DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004-2901
(202) 694-7000

January 14, 2000

Mr. W. Lee McVey
194 Freedom Court
Fremont, CA 94539-6267

Dear Mr. McVey:

Thank you for your letter of December 3, 1999, concerning the normal electrical distribution system at Lawrence Livermore National Laboratory (LLNL). In this letter, you have delineated design changes that could enhance the reliability of the electrical utility system. The Board's staff has also reviewed the electrical distribution system at LLNL and reported observations quite consistent with yours. However, the Board's staff review was somewhat more narrowly focused.

The focus of electrical safety reviews performed by the Defense Nuclear Facilities Safety Board (Board) and its staff is typically on safety-class and safety-significant emergency power systems. Because the normal electrical distribution system is not designed to withstand design basis events, e.g., earthquakes, it is assumed to fail, regardless of how reliable the system might be. Safety-class emergency power systems are required to supply power to safety-class loads during any loss of off-site power, even under accident conditions. However, as you mentioned in your letter, the design of the normal electrical distribution system should ensure that it is as reliable as can be reasonably achieved. This reliability typically includes providing power to the site from two independent, off-site sources.

The review of the Building 332 electrical distribution system mentioned in your letter was performed by members of the Board's staff on October 12–14,1999. For reasons discussed above, the emphasis of this review was on the emergency power system, which is designated as a safety-class system in the Building 332 Safety Analysis Report (SAR). The Board's staff concluded that the safety-class emergency power system does not meet current nuclear industry requirements for safety-class systems. It has several deficiencies related to single failure, redundancy, and physical separation. Detailed observations of the Board's staff are documented in a staff issue report of November 23, 1999. The Board sent a letter to the Department of Energy (DOE) on December 21, 1999, that encloses this report and asks DOE-Headquarters to keep the Board abreast of DOE's action regarding the issues discussed in this report.

Enclosed are the Board's letter and the staff issue report for your information. Other Board letters and staff reports are posted on our web site (www.dnfsb.gov) subsequent to their transmittal to DOE. I appreciate that you took the time to communicate your observations to the Board.

Sincerely,

John T. Conway
Chairman

c: Mr. Mark B. Whitaker, Jr.

Enclosures

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004-2901
(202) 694-7000

December 21, 1999

Brigadier General Thomas F. Gioconda
Acting Assistant Secretary for Defense Programs
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0104

Dear General Gioconda:

Enclosed for your consideration and action, as appropriate, are observations developed by members of the staff of the Defense Nuclear Facilities Safety Board (Board) concerning electrical, instrumentation and control, and fire protection systems and the year 2000 (Y2K) program at Lawrence Livermore National Laboratory (LLNL). In the enclosed report, the Board's staff concludes that LLNL's safety-class emergency power system does not meet current safety-class standards. Also, the preventive maintenance and calibration program for the emergency power system does not appear to be adequate. The Board is concerned that this safety-class system is neither designed nor maintained to safety-class standards. The staff's report also notes other potential areas for improvement, particularly LLNL's Work Smart Standards for safety-related instrumentation and control systems and lightning protection for Building 332.

The Board asks to be kept abreast of the Department of Energy's actions regarding the issues discussed in the enclosed report. Please feel free to contact me if you have any questions on this matter.

Sincerely,

John T. Conway
Chairman

c: Mr. Mark B. Whitaker, Jr.
Dr. James Turner

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

November 23, 1999

MEMORANDUM FOR: G. W. Cunningham, Technical Director
J. K. Fortenberry, Deputy Technical Director

COPIES: Board Members

FROM: A. K. Gwal

SUBJECT: Electrical, Instrumentation and Control, and Fire Protection Systems and Year 2000 Program at Lawrence Livermore National Laboratory (LLNL)

This report documents a review by members of the staff of the Defense Nuclear Facilities Safety Board (Board) of the electrical, instrumentation and control, and fire protection systems and the year 2000 (Y2K) program at Lawrence Livermore National Laboratory (LLNL). This review was conducted by staff members A. Gwal, W. White, A. Matteucci, and J. Deplitch on October 12–14, 1999. The report also reflects the results of a follow-up review of documents provided to the staff and a telephone conference held on November 10, 1999, with personnel from LLNL and the Department of Energy's (DOE) Oakland Operations Office.

The staff reviewed site-wide requirements for electrical, instrumentation and control, and fire protection systems. The staff also reviewed the adequacy of site-wide requirements for fire protection and implementation of fire protection codes and standards, noting no significant problems. In addition, the staff toured Buildings 332 and 334 to evaluate the design of electrical distribution systems and observe the installed condition of equipment related to electrical, instrumentation and control, and fire protection systems.

Site-wide Requirements for Electrical, Instrumentation and Control, and Fire Protection Systems. The Board's staff reviewed the adequacy of LLNL's Work Smart Standards and laboratory requirements related to electrical, instrumentation and control, and fire protection systems. Although the current LLNL standards (through a requirement to comply with DOE Order 420.1) provide direction on the design of safety-class and safety-significant electrical and fire protection systems, there are no standards related to the design of safety-class or safety-significant instrumentation and control systems. This lack of identified standards may be due, in part, to the fact that none of the team members developing the Work Smart Standards had any significant design experience with safety-related electrical or instrumentation and control systems. For future safety-related instrumentation and control systems, it would be prudent for LLNL to consider the application of appropriate industry standards from such

organizations as the Instrument Society of America and the International Electrotechnical Commission.

Emergency Power Systems. The Board's staff evaluated the design of the electrical distribution system for Building 332. The emphasis of this review was on the emergency power system, which is designated as a safety-class system in the Building 332 Safety Analysis Report (SAR). The safety-class power system at Building 332 provides reliable power to the safety-class glovebox exhaust system, downdraft ventilation system, room exhaust system, room supply system, and fire protection system. It consists of two emergency diesel generators, automatic transfer switches (ATSs), and one uninterruptible power supply (UPS) for the facility's vital facility emergency systems. An additional emergency generator, with ATS and UPS, is used for security. The staff noted the following issues with this safety-class emergency power system:

- The safety-class emergency power system does not meet current nuclear industry requirements for safety-class systems. It has several deficiencies related to single failure and redundancy (Institute of Electrical and Electronics Engineers [IEEE] Standards 308 and 379) and physical separation (IEEE Standard 384). For example, all emergency power supplies go through a single switchgear.

- During the staff's visit, LLNL facility management and engineering personnel were unable to provide evidence of a program for preventive maintenance and calibration of the safety-class relays. The staff was informed after the site review that a calibration program does exist for 600-volt and higher equipment. LLNL is in the process of developing a reliability-centered maintenance program for the lower-voltage equipment. This program is scheduled to be in place by January 2000.

- While examining key components (such as transformers) of the safety-class electrical power system, the staff noted that some of the older electrical equipment had questionable seismic support. Recently upgraded equipment, such as emergency motor control centers and ATSs, appears to be well supported. LLNL personnel were unable to locate seismic calculations for many of the older components (such as transformers) of the safety-class electrical system. Calculations generated after the staff's visit confirmed that for certain safety-class transformers, the existing seismic support was inadequate. LLNL continues to evaluate the seismic support for existing safety-class electrical equipment and for non-safety-related equipment (such as overhead pipes) whose failure might impact the safety-class electrical system. According to LLNL personnel, the calculations and any modifications necessary to correct deficiencies should be completed by April 2000.

- The staff reviewed two fault tree models in the Building 332 SAR, identifying failure and fault modes related to the electrical power system. The top events for these models are "Loss of HVAC," which includes as a subtree "Loss of Building (332) Power," and "Glovebox Integrity Failure." These fault trees appeared to be

reasonable in terms of the types of top events, the types of fault or failure modes considered, and the overall top event probabilities. The assumptions and limitations of the analysis, however, were not readily apparent. This SAR was produced in 1994–1995, and it would appear appropriate to update the assessment and related documentation to address past and current operational conditions and experiences. A sound technical basis supporting the reliability of the safety-class electrical power system is especially important given the system's deficiencies with respect to safety-class electrical standards.

Lightning Protection System. For Building 332, the Board's staff observed that the lightning protection system does not meet the requirements of National Fire Protection Association (NFPA) standard NFPA-780, *Lightning Protection Code.* The few existing components of a lightning protection system that are installed are not maintained. LLNL is currently evaluating the need for lightning protection for this facility. The staff believes a lightning protection system in accordance with NFPA-780 would be appropriate for Building 332.

Y2K Program. The staff conducted a follow-up review of the LLNL Y2K program, previously reviewed in December 1998. The staff's observations from the prior review were forwarded to DOE along with the Board's January 8, 1999, reporting requirement on Y2K evaluations of safety-related systems. Since the staff's previous visit, LLNL personnel have identified their safety-related systems in accordance with DOE's revised instructions. The level of documentation for the actual evaluations and the rigor of system test plans were not as stringent as for mission-essential systems. However, it is unlikely that LLNL will experience any adverse effects due to Y2K anomalies, given the age of the safety-related equipment at the laboratory (e.g., the typically analog nature of most systems), the fact that at least some minimal testing was done for all systems with a date function, and the existence of adequate measures to compensate for the failure of any safety system.