Department of Energy
National Nuclear Security Administration
Washington, DC *20585*

May 14,2004

OFFICE OF THE ADMINISTRATOR

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W.
Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

In your July 1,2003, letter you asked to be kept abreast of the National Nuclear Security Administration's actions taken in response to issues raised by your staff during a review of electrical and lightning protection and detection systems for facilities at the Nevada Test Site. Enclosed is a response that was prepared by our Nevada Site Office and provided informally to your staff. I think the enclosed response represents a reasonable approach to addressing issues raised in your letter. If you have any questions, please feel free to contact Ms. Kathy Carlson, or have your staff contact Mr. John Leppert at the Nevada Site Office at 702-295-1553.

Sincerely,

Linton F. Brooks
Administrator

Enclosure

cc: K. Carlson, DOE-NSO
M. Whitaker, DR-1

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APR 15 2004

Everet H. Beckner, Deputy Administrator for Defense Programs, NNSA/HQ (NA-10) FORS

REVIEW OF ELECTRICAL AND LIGHTNING PROTECTION AND DETECTION SYSTEMS FOR FACILITIES AT THE NEVADA TEST SITE

Reference letter dated November 20,2003, subject as above.

Subsequent to the referenced letter, there were further discussions between your staff, Defense Nuclear Facilities Safety Board **(DNFSB)** staff, and the Nevada Site Office regarding some **of** the items in our response. As a result, we have clarified portions and are resubmitting our response (enclosed). **My** office has discussed this issue with Jack Deplitch, the DOE DNFSB site representative, and he had no major objections. However, Mr. Deplitch indicated there were several items he intends to follow **up** with during his next visit.

If you have any questions, please contact me at **(702)** 295-3211 or John L. **Leppert,** Acting Director for Stockpile Stewardship Division, at **(702)** 295-1144.

Kathleen A. Carlson
Manager

STD:JLL-04054
SHM 07-01

Enclosure:
As stated

cc w/encl:
Xavier Ascanio, NNSA/HQ (NA-124) GTN
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Response to Specific Issues
Attachment to the July 1, 2003 letter from the DNFSB Chairman
to the Administrator, NNSA

U1a:

Lightning Detection Capabilities—U1a is not capable of detecting locally forming storm cells, such as the one that caused the October 1, 2002, occurrence. Given this deficiency in the facility's lightning detection and warning capability, it is not clear that certain special activities conducted at U1a are adequately safe from lightning threats. U1a personnel are investigating the implementation of field mills to detect locally forming storms that could produce lightning events. Until these devices are installed and can be effectively utilized, however, it appears that compensatory measures are required to ensure nuclear and explosive safety during U1a operations.

The Nevada Test Site (NTS) has a lightning detection system that provides real-time data on the location of lightning strikes. This information is documented by the National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory/Special Operations and Research Division (ARL/SORD) Duty Forecaster and made available via the ARL/SORD website. In addition, other resources such as weather satellite and radar are available in the preparation of weather forecasts. These are complied and disseminated in accordance with the ARL/SORD "Station Duty Manual, Volume 11, Routine Duties" and the "Hazardous Weather Notification Procedure." Hazardous weather advisories, which include NTS lightning alerts, are broadcast via all radio nets in addition to telephonic notification to specific facilities. The U1a Complex has a site specific procedure (OP-2003.009, Lightning-Personnel Safety) in place that specifies actions to be taken when "lightning activity or conditions exist that may produce lightning." For worker safety, lightning within 10 miles of the U1a Complex is the threshold for taking action. This distance exceeds the nationally recognized 30-30 rule which recommends seeking shelter when lightning is six miles away (~ 30 seconds between the lightning flash and thunder clap) and waiting at least 30 minutes after the last clap of thunder or lightning flash before resuming activities.

In the October 1, 2002 case referenced above, there were no above-ground activities involving HE and/or SNM at the U1a Complex. The ARL/SORD records show a Lightning Alert was posted on the web site at 1158 PDT and individuals on the "NTS Hazardous Weather Notification List" were contacted via telephone between 1200 PDT and 1207 PDT. At that time the U1a Complex was not on this list. As a result of this incident the following actions have been taken:

1. U1a has been added to the "NTS Hazardous Weather Notification List";
2. A notification is now made by ARL/SORD if a lightning strike is observed within a 10 mile radius of the Complex. This notification is made whether or not there are surface activities involving HE and/or **SNM.**
3. The Lightning-Personnel Safety procedure (OP-2003.009) has been revised and enhanced.

There is further discussion under the site-wide lightning detection and warning section that addresses the issue of worker safety.

In the case of subcritical experiments (SCEs), the "Safety Evaluation Report 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 (COA) requiring that a "TSR level lightning protection SSDF(s) must be developed for above-ground delivery of the SCE to the U1a Complex." Both Laboratories have established a requirement that there is no lightning within 30 miles prior to beginning delivery in response to this COA.

Legacy Cable Combustible Loading—The Board's staff observed large bundles of legacy coaxial and diagnostic cables that represent an excessive amount of combustible loading (insulation and jacket material of the cables) in the tunnel. During a fire, these cables would burn readily, allowing fire to propagate through the tunnel complex. In addition, the combustion of these materials would generate large volumes of toxic gases that could pose serious life-safety hazards to down-hole facility workers.

The combustible loading study for the U1a complex legacy cables is being prepared by BN's teaming partner (Keystone/Delphi) and is still being revised at this point to address issues raised relative to the documentation of some of the supporting information, and other comments relating to facility operations. However, the study addresses the probable risk associated with a fire in the U1a Complex leading to a fire in the legacy cables. The determination thus far is that this event is in the beyond extremely unlikely or incredibly unlikely range (on the order of 1.8E-7). Thus, the report concludes that the existing equipment design and administrative controls are adequate, and no facility modifications are warranted to address this issue. There is no firm date at this time for submittal of the study.

As far as the issue of having power cables mixed in with the diagnostic cables is concerned, the belief is that it is very unlikely that this has occurred, but not inconceivable. The only way to demonstrate that this has not occurred is to trace the individual cable bundles out to assure that there is no intermixing and, if necessary, open the diagnostic cable bundles up at discrete locations. BN Engineering is continuing to actively investigate issues relating to legacy diagnostic and power cables in the U1a Complex.

Device Assembly Facility (DAF):

Lightning Standoff Distance—The staff observed that the lightning standoff, including detailed information on the proper use of qualified, process-related isolation devices, is not adequately captured in the existing Safety Analysis Report (SAR). The establishment of sufficient clear-air standoff distance is an essential component of the lightning

protection philosophy currently employed at this facility. Although a variety of documents and reports (including the Nuclear Explosive Safety Master Study and Single Integrated Input Document) provide detailed information in this area, required standoff distances are not expressly delineated in the existing SAR. In addition, electrical isolation devices are not credited and functionally classified relative to this important safety function.

It is unclear how standoff requirements and other important components of the lightning protection philosophy will be codified in the upcoming DAF Documented Safety Analysis (DSA) being developed to comply with the mandates of Part 830 to Title 10 of the Code of Federal Regulations, Nuclear Safety Management. To ensure nuclear and explosive safety at the DAF, the results of existing reports and analyses should be used to clearly capture and appropriately credit all elements of the lightning protection system in the new DSA.

The DAF *SAR* documents the standoff from the floor (2 ft.) and wall (3 ft.), while the Nuclear Explosive Safety (NES) Single Integrated Input Document (SIID) provides standoff only for the wall (3 ft.). The DAF DSA, section 3.4.2.7, Lightning Induced Accidents, provides a comprehensive discussion of lightning-energy-related threats to DAF operations both outside and inside the facility. Potential insults include: direct lightning strike (outside), induced currents through electrical connections, mechanical connection, and electrical arc. Hazards analysis has been performed for various scenarios and the results documented. Supporting studies for this analysis include the NES **SIID,** Pantex Site SAR, and other studies. The lightning standoff distance has been identified explicitly in the hazard analysis for the new DSA as an important administrative control requiring explicit coverage in the Technical Safety Requirements (TSRs) because of its role in preventing electrical insults during lightning events to high explosives with the potential for high-explosion violent reaction (HEVR). Section 5.6.10 of the TSRs has "maintain at least a 3-ft distance between significant amounts (>2 lb) of HE and the Affected Building walls" as a key element of the Explosive Safety Program.

Unprotected Uninterruptible Power Supply (UPS)—Three large UPS units are relied upon to provide emergency power to important systems throughout the facility (e.g., emergency lighting, radiation air monitors, and blast door interlocks). These UPS units are located in the electrical room and are constructed with partially open top panels that provide heat dissipation. The orientation of these units is such that they sit directly beneath sprinkler heads of the fire suppression system. Given the partially open upper panels, water spray from the sprinkler system during a fire or a spurious activation would penetrate the UPS equipment and could initiate water-induced short-circuiting, a common-cause failure that would leave emergency loads without uninterruptible emergency power.

An engineering design is in process to determine the best method for prevention of fire suppression water entering into the vents on the top of the *UPS* units. Change Request #DAF-CT-0861 has been initiated to resolve this issue. The Change Request will be implemented through the normal configuration management process and executed as

funding becomes available. It is anticipated this work will be completed by the end of FY 04.

Calibration of Protective Devices — To ensure reliable operation, Institute of Electrical and Electronic Engineers (IEEE) Standard 242-2001, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems, recommends that electrical protective devices be maintained and calibrated in accordance with manufacturer's instructions. During a walkdown of the electrical room, the Board's staff observed that the calibration date had expired by several years for many of the protective devices. DAF personnel stated they would verify that required calibrations had been performed or perform the calibration tests on the expired relays to ensure that they will operate within allowable limits.

The requirement for calibration of the Siemens Westinghouse SPB-100 breakers and ground fault relays has been researched. Based on conversations with the manufacturer's Senior Account Manager, the tolerance of the relays will vary over time and require maintenance and calibration at a regular basis with a periodicity dependent upon service and environment conditions (generally 3 to 4 years). This activity has been incorporated into the DAF preventive maintenance program to ensure it is performed during the recommended intervals.

Pressure Alarm — Compressed air is required for closing and opening of critical cell and bay doors. Compressed air accumulators have pressure gauges, but no alarms annunciate in the controller operator's room upon loss of air or low pressure. Compressors for the air accumulators are located outside the main DAF building. If pressure were lost during operations, however, manually opening the doors during an emergency would be difficult. Procedural administrative controls exist at the DAF to check for air pressure prior to any operation. An alarm to annunciate low air pressure would provide a more reliable system for determining the operability of these critical cell and bay doors.

Metasys, the DAF automated energy management system, provides a low air pressure alarm function. Additional defense-in-depth features include: a Metasys alarm if one of the three compressors fail and the existence of an air tank at each building that allows five cycles of the door. These features provide adequate assurance for egress from DAF facilities during emergency conditions.

Oil-Insulated Transformer — Two oil-insulated transformers located inside the DAF structure are parts of the facility power distribution system. The transformer oil provides cooling for the transformer. Because the oil is flammable, it poses a fire hazard should the transformer leak or fail catastrophically. American National Standards Institute (ANSI) C2, National Electrical Safety Code, and National Fire Protection Association (NFPA) 70, National Electric Code, require that indoor oil-insulated transformers be located in a separate transformer vault. The code requirements for the transformer vault include fire walls and doors, ventilation, and oil containment. The DAF transformer is collocated with other electrical equipment, and the fire wall is breached by several

cables in metal trays that are routed through the room. In addition, the cables could be damaged during a fire, and the loss of any function they provide needs to be evaluated.

A recent safety walk down of the transformer room determined that DAF transformers are currently located in a transformer vault that provides a minimum fire resistance of three hours. Fire dampers are provided in ventilation openings. Penetrations have an approved fire rated sealant. At this time a few require resealing which will be accomplished as part of the scheduled maintenance. Oil containment (curb/dike) is provided with a line that drains to an underground tank in the DAF forecourt. The transformer vault meets the National Electrical Code handbook (1999) requirements. The oil in the transformers was sent to a laboratory to verify the material and the report is being evaluated against applicable codes and standards. The walk down noted combustible items being stored in the transformer room. Further evaluation has determined the items in question could remain if the transformers contain "Less Flammable" fluid. **A** change request is being processed to change the transformer fluid to a "Less Flammable" fluid. This change out should be completed by the end of this calendar year.

There are a few cables that enter the transformer room per design. Two of the cables are for the Plant Announcement and lighting systems that are provided for the transformer room. **A** fire alarm cable is also provided for a speaker in the transformer room and adjacent corridor. Another cable that traverses the room supports the Radiation Alarm Monitoring System. The remaining cables are associated with the power distribution system and transformers in the room. The potential impact of a fire in the transformer room is expected to be mitigated by the installed fire suppression system and fire barriers and was not identified as a vulnerability in the DAF Fire Hazards Analysis or Documented Safety Analysis. The Safety Basis Implementation Plan for the DAF will ensure applicable contractual requirements are implemented (e.g., NFPA 70 – National Electric Code) in accordance with NNSA expectations.

G-Tunnel.

Ventilation System – Electric motors, motor controllers, and power cables (which are located outdoors) at G-Tunnel are old and degraded. The Board's staff observed severely damaged power cables, some with badly cracked jacket material, installed and routed through open vertical conduits. Water may have entered through these open conduits and deteriorated the electrical characteristics of the cable. The ventilation fan motor controllers were observed to be quite antiquated and exhibited a good deal of age-related wear. As a result, it was not clear that these components could be relied upon to perform their intended life-safety function. Given concerns regarding worker life-safety, it would be prudent to evaluate the complete ventilation system, including electric motors, controllers, cables, and the installed ventilation ducts inside and outside the tunnel.

The cables that were identified at the time of the walk-through were inactive cables and were abandoned sometime in the 1980's. Rather than cut the conduit and cable off flush

with the concrete pad, BN personnel installed a small water-tight enclosure over the protruding conduit. No further action is required.

Failure of the system would not cause an imminent life-safety issue. In the event of a failure, personnel would make an orderly evacuation of the underground complex. All systems will be shut down with the exception of utility power, compressed air, and water. If required, operations could actually continue underground during a ventilation system failure providing there is continuous monitoring by Industrial Hygiene personnel and contaminant-producing equipment is eliminated. In the event of a ventilation system failure coincidental with an underground emergency, personnel would don their self-rescuers and report to the refuge chamber, exactly as they would with the ventilation system operating. **A** dedicated compressed air line supplies fresh air to the refuge chamber.

The ventilation system is antiquated and its continued, long-term operability is questionable. A thorough evaluation of the ventilation system is prudent; however; given the age of the system components, better use of limited funding would be to prepare a proposal to replace the entire fan/starter system and evaluate the ventilation ductwork for segmented replacement. The current estimate for this work is $1 million.

Site-wide Lightning Detection arid Protection *The B l'. staff th s general observations regarding lightning detection, warning, and protection capabilities of the nuclear facilities at NTS.*

Several facilities at NTS, including the DAF, JASPER, and U1a, perform operations in which SNM is collocated with significant quantities of HE. To protect these operations from lightning-related insults, both the DAF and U1a employ a IO-mile lightning proximity threshold. A strike inside this boundary triggers a halt-work order and the initiation of measures aimed at placing potentially vulnerable assemblies in a lightning-safe configuration and location. Unlike the Pantex Plant, however, DAF and U1a do not appear to have a defensible technical basis for ensuring that a IO-mile threshold can provide adequate forewarning to make potentially sensitive assets lightning-safe. Pantex uses a 35-mile lightning proximity threshold to declare cessation of nuclear explosive ***work.*** *This threshold was derived from thorough evaluations predicting worst-case shutdown times for all approved nuclear explosive operations. It appears that this type of evaluation, or some other technically rigorous analysis, is warranted and necessary to ensure nuclear and explosive safety at the NTS facilities.*

Lightning scenarios could initiate high-consequence accidents at NTS facilities where operations (normal or otherwise) involve SNM collocated with HE. Some operations involving SNM and HE could commence at various NTS facilities with little or no forewarning. However, not all of the facilities that could potentially house these operations are currently equipped with adequate lightning detection capabilities or well-documented lightning protection controls. It would be prudent to devise and ready

for operation compensatory measures designed to mitigate potential lightning hazards until robust lightning detection and protection programs have been adequately documented and implemented at affected onsite facilities.

The Lightning Focus Group (LFG) is planning several actions. The first is to develop a site-wide policy on lightning safety which will require selected facilities prepare procedures to address actions to be taken when lightning is present based on the risk. The second is to conduct a study on the effectiveness of field mills at the NTS. While the exact study protocol has not been developed, it is anticipated this study will take several years to complete to ensure a representative sample of thunderstorms is used to validate the effectiveness of field mills at the NTS.

Delivery of experiment packages requires no lightning within 30 miles of the DAF or U1a. For SCEs underground at U1a, procedures are in place to prevent an electrical insult from impacting the experimental package. OP-2003.009, Lightning-Personnel Safety, also specifies actions to be taken at the U1a Complex when lightning is present. The DAF has been designed as a Faraday cage and there are field mills around the facility. The field mills and ARL/SORD lightning information are monitored whenever HE operations are in progress in accordance with DAF Procedure DAF-PRC-TO-02, Lightning Threat Warning System. In addition there is a stand-off distance between the building walls and HE. There is a field mill located in Area 27 near the JASPER facility. LLNL has a procedure, NTO-NTS-308, Lightning Detection and Protection at the Nevada Test Site, covering its activities at the NTS.