02-0001741

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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August 6, 2002

The Honorable Everet H. Beckner
Deputy Administrator for Defense Programs
National Nuclear Security Administration
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0104

Dear Dr. Beckner:

On September 22, 1999, the Defense Nuclear Facilities Safety (Board) sent a letter to the Department of Energy, portions of which detailed observations of the Board's staff regarding elements of lightning protection systems at Los Alamos National Laboratory (LANL). The National Nuclear Security Administration (NNSA) responded to the Board's letter on January 9, 2001, and provided a path forward for resolving the issues raised.

Enclosed for your use, and action, as appropriate, is a report presenting additional observations developed by the Board's staff during a recent follow-up review of the lightning protection systems at LANL. In particular, the Board wishes to direct your attention to the safety class lightning protection system at the Weapons Engineering and Tritium Facility. The observed material condition of this safety class system did not appear to provide adequate lightning protection for the facility. NNSA would also benefit from the careful consideration of the lessons learned during the implementation of lightning controls at the Pantex Plant and how to apply those lessons to LANL explosive operations.

Sincerely,

John T. Conway
Chairman

c: Mr. Mark B. Whitaker, Jr.
Mr. Ralph E. Erickson

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

July 8, 2002

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: A. K. Gwal

SUBJECT: Review of Lightning Protection Systems at Los Alamos National Laboratory's Nuclear Facilities

This report documents a review by members of the staff of the Defense Nuclear Facilities Safety Board (Board) of lightning protection systems (LPS) at the Los Alamos National Laboratory (LANL). This review was conducted by staff members A. Gwal, W. White, C. Martin, and A. Jordan, and outside expert R. Collier. Findings were discussed with personnel from LANL and the Department of Energy (DOE), National Nuclear Security Administration's (NNSA) Office of Los Alamos Site Operations (OLASO).

Background. On September 22, 1999, the Board sent a letter to DOE, portions of which detailed issues such as the installation of a lightning detection and warning system to allow more reliable shutdown of vulnerable operations during lightning storms, testing of the insulation properties of certain components (e.g., hoist slings, vacuum lines), and updating of the existing authorization basis to address the revised requirements for mitigation of lightning hazards. NNSA responded to the Board's letter on January 9, 2001, and provided a path forward for resolving these concerns. During this review, the Board's staff assessed the progress LANL has made toward resolving these issues, and conducted a more focused review of LANL LPSs.

Lightning Protection Systems. Several criteria are used to determine the need for lightning protection for various facilities and operational conditions. Industry- and Laboratory-wide standards provide the basis for LPSs: National Fire Protection Association (NFPA)-780, *Standard for the Installation of Lightning Protection Systems*; Underwriter's Laboratory (UL)-96, *Lightning Protection Components*; UL-96A, *Installation Requirements for Lightning Protection Systems*; DOE M 440.1-1, *DOE Explosives Safety Manual*, and related documents. LANL has captured requirements for LPSs in *Criterion 507—Lightning Protection Systems* in its *Operations and Maintenance Manual*, presenting clear criteria for facility managers to follow.

To ensure consistency with the approach to lightning protection taken by the Pantex Plant, LANL has used the same experts from Sandia National Laboratories (SNL) who were involved in the development of controls at the Pantex Plant, especially to evaluate lightning protection for certain explosive operations at LANL. By implementing the recommendations of these experts, LANL has been upgrading its existing LPS controls.

Lightning Protection System for Weapons Engineering and Tritium Facility—In a unique case for LANL, the LPS for the Weapons Engineering and Tritium Facility (WETF) was recently designated a safety-class system, credited with reducing the likelihood of a nuclear material release due to an explosion or fire in the facility. However, the observed material condition of this system does not appear adequate to provide the high level of lightning protection that would be expected of a safety class system. A walkdown of the LPS for the roof area of the WETF revealed numerous deficiencies, including several instances of unbonded metallic penetrations and electrical conduit. Most of these deficiencies appeared to relate to modifications made to roof systems after the LPS had been installed. In addition, WETF personnel are visually inspecting the LPS annually, which is less frequent than required by *Criterion 507—Lightning Protection Systems* for Management Level 1 and 2 (i.e., safety class) systems.

Lightning Protection System for Explosive Facilities—For certain explosive facilities at LANL, Faraday cage-type LPSs are being developed that are similar to those credited for nuclear explosive operations at the Pantex Plant. These LPSs are particularly important for facilities where the work involves high explosives with attached detonators. When those operations also involve nuclear material, it is important that the facilities provide a level of protection similar to that provided at Pantex. LANL personnel, with support from SNL, have conducted preliminary evaluations of certain key facilities at LANL. Progress has been made on bonding facility electrical penetrations and adding surge suppression to incoming electrical and telephone lines.

It is not clear, however, that LANL personnel have adequately considered all of the lessons learned at the Pantex Plant during the past few years. As of the staff's review, slings used for hoisting had not been evaluated for electrical isolation characteristics. Also, the staff observed penetrations from low-voltage circuits that were not bonded or surge-suppressed. Additional issues related to specific explosive facilities are outlined below.

Buildings TA-8-23 and TA-16-411—SAND99-0233, *Low-Level, Measured Response of Los Alamos National Laboratories TA 16–Building 411 and TA 8–Building 23 to Direct Flash Attachment of Lightning* (dated February 1999), provides an initial analysis of the effectiveness of the partial Faraday cage configurations of Buildings 23 and 411. However, the measurements were made under conditions that included incomplete bonding of gaps and penetrations. In addition, the tests were conducted for frequencies at and below 1 MHz. Data in the 1 to 10 MHz range, which covers important spectral content of the average lightning strike, and where magnetic coupling to critical assets would be more pronounced, are not available. The levels of vulnerability of critical assets to excitation from magnetic coupling have not yet been determined.

Walkdowns by the staff revealed large-diameter penetrations and incomplete bonding (floor to wall and wall to ceiling) in Building 411. Building 23 exhibited external bond straps, door seams, gaps at window screens, inadequate surge protection on power and phone lines, unanalyzed interior structural elements, and unbonded penetrations.

Lightning Protection Systems for Other Nuclear Facilities—For nuclear facilities in which the authorization basis does not require lightning protection as a safety system or permit the use of explosives, LANL normally requires LPSs that are compliant with NFPA-780. However, numerous reviews during past years by both DOE and LANL personnel indicated that the LPSs currently installed were not being adequately maintained.

During its review, the Board's staff observed that LANL has made progress in qualifying lightning protection inspectors and conducting inspections of facility LPSs. Lightning protection inspections are, in most cases, conducted by personnel from Facility and Waste Operations Division (FWO), using an FWO inspection procedure. The personnel carrying out these inspections appear to be doing so in a reasonably thorough manner. Identified deficiencies, however, are not necessarily being addressed in a timely manner. At the Chemistry and Metallurgy Research Facility (CMR), for example, work was only recently initiated on correcting a significant number of deficiencies identified in several inspections performed during the last few years. One of the major deficiencies in CMR was a large section of roof that lacked air terminals and cables. The Board's staff also observed other existing deficiencies, including unbonded penetrations and a large unbonded walkway and ladder section. Walkdowns of TA-48 and TA-55 also revealed potential deficiencies related to lack of lightning protection for stacks, instrument lines, and other roof appurtenances.

Lightning Detection and Warning Systems. LANL has no site-wide lightning detection and warning system. Because of its topography and location near a mountainous ridge, weather can vary widely on the laboratory's 43 square miles, and storms sometimes form directly above or near outdoor activities. Advance notice of approaching lightning is currently provided by a number of different means for different facilities and operations. These means range from audio/visual observations to electric field mills to the use of real-time lightning data from the National Lightning Detection Network (NLDN). Among the more comprehensive systems in place at the laboratory is that used by the Dynamic Experimentation Division (DX). This system includes four field mills and a connection to the NLDN. Elements of this system, perhaps in combination with other technologies used by the meteorology group at LANL, could be used to develop a comprehensive system that would provide site-wide coverage.

LANL also has not developed clear criteria to be used to determine when a lightning warning should be issued. (For example, the Pantex Plant developed warning criteria based on such factors as the time needed to complete a weapon transportation operation and the nominal rate of advance of panhandle area thunderstorms.) Such criteria would need to be evaluated to ensure that they provide sufficient notification to allow safe termination of ongoing operations that are vulnerable to a lightning strike, or implementation of controls for operations that cannot be abandoned safely in place. In particular, the Board's staff reviewed recent data for the DX Division and the Dual-Axis Radiographic Hydrodynamic Test (DARHT) facility, which indicated that the current criteria for lightning warning may not allow sufficient time to safely suspend certain operations that cannot be abandoned.