DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

August 30, 2012

The Honorable Thomas P. D'Agostino
Administrator
National Nuclear Security Administration
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0701

Dear Mr. D'Agostino:

The Defense Nuclear Facilities Safety Board (Board) has identified systemic deficiencies related to the adequacy of the development, review, and approval of safety control strategies for nuclear operations at Lawrence Livermore National Laboratory (LLNL). Issues of concern to the Board are summarized below, while additional detail is provided in the enclosure to this letter.

In letters dated January 27, 2010 and May 16, 2011, the Board outlined a number of problems associated with the safety basis and control strategy at the laboratory's Tritium Facility. These issues were related to inadequacies in the confinement strategy and failure to adhere to the Department of Energy's (DOE) preferred hierarchy of controls. After more than two years of iteration between the laboratory and the Livermore Site Office (LSO), the site office approved a revised safety basis on June 28, 2012. The revised safety basis represents an improvement compared to the previous document, but does not adequately resolve the Board's concerns. In particular, the performance criteria and surveillance test for the credited glovebox confinement system significantly depart from national consensus industry standards and DOE guidance. In addition, the control credited to protect workers from tritium exposures during fires is administrative in nature even though engineered controls are readily available and preferred under DOE's established hierarchy of controls as noted in DOE Standard 3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.* This administrative control relies on worker self-protection (as a creditable control strategy), which is not well defined in nuclear safety analysis.

More recently, the Board's review of a classified experiment involving high explosives in contact with special nuclear material at the laboratory's Plutonium Facility revealed that the associated hazard analysis was deficient. In the analysis, LLNL analysts misapplied technical data related to airborne release fractions and respirable fractions to derive the unmitigated consequence estimate for potential radioactive releases. The LLNL analysts used this estimate to conclude that a release would have negligible consequences and that no credited safety controls were necessary. LSO analysts did not identify this technical flaw during their review and

ultimately approved the safety basis for the experiment despite the deficient consequence analysis.

The Board was also concerned about LSO's approval of the laboratory's request for a temporary deviation from the Technical Safety Requirements in the Plutonium Facility. The LLNL contractor requested a deviation to continue unrestricted operations to meet normal programmatic mission needs while the facility's safety-class fire suppression system was inoperable. The justification for the request did not explicitly identify all the sources and characteristics of the increased risk that would result from the inoperable safety system. Consequently, the request mischaracterized the risk and did not identify appropriate compensatory measures or operational restrictions necessary to offset the increased risk.

Collectively, these issues indicate that LSO and LLNL are applying insufficient rigor and conservatism in the development, review, and approval of safety control strategies. Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests a report and briefing within 60 days of receipt of this letter providing NNSA's perspective and plans to improve the development, review, approval, and oversight of safety control strategies at LLNL.

Sincerely,

Peter S. Winokur, Ph.D.
Chairman

Enclosure

c: Ms. Kimberly A. Davis
Mrs. Mari-Jo Campagnone

Enclosure

Additional Details on Safety Basis Issues at Lawrence Livermore National Laboratory

Tritium Facility Safety Basis. The Defense Nuclear Facilities Safety Board (Board) reviewed the safety basis and control strategy at Lawrence Livermore National Laboratory's (LLNL) Tritium Facility during September 2009 through February 2011. The Board issued a letter on January 27, 2010, outlining a number of problems with the safety basis and control strategy for the Tritium Processing Station. After additional review, the Board issued another letter on May 16, 2011, highlighting ongoing and additional issues with the safety basis for the Tritium Facility.

The Board noted that in the safety basis for the Tritium Facility, LLNL analysts had not specified appropriate safety controls for certain fire scenarios involving tritium, and had not specified an appropriate safety-significant confinement boundary to prevent or mitigate tritium leaks. Further, the proposed overall control strategy was in conflict with the hierarchy of controls prescribed in DOE Standard 3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, in that a number of mitigative administrative controls were credited in lieu of existing, preventive engineered features. In response to the Board's letter of May 16, 2011, the Livermore Site Office (LSO) Manager directed the contractor to designate certain tritium gloveboxes as safety-significant engineered confinement boundaries.

After nearly a year of deliberations with the contractor, LSO approved a safety basis on June 28, 2012, intended to implement this direction. The approved safety basis stipulates a performance criterion for the Tritium Processing Station glovebox such that less than 10 percent of the glovebox atmosphere is released in 1 hour. LSO approved this leak rate based on a calculation of worker consequences that non-conservatively assumes instantaneous dilution of leaked tritium into the entire volume of a room. Moreover, the approved glovebox leak rate is two orders of magnitude greater than rates recommended by national consensus industry standards for gloveboxes and existing DOE guidance in DOE Handbook 1129-2008, *Tritium Handling and Safe Storage* and DOE Handbook 1169-2003, *Nuclear Air Cleaning Handbook.* The Board finds this to be a non-conservative application of DOE Standard 3009, which states, "Performance criteria for safety-significant SSCs [structures, systems, and components] should be representative of the general rigor associated with non-nuclear power reactor industrial and OSHA [Occupational Safety and Health Administration] practices."

The Board believes this approach, approved by LSO, reflects a safety strategy which fundamentally relies on the tritium room monitors alerting workers to a tritium release rather than crediting engineered controls to prevent the release. This safety strategy indicates a continued reluctance to adhere to DOE's preferred hierarchy of controls, despite the opportunity to credit existing engineered features (e.g., qualified process piping and fire detection and alarm system).

Classified Experiment. During January 2012 through May 2012, the Board reviewed the safety basis and control strategy for a classified experiment that was conducted at LLNL's

Plutonium Facility on May 23, 2012. The experiment involved the use of high explosives near special nuclear material. In the safety basis, LLNL analysts did not credit any engineered features as safety systems, structures, or components, based on a hazard analysis that concluded there was no potential for special nuclear material to be released.

The hazard analysis for the experiment dismissed the potential for the aerosolization of plutonium in contact with high explosives based on values and references contained in DOE Handbook 3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*. However, the Board's review of the Handbook and its underlying references revealed that the data were not applicable to the configurations of interest, and the values for airborne release and respirable fractions used in the safety basis were not demonstrably conservative.

Subsequently, LLNL and LSO personnel asserted that, notwithstanding the questions related to the Handbook values, the metal encapsulation associated with the experimental design could be credited as a safety-significant confinement boundary. This assertion was based on extrapolation from a limited number of historical classified test reports and expert judgment. However, LLNL engineers did not develop formal documentation to support this claim, and in the end, the experiment was performed using administrative controls and personal protective equipment, and without crediting available engineered features (e.g., the confinement chamber).

Temporary Deviation from Technical Safety Requirements. On May 7, 2012, the manager of the Nuclear Materials Technology Program at LLNL requested, and the LSO Manager approved, a deviation from the Plutonium Facility's Technical Safety Requirements (TSR) to allow continued normal operations while the credited safety-class fire suppression system was inoperable. The Board believes that LLNL and LSO managers approved this departure from the approved safety basis without having a sound technical justification, without putting in place compensatory measures that would have effectively mitigated the additional risk, and without imposing any operational restrictions to minimize risk while the system was degraded.

The fire suppression system in LLNL's Plutonium Facility uses a safety-class nitrogen supply to provide motive force to discharge a surge volume of firewater to protect certain high-efficiency particulate air filters from excessive heat during a fire. The facility TSRs require the suppression system to be operable during normal operations.

On May 7, 2012, facility operators detected a leak in the nitrogen system, rendering it and the credited suppression system inoperable. In this situation, the TSRs required that the facility shift to standby mode in 2 hours and to maintenance mode within 3 days unless the suppression system could be restored to service. As noted above, LLNL management requested a deviation from the TSRs to allow continued unrestricted operations. Discussions with LSO personnel indicated that the primary impetus for continued operation was to continue programmatic activities and to complete the classified experiment involving high explosives described above.

The laboratory's request for the temporary deviation described the overall risk as negligible. As compensatory measures, effective for a maximum of 2 weeks, the LSO Manager

approved the performance of daily checks of the normal non-safety domestic water supply and facility compressed air system to ensure the availability of these systems to supply firewater. These measures did not adequately address the loss of functionality of the credited safety class system that is required to operate during seismic scenarios nor did they demonstrably enhance the reliability or availability of the normal water supply.

The Board agrees that the overall risk of the deviation was low. However, LLNL and LSO personnel developed and approved the temporary deviation without (1) justifying the need to continue normal operations while the credited fire suppression system was inoperable, and (2) identifying effective compensatory measures.