of experience to exchange information, share lessons learned, and maintain awareness of state-of-the-art technology improvements and calculation advances.

5.4.1(b) Equipment Capabilities Gaps

The equipment capabilities gap is:

b1. Lack of capability to identify and measure highly attenuated holdup deposits (i.e. self-attenuation of deposits up to, and including, an infinite thickness, and attenuation by intervening matter between the detector and holdup material).

A combination of technology development and more advanced analysis capabilities may improve the ability to properly assay highly attenuated deposits. Infinitely thick holdup deposits are a difficult technical challenge for NDA. Other nonionizing radiation-based methods or administrative controls may be more feasible solutions to solving this problem. Additional equipment capability needs may be identified in the future as measurement needs within the nuclear security enterprise change.

5.4.1(c) Directives Gaps

The directives gaps are:

c1. Lack of requirements for new equipment or facilities, and changes to existing equipment and facilities, to implement best engineering practices for fissile holdup management: evaluation of the potential for holdup, design of engineered features to preclude or minimize holdup potential, and the design of equipment or facilities to facilitate holdup monitoring and removal;

c2. Lack of standardization of calculation procedures, uncertainty determinations, and common terms; and

c3. Lack of requirements to invoke consensus standards as a basis for NDA holdup measurement programs.

All of the facilities visited during the best-practice reviews were designed and constructed many years ago, and therefore predate the practice of measuring holdup using NDA techniques. Consequently, holdup measurements had to be adapted to support the existing operations. These existing operations, in many cases, have measurement point locations that are dictated by fixed equipment configurations. The design did not include provisions for the prevention of accumulations and did not anticipate the need for equipment cleanout. The ability to make safe, simple, and efficient measurements should be considered when making design decisions.

Reviews of configuration changes to facilities and processes should include input from an NDA professional to determine the potential impact to holdup measurement effectiveness. The invocation of these reviews should be formalized into site documentation.

It is important that terms be used consistently by both NDA practitioners generating the data, and stakeholders using the results, to ensure common agreement with the values and uncertainties being reported, assumptions, corrections, and other variables affecting the measurement result. The consistency usage and application of terms should be universal across the nuclear security enterprise. The most effective way to achieve this level of consistency is to require that standards be followed.

There presently is no requirement to invoke consensus standards as a basis for NDA holdup measurement programs. A site NDA program management requirements document, describing contractor implementation of applicable consensus standards and development of the technical basis for holdup measurements, is an effective means of closing this gap..

5.4.1(d) Research and Development Gap

The research and development gap is:

d1. Lack of ongoing holdup measurement R&D within the DOE complex in the areas of instrumentation, algorithms, evaluation of applications, evaluation of measurement uncertainty, and software.

Current capabilities continue to degrade with time due to the lack of ongoing research and development. Reestablishment of consistent, long-term, and effective DOE funding support for domestic NDA R&D supporting operating facilities and facilities undergoing deactivation and decommissioning (D&D) is a priority. The most important long-term project that needs to be addressed is the development of a standardized uncertainty model with complex-wide application to replace the multiple, varied approaches currently used. Broader R&D areas that should receive focus with reestablished, consistent, long-term funding are: medium-resolution detector development, testing, and application to *in situ* holdup measurements (this is an area that would benefit D&D operations significantly), thorough evaluation and integration of new commercial developments into operational holdup measurement equipment, and detector and technique developments in the areas of reliability and human factors engineering.

Developments specifically identified during site visits that could be addressed with a viable R&D program are: 1) an independent verification technique or a well-characterized test bed to verify holdup measurements performed; 2) implementation of a modified version of the holdup measurement software (HMS4) that simultaneously analyzes multiple energy lines, which would reduce data analysis time and the potential for human error; 3) fully developed, documented correction factors for area measurements performed at an angle relative to the nuclear material deposit; and 4) development of attenuation correction parameters for non-regular geometries such as a half-filled pipe, round geometry shielding, and thick shielding with variable attenuation path lengths.

5.4.1(e) Quality Assurance Gaps

The quality assurance gaps are:

e1. Lack of Data Quality Objective (DQO) processes for ensuring that the NDA holdup quality assurance (QA) requirements are adequately understood and addressed and the DQOs are clearly established and met, ensuring synergistic interactions between NDA and other disciplines, such as nuclear criticality safety;

e2. Lack of formal documented software verification and validation (V&V) processes for software development and procurement used for holdup calculations; and

e3. Lack of formalized measurement validation programs.

The DQO methodology provides a valuable means for defining the needs and capabilities of holdup NDA. The participation of NDA customers in the DQO process is an effective method for properly selecting the necessary NDA method, analysis, and reporting of results, thereby allowing the customer to understand the limitations of the measurement results. The DQO process also provides a means of allowing the NDA personnel to better understand the customer's use of the measurement results.

Items such as spreadsheet analysis used for repeated calculations should be considered controlled software at all sites and subject to software QA. A graded V&V approach should be used for single-use spreadsheet calculations that are used in lieu of hand calculations.

The TSG recommends that a mandatory, documented validation plan for measurement programs be followed. Validating *in-situ* holdup measurements is extremely difficult. When practical, holdup measurements should be compared to cleanout values. This method is extremely difficult, expensive, time-consuming, and quite often not possible. Holdup measurement validation by alternate NDA methods is not routinely performed, but could be used as an alternative to comparisons to cleanout values as a validation method.

5.4.1(f) Oversight Gaps

The oversight gaps are:

f1. Lack of self-assessments of NDA programs by NDA personnel and other stakeholders with sufficient frequency to provide programmatic enhancement;

f2. Lack of a centralized NDA program with a program manager to act as a single point of contact for NDA measurement activities, policy and procedure implementation, V&V, assessment, safety responsibility, and training.

Assessments by knowledgeable personnel are a valuable tool for identifying weaknesses and strengths of various aspects of a program, including the purpose, task definition, planning, performance, training qualification, analysis, and reporting. Such oversight should be scheduled

on a routine basis and focus on specific improvement goals and areas of identified needs. Self-assessments performed by NDA personnel and typical customers for the purposes of compliance with criticality safety, material control and accountability, safeguards and security, waste characterization, and radiation protection requirements typically yield improvement opportunities and help to cultivate communication among organizations. The selection of effective corrective actions applied to deficiencies identified in assessments is paramount to real improvement for any program. The implementation of a centralized program has been fundamental to success in criticality safety organizations; NDA should be no different.

Conclusion

The TSG's gap analysis identified needs for improvement in the areas of training and qualification; equipment capabilities; directives; research and development; quality assurance; and oversight. Less than optimal performance in these areas has the potential to impact safety and mission goals if left unaddressed. Addressing the identified gaps will improve reliability and performance of NDA holdup programs. Many of the gaps identified indicate improvements that should be implemented complex-wide to be effective. Addressing these gaps will move the complex forward in the areas of more effective measurements, higher-accuracy results, better and more easily understood uncertainty estimates, and improved customer satisfaction with more realistic expectations. Other gaps were identified as being present at only a single site. Resources of time, funding, and effort by DOE, the National Nuclear Security Administration (NNSA), and site contractors will be required to fill all of the identified gaps.

The next Implementation Plan Commitment, 5.4.2, requires a deliverable of a "Prioritized action plan with schedules and milestones to address the gap analysis results." The successful completion of Commitment 5.4.2 requires programmatic prioritization, integration, and funding by NNSA, with technical input provided by the TSG.