DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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March 28, 2005

The Honorable Linton Brooks
Administrator
National Nuclear Security Administration
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0701

Dear Ambassador Brooks:

On July 1, 2003, the Defense Nuclear Facilities Safety Board (Board) sent you a letter relaying observations related to electrical and lightning protection systems for several facilities at the Nevada Test Site (NTS). In your response of May 14, 2004, you presented a reasonable approach to addressing many of the issues raised in the Board's letter. Recently, the Board's staff conducted a review of the status of these issues. Enclosed for your information and use, as appropriate, is a report prepared by the Board's staff that provides observations on the actions taken to date.

The Board is also concerned about the slow progress in developing and moving forward with a defined action plan for addressing known problems with G-tunnel, the NTS facility proposed for handling damaged or improvised nuclear devices under certain emergency circumstances. Although the Nevada Site Office (NSO) has initiated actions to address some of the specific issues raised by the Board with respect to the ventilation system for G-tunnel, numerous issues noted by the Board or by NNSA and its contractors remain unresolved.

NNSA needs to move forward aggressively to ensure the adequacy of G-tunnel for its mission. Accordingly, pursuant to 42 U.S.C. §2286b(d), the Board requests within 120 days that NNSA identify the desired conditions of readiness for G-Tunnel, including facility and equipment improvements, and provide its plan and schedule to establish those conditions. In addition, the Board asks to be kept informed regarding the status of actions to address the other issues noted in the enclosed report.

Sincerely,

John T. Conway
Chairman

c: Mr. Mark B. Whitaker, Jr.

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

FROM: A. Gwal

SUBJECT: Electrical and Lightning Protection Systems at the Nevada Test Site

This report documents a review of electrical and lightning protection systems at the Nevada Test Site (NTS). Members of the staff of the Defense Nuclear Facilities Safety Board (Board) J. Deplitch, A. Gwal, and W. White visited NTS January 25–27, 2005, to review electrical and lightning protection systems for the U1a Complex, Device Assembly Facility (DAF), G-Tunnel, Joint Actinide Shock Physics Experimental Research Facility, and Radiological Waste Management Complex (RWMC).

Background. On July 1, 2003, the Board sent a letter to the National Nuclear Security Administration (NNSA) identifying issues related to the electrical and lightning protection systems in the U1a Complex, DAF, G-Tunnel, and Joint Actinide Shock Physics Experimental Research Facility at NTS. In May 2004, nearly a year after the Board's letter, NNSA responded by committing to address many of these issues. The staff's review in January 2005 was conducted in part to follow up on NNSA's commitments. The staff found that, with some exceptions, little progress had been made in addressing issues raised by the Board in its July 2003 letter.

U1a Complex. The Board raised issues regarding the need to ensure that certain activities conducted at U1a are adequately protected from the hazards posed by lightning. In response, NNSA committed to several actions, most of which were completed prior to NNSA's May 2004 response. These actions included adding U1a to the NTS Hazardous Weather Notification List; notifying U1a of all lightning strikes within 10 miles of the complex, regardless of ongoing activities; and revising and updating the Lightning-Personnel Safety procedure (OP-2003.009).

NNSA also noted in its May 2004 response that the "Safety Evaluation Report SER for the Los Alamos National Laboratory and Lawrence Livermore National Laboratory Subcritical Experiment Bounding Hazard Analysis and Technical Safety Requirements" established a condition of approval requiring that a safety-significant lightning protection design feature be developed for above-ground delivery of subcritical experiments to the U1a Complex. The development of such a safety-significant design feature has not been accomplished, and Nevada Site Office (NSO) personnel were unaware of any ongoing effort to that end.

The Board also raised issues concerning the potentially excessive combustible loading represented by legacy diagnostic and power cables within the U1a Complex. NNSA committed

to completing a study to address the probability of a fire within the U1a Complex leading to a fire in the legacy cables. This study was finalized 5 days before the staff's review began in January 2005, but does not appear to have been changed significantly since NNSA discussed the report in its May 2004 response to the Board. The study concludes that the cumulative, conditional probability of an accident involving a load haul dump (LHD), used for underground earth moving, is about the order of magnitude of 1×10^{-2} per year.

Operational history for 2004 indicated at least five incidents associated with LHDs, one of which involved the LHD rolling over and leaking fuel oil. The frequency and significance of these events were significant enough to warrant a stand-down of LHD operations in 2004. The report also discounts the probabilities of fires from cable failures.

The Board's staff concluded that the study had likely underestimated the frequency of fires in the legacy cables. As a result, the staff believes it would be advisable for NNSA to consider additional measures to either prevent or mitigate the hazards associated with this scenario. In particular, NNSA ought to consider implementing a policy to remove existing legacy cabling, particularly that associated with completed activities, to limit the growth of the combustible loading in the U1a Complex. It would be advisable as well to consider implementing additional controls when LHDs are operated in the vicinity of legacy cabling (e.g., applying fire-retardant coatings or wraps on the bundle of cables along frequently traveled routes or establishing temporary fire watches).

The Board's staff also reviewed the list of cables in the report and observed the presence of several power cables in the bundles of legacy cables. Power cables are capable of initiating fire as a result of the failure of insulation or jacket material due to age-related degradation and other electrical short-circuit-related failures. The report assumes that a short-circuit in the power cable would trip the circuit breaker and stop further heat generation. However, the electrical systems at the U1a Complex are neither designed nor required to be safety-class. The failure of a breaker could result in the initiation of a fire. The Board's staff believes the use of fire wraps or fire-retardant coatings on the selected legacy bundles of cables ought to be considered, with particular attention to the effect of the fire wraps or coatings on the ampacity derating of the power cables in the legacy bundle and the structural support system.

Device Assembly Facility. The staff agreed to postpone its request to evaluate electrical and lightning protection systems at DAF during this review so that DAF personnel could concentrate on a separate, ongoing contractor Operational Readiness Review related to critical experiment facility activities. The staff was able to walk down the DAF facility during the review, however, and address the status of other issues raised in the Board's previous correspondence. Issues related to the calibration of protective devices and the pressure alarm systems are considered resolved. The issues discussed below remain open.

Lightning Protection—In July 2003, the Board noted the importance of capturing and crediting all elements of the lightning protection system in the new Documented Safety Analysis (DSA). NNSA's response in May 2004 noted that the DAF DSA, which was finalized in

September 2003, captured many of the items of concern to the Board. The staff will review specific applications to any proposed nuclear explosive operations as part of its review of the safety basis for the proposed operation.

Uninterruptible Power Supplies (UPSs)—The Board's July 2003 correspondence identified the possibility that inadvertent actuation of the fire suppression system could impair or disable the safety-significant UPSs. In its response, NNSA agreed to initiate a change request to determine the best method of protecting the UPSs, and to complete the work associated with the change request by the end of fiscal year 2004. Although DAF has made progress in evaluating potential modifications to the UPSs to address this issue, the work has not been completed.

Oil-Insulated Transformers—In its July 2003 correspondence, the Board noted issues associated with the two oil-insulated transformers located inside the DAF structure. The DAF transformers are collocated with other electrical equipment, and a fire in the transformers could impact the facility and this equipment. NNSA agreed to replace the oil in the transformers with a less flammable fluid by the end of calendar year 2004. This effort is under way, but has not been completed.

G-Tunnel. The Board raised several issues related to the ventilation system for G-tunnel in 2003, including damaged power cables and antiquated fan motor controllers. In response, NNSA agreed that the long-term operability of the ventilation system is questionable and committed to evaluating the system thoroughly. NNSA and Bechtel Nevada personnel provided additional information to the staff during its January review.

To address the issues raised by the Board, Bechtel Nevada evaluated the ventilation system, and the most deteriorated ventilation ductwork inside the tunnel is currently being replaced. The following additional design modifications to the ventilation system are also under consideration:

- An automatic system to shut down the ventilation system upon detection of device detonation
- Replacement of the fan/starter system
- Installation of four new in-line ventilation fans

Bechtel Nevada personnel also presented the staff with a list of improvements being considered for electrical and lightning protection systems in G-Tunnel:

- Completing a detailed survey to confirm that no continuous electrical pathways exist to the device within the disposition alcove
- Completing a Faraday cage in the disposition alcove

- Removing underground legacy cabling
- Installing a lightning detection system
- Installing a portal grounding grid
- Installing backup power to the tunnel complex
- Installing a tunnel air quality monitoring system

In addition to the improvements above, the G-Tunnel DSA and Safety Evaluation Report (SER) identify numerous other improvements for nuclear explosive safety and for lightning, electrical, fire, and shock impact hazards.

The necessary improvements to support G-Tunnel readiness appear to exceed available resources. The staff saw no evidence of a comprehensive project plan that prioritizes potential improvements based on the cost and risk reduction they would provide. On February 11, 2005, after the staff review, NSO requested that Bechtel Nevada develop an implementation plan for the G-Tunnel TSRs. While it is important to begin implementing the control set in the TSRs, it would also seem prudent to have a project plan and path forward that integrate all necessary improvements on an appropriately prioritized basis.

Site-wide Lightning Detection and Protection. The Board's July 2003 correspondence raised two issues related to site-wide lightning detection capabilities at NTS. First, the staff noted that no technical basis exists for assuming that the thresholds used for lightning alerts provide sufficient time to suspend at-risk operations. The staff also noted the need to establish adequate lightning detection capabilities and documented controls for all facilities for which lightning could pose an operational hazard.

NNSA's response did not address the issue of the technical basis for lightning alert distances. In discussions during the staff's most recent review, the staff suggested that NTS personnel might consider evaluating historical alert information to determine the range of advance warning times being provided by the current alert distances. This would make it possible to either justify the existing alert distances or provide a basis for alternative distances.

In its response, NNSA did address the issue of the need to establish clear and well-documented lighting controls for all impacted facilities. NNSA agreed to establish a Lightning Focus Group to take several actions, primary among these being to develop a site-wide policy for lightning safety and to complete a study on the effectiveness of field mills as part of the lightning detection system at NTS. The Lightning Focus Group appears to consist of a single NSO person. The policy is still under development, and no scope of work has been defined for the proposed study on the effectiveness of field mills.

Radioactive Waste Management Complex. The staff reviewed the lightning protection systems at RWMC. While preparing for the staff's review, RWMC personnel had noted that they were not conducting required preventive maintenance for the facility's lightning protection system. The visual inspection was conducted just prior to the staff's review, and the electrical inspection is in progress. Personnel at RWMC committed to capturing the maintenance requirements in a preventive maintenance procedure.

Summary. Nearly 2 years has passed since the Board's original review, and more than 8 months has passed since NNSA's response. A significant number of the action items to which NNSA committed remain unfinished. The staff discussed this lack of progress with the NSO Manager, who agreed that these actions would be tracked more closely in the future.

The staff also discussed the need to develop an approach for lightning protection of G-tunnel before committing to capital expenditures aimed at improving lightning protection for the facility. NSO agreed and committed to including lightning protection enhancements among the list of facility items to be prioritized and funded as part of the ongoing readiness effort.