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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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January 18, 2008

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

Dear Mr. D'Agostino:

The Device Assembly Facility (DAF) at the Nevada Test Site continues to implement planned activities that expand its mission, including receipt, storage, and operations involving special nuclear material; nuclear explosive operations; and the installation of equipment to perform potential criticality experiments. The Defense Nuclear Facilities Safety Board (Board) has identified major issues with the safety related fire suppression system. These issues call into question the ability of the system to perform reliably in case of need. The Board has previously expressed concerns with respect to the reliability of the DAF fire suppression system in letters to the National Nuclear Security Administration (NNSA) dated November 3, 2004, and November 28, 2005. The fire suppression system deficiencies raised in those letters remain largely unaddressed.

The Board's staff recently conducted a review of fire protection at DAF and identified several significant issues concerning the availability and reliability of safety-class and safety-significant fire protection features. The fire suppression system does not meet the typical design features for a safety-class system, e.g., redundancy to preclude a single active failure or a safety-significant system. In addition, the potential for impairment of the existing fire suppression system is not clearly defined in the DAF safety basis. These issues are documented in the enclosed report.

In the past year, the Nevada Site Office conducted vital safety system reviews, safety management program assessments, and a review of the draft update to the DAF safety basis. These efforts have also identified a list of deficiencies in the fire protection system at DAF.

The Board is especially concerned about the continuing degradation of the underground piping that supplies water to the DAF fire protection system. This degradation results in unacceptable amounts of debris in the water supply, which can adversely impact the fire protection system. The Board does not believe that periodic flushing and cleaning of strainers is an adequate strategy ensuring that the fire protection system will perform as anticipated in the

DAF Documented Safety Analysis. The Board believes this long-standing problem with the water supply piping needs to be resolved before more hazardous nuclear operations, e.g., nuclear explosive operations or criticality experiments, begin at DAF. Corrective actions and appropriate compensatory measures need to be developed and implemented promptly to address this and other issues discussed in the enclosed report, as well as deficiencies identified by Nevada Site Office.

Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests that NNSA provide a briefing to the Board within 45 days of receipt of this letter to address the following questions:

1) What actions will be taken to correct deficiencies in DAF's fire protection water supply?

2) What is the schedule to improve the reliability of DAF's fire suppression systems?

Sincerely,

A. J. Eggenberger

A. J. Eggenberger
Chairman

c: Mr. Gerald L. Talbot, Jr.
Mr. Mark B. Whitaker, Jr.

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD
Staff Issue Report

November 20, 2007

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: C. March
J. Deplitch

SUBJECT: Fire Protection at the Device Assembly Facility

This report documents a review conducted by the staff of the Defense Nuclear Facilities Safety Board (Board) of fire protection at the Device Assembly Facility (DAF) at the Nevada Test Site. To perform this review, staff members C. March and J. Deplitch met with representatives of the Laboratory Joint Nevada Test Site Program Office, Lawrence Livermore National Laboratory, National Security Technologies, LLC, and the National Nuclear Security Administration's Nevada Site Office (NSO).

Background. DAF was designed in the 1980s, with construction of the facility beginning in April 1988. Lawrence Livermore National Laboratory and Los Alamos National Laboratory took beneficial occupancy in 1996, and operations began in 1998.

DAF has a fire protection program as required by Department of Energy Order 420.1A, *Facility Safety*. Passive protection features incorporate 2-hour rated fire barriers between the various DAF buildings, creating separate fire areas, while active fire suppression consists of automatic sprinklers. The water supply for DAF is provided by a 250,000 gallon on-ground steel water storage tank located on a hill approximately 0.5 miles behind and 230 feet above DAF. A single 12-inch diameter main feeds a 10-inch diameter cement-lined ductile iron underground distribution loop, providing domestic potable, industrial, and firefighting water to DAF.

All buildings (except the parking garage, Building 510) are currently protected by automatic sprinkler systems. The systems in buildings that would support nuclear explosive operations are designated safety-class, while the systems in buildings for the downdraft table, glovebox, and Criticality Experiments Facility are designated safety-significant. DAF also has a fire alarm system to warn personnel of fires, radiation alarms, security intrusions, or gas attacks in the facility. Should any of these threats occur, the fire alarm system would respond with audible and visual warnings unique to the threat. Both levels of DAF are also provided with portable fire extinguishers and equipped with wet standpipe systems for use by the Nevada Test Site fire department.

Underground Piping. The ability of the fire protection water supply system to provide sufficient water to safety-class and safety-significant automatic sprinkler systems is a concern. During initial installation of the water distribution system at DAF (in about 1987), the 27 fire suppression system lead-in pipes were installed using coal-tar-lined steel pipe. These pipes should have been joined using mechanical fittings, but the installing contractor field-welded the joints. The welding damaged the coal-tar coating, which has subsequently been flaking off. This was first observed in about 1994, approximately 4 years after DAF was turned over to NSO. With the pipe's protective coating absent, corrosion of the interior steel pipe walls at every welded joint began and continues to this day. The loose pieces of coal tar lining material could impair the fire suppression system. Several hundred joints and several thousand feet of underground fire mains are affected.

To address these conditions until repair or replacement of the lead-ins could be accomplished, the Nevada Test Site operating contractor initially began flushing the underground mains and installed strainers in the fire protection risers. The contractor later flushed the piping within DAF to remove any material that might have lodged in the pipe before the problem was discovered. The contractor also performed internal video surveillance of representative underground piping to obtain a visual confirmation of the extent of the damage in 1995 and 2000. NSO has not secured funding to repair or replace the damaged piping since the problem was first discovered. Trending of the results of the flushing was first suggested in 1998, but did not begin until this year.

As of September 15, 2007, DAF had flushed 17 of the 27 suppression system underground mains as part of a biannual flushing requirement. Of those mains completed, the DAF system engineer considers 4 to have failed the surveillance because of excessive debris, and they are being flushed on an accelerated schedule in an attempt to remove all loose material. Building 712 underground piping has been flushed more than 10 times, with over 6 kg of debris being collected. Other poorly performing systems piping included Building 491 (1.7 kg collected), Building 492 (0.5 kg), and Building 494 (1.2 kg).

During a system walkdown, the Board's staff noted that the strainers installed in the risers are not listed or approved for fire protection service. An evaluation is needed to validate that the installed equipment meets or is equal to the requirements of National Fire Protection Association (NFPA) 13, *Standard for the Installation of Sprinkler Systems,* and NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*. Equipment that is not acceptable should be replaced. The Board's staff also observed that the mesh size of the strainers varies according to the size of the strainer, and was not selected on the basis of its effectiveness in straining the system's debris or meeting the NFPA 25 recommendation for 3.2 mm (1/8-inch) perforations.

Underground Lead-in Flushing Procedure. After reviewing the procedure used to flush the underground lead-ins and witnessing the activity, the Board's staff identified several issues related to the adequacy of the procedure:

- The strainers used to collect foreign material in the flush water do not necessarily have the same mesh size as the strainers installed in the risers. In many cases, the perforations of the test strainer are larger than those of the permanent riser strainer. This test arrangement captures less material than do the permanent strainers and does not reflect the potential for plugging of the permanent strainers. Further, there is an unknown quantity of debris passing through the test strainer, resulting in an underestimate of how much lining or corrosion products are being removed to protect the risers.

- While some flow data are collected, the procedure does not establish minimum flushing rates to obtain a minimum velocity of 10 feet per second as recommended in NFPA 13 and NFPA 25.

- There are no acceptance criteria to evaluate whether the quantity of debris collected during a flush warrants considering the system failed and/or requiring more frequent flushing. Decisions are based on the judgment of the system engineer, which appear qualitative and arbitrary.

- Annual flushing for the underground lead-ins was originally established in 1995 and continued through 2005. With implementation of the DAF Documented Safety Analysis (DSA) and the associated Technical Safety Requirements (TSRs), the frequency of flushing for all systems was changed to every 2 years, but no technical justification was provided for the schedule change.

Tracking and Trending of Underground Lead-in Flushing. Foreign material collected during the flushing operations performed since 1995 has been retained; however, no formal tracking or trending of the available data had been conducted until this year. This process is being conducted on an ad hoc basis, with the quantity of lining, collected by building, being entered into a system engineer's spreadsheet. While this information is useful, additional evaluation may be warranted. The staff's observations on other tracking and trending issues are summarized below:

- The 2007 data collected to date indicate a noticeable increase in the foreign material collected for some systems, and a significant increase for five systems. This situation needs to be evaluated to determine the appropriate course of action for future flushing.

- The material collected from some buildings appears to have changed from liner material to mineral nodules, scale, and iron oxide particles, indicating the likelihood of significant corrosion of the piping material. The impact of such corrosion may be significant.

- It is possible that other characteristics of the foreign material collected, in addition to mass, could be evaluated. There may be additional useful correlations to indicate the current condition of the pipes. For example, is the quantity of foreign material collected increasing, decreasing, or remaining constant? How does the change in the quantity of foreign material collected relate to the flushing schedule? Is there a relationship between the total quantity of liner material removed during flushing and the quantity of corrosion products, indicating more rapid deterioration of the pipes?

- Finally, the tracking and trending system needs to be formalized to ensure that data from flushing operations are preserved and put to effective use.

Water Supply. The present water supply to DAF does not meet the requirements for a support system for a safety-class fire suppression system. Since there exist only one tank and one main feed to the DAF site, the system is subject to multiple single-point failures. The overall risk to the project has not been identified because no design adequacy review for the water supply has been conducted. While there has been some improvement in recent years due to the elimination of process water demands not associated with DAF, the water supply system is still outside the safety-class boundaries established in the DSA and not controlled by DAF management.

A tank water level indicator is currently being installed in DAF to help manage the tank inventory. However, this indicator is insufficient by itself, as the flow path between the tank and DAF is not operated as a safety system and could be disabled without the knowledge of DAF management. The water supply needs to be designated and operated as a required safety-class system.

NSO Fire Protection Assessments. NSO conducted four fire protection–related assessments of DAF in the past year. A total of 26 findings were identified. Significant findings include the following:

- There is no objective evidence that the fire sprinkler systems can provide the water density required by the DSA. Further, the available calculations do not include the potential impact of the strainers added to address the debris from the failed lead-in lining or the potential degraded condition of the lead-ins.

- The water supply system and tank are not designated safety-class in support of the safety-class sprinkler systems.

- Tracking and trending of the fire protection system has not been formally documented and integrated into the decision-making process for maintenance and upgrade of the system.

- Several life safety deficiencies had been identified, but not documented with appropriate exemptions or equivalencies.

- The contractor's assessment process for the fire protection program was not comprehensive.

- The fire detection system for one building with a safety-class sprinkler system is not designated as safety-class, even though its failure would prevent the operation of the sprinkler system's capabilities.

NSO and DAF management are working to develop an acceptable corrective action plan for all of the findings of the NSO assessments.

Update of Documented Safety Analysis. The second update to the DAF DSA and TSRs approved in December 2003 is being developed. The update is a major revision of the DSA and TSRs. NSO has provided comments on the draft update, including comments on the fire protection system that are consistent with the findings of its assessments. NSO's comments address the reliability and vulnerabilities of the fire suppression system, the availability of the water supply, and the advisability of considering the water supply system a safety system.

The contractor's resolution of NSO's comments includes adding to the TSRs a specific administrative control for an 8-foot standoff distance between combustible materials and high explosives, as well as daily surveillance of the riser pressure. The 8-foot standoff distance is consistent with practice at the Pantex Plant, although the content and quantity of combustible material appear to be undefined. Riser pressure will provide some indication of the availability of water, although it will not provide verification of an adequate water flow. While the addition of these specific administrative controls represents an improvement, the Board's staff believes they should be treated as compensatory measures until deficiencies of the engineered controls are corrected, and defined as defense-in-depth thereafter.

Conclusion. The fire suppression system at DAF does not meet the expectations of a safety-class or safety-significant system. Numerous deficiencies have been identified, and the potential for impairment of the system is not clearly identified in the DAF DSA. These findings and deficiencies need to be explicitly acknowledged in the authorization basis, and appropriate compensatory measures instituted pending completion of corrective actions. This should be completed before more hazardous nuclear operations, e.g., nuclear explosive operations or criticality experiments, begin at DAF.