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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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March 18, 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 November 3, 2004, the Defense Nuclear Facilities Safety Board (Board) sent a letter to the National Nuclear Security Administration (NNSA) requesting a report on actions being taken to identify and correct any deficiencies in the Device Assembly Facility (DAF) structure, its equipment, or its safety management programs to support the increased scope and operational tempo of activities at the Nevada Test Site. The Board has reviewed your response of February 8, 2005. While the response does not appear to fully address the Board's concerns, follow-on discussions are being held with NNSA to better understand the process being used to identify and address deficiencies at DAF.

The enclosed report prepared by the Board's staff provides an example of ongoing facility degradation that needs to be addressed. Specifically, there is extensive rainwater leakage into the facility through expansion joints and building penetrations, and possibly through structural cracks. There is also extensive cracking of the facility walls and floors. This latter condition was known, and a published report indicates concrete shrinkage as the cause; however, this interpretation appears to be incompatible with the locations of the cracks and the duration of the construction period. A unique aspect of DAF is that it was exposed to ground motion from several years of underground testing, both during and after construction. Thus, DAF has been subjected to an unknown level of vibratory ground motion that should be quantified as part of any effort to understand the potential cause of concrete cracking. The locations and extent of the structural cracks must be investigated and documented more throughly before confidence in the cause of the cracking is warranted. A comprehensive review of the structural capability of the facility and any necessary repairs cannot be completed prior to this condition assessment.

In light of these observations and your schedule for expanded nuclear operations, an immediate condition assessment of DAF is warranted. Therefore, pursuant to 42 U.S.C. §2286b(d), the Board requests a report within 45 days of receipt of this letter providing the results of a condition assessment and mapping of building leaks and structural cracks at DAF.

The report should address the extent and paths of the rainwater leakage problem, which should be investigated as soon as possible before the evidence disappears with the end of the rainy season. The report should also provide NNSA's plans for addressing any identified deficiencies.

Sincerely,

John T. Conway
Chairman

c: The Honorable Everet H. Beckner
Ms. Kathleen A. Carlson
Mr. Mark B. Whitaker

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

FROM: J. Kimball

SUBJECT: Device Assembly Facility Seismic/Structural Review

The staff of the Defense Nuclear Facilities Safety Board (Board) met with personnel from the National Nuclear Security Administration's (NNSA) Nevada Site Office and its contractors and consultants on February 23–24, 2005, to discuss the seismic/structural adequacy of the Device Assembly Facility (DAF) at the Nevada Test Site. The purpose of the meeting was twofold: to perform a walkdown of DAF to gain an appreciation of the extent of concrete cracking on the walls and floors, and to discuss the status of previous analyses of seismic hazards and seismic structural adequacy.

The DAF manager provided an overview of the operations and safety basis for DAF. Construction of DAF occurred between about April 1988 and July 1989. As noted below, these dates are important in understanding the cause of observed concrete cracking. The facility manager summarized actions that have been initiated to update the DAF seismic hazard assessment. Lawrence Livermore National Laboratory (LLNL) has determined that the existing probabilistic seismic hazard analysis (PSHA) is no longer current and must be updated. LLNL has prepared a preliminary draft project plan to initiate this work, and is in the process of securing funding for project execution. In addition, a master equipment list is being prepared for each DAF building. Such a list is important for ensuring that seismic qualification of equipment is complete.

The DAF walkdown gave the Board's staff an opportunity to visit numerous buildings within the facility (cells, bays, bunkers, etc., are referred to as "buildings") to observe the size and spacing of cracks that have been noted in the concrete walls and floors. The walkdown included buildings on both the first and second floors. The staff made several observations:

- Cracking of the walls and floors generally occurs in regular spaced patterns, with many cracks progressing circumferentially down one wall, across the floor, and up the opposite wall. Observation of roof cracks was not possible because of the existence of false ceilings.

- The cracking is prevalent throughout the facility, including cell round rooms. Given the duration of construction, about 1 year, it is difficult to attribute the cracking to concrete shrinkage as concluded in a memorandum prepared by LANL dated July 1, 2003. Given the wide range of environmental conditions that most likely occurred during the 1 year construction period, certain sections of the building would be expected to remain relatively crack free. This was not the case. Moreover, cracks

located about 10 feet from expansion joints are not likely due to concrete shrinkage, which should have occurred during the curing period when backfill was not yet in place.

- There was some discussion regarding the cause of the observed cracking. The staff raised questions regarding the ground motion experienced by DAF as a result of the nuclear testing program, before such testing was halted in 1992. While DAF personnel appear to favor concrete shrinkage as the cause of the cracking, this interpretation is subject to debate. The staff encouraged DAF personnel to compile data on the ground motion from these events at DAF.

- Forty-two of the cracks are being monitored. It was not clear to the staff why certain cracks were selected for monitoring and whether the worst cracks are being monitored. Some of the crack monitors could be challenged as showing minor amounts of rotation. However, surveys of crack widths indicate that little if any movement occurred between 1999 and 2005.

- While an exact count was not made, numerous water leaks were observed. Prior to the staff's visit, the area in the vicinity of DAF had experienced a large amount of rainfall. While some of the leaks were aligned with expansion joints (there are four such joints), many were not. It was not clear whether water was also coming into the facility via penetrations and building cracks. The amount of leakage calls into question the integrity of the liner between the concrete roof and overlying soil. The conduct of nuclear operations under the current state of water leakage may not be appropriate.

The staff developed a list of underground nuclear tests that occurred during and after construction of DAF. The data revealed that DAF has experienced ground motion from at least 25 tests, 11 of which are within about 25 kilometers of the site. One of these tests had energy equivalent to that of a magnitude 5.9 earthquake. The staff will pursue the estimation of ground motions for these events as part of the effort to understand the cause of concrete cracking.

LLNL staff and consultants reviewed the previous simplified DAF PSHA and structural analysis. The simplified PSHA was completed by Geomatrix Consultants in 1996. A former Geomatrix staff member noted that the original PSHA work was based on the assumption that detailed documentation of the PSHA results would be provided in a follow-up phase. This phase was not completed by LLNL. Given that the existing simplified DAF PSHA is about 10 years old, LLNL personnel recognize that an update is needed. This determination was prompted by changes in the state of practice, particularly the modeling of earthquake ground motion attenuation (results that have become available from the Yucca Mountain Project PSHA), and the need to collect better DAF specific geotechnical data to understand the site's response to earthquake ground motion. Investigations are planned to obtain subsurface information such as the shear wave velocity for subsurface soils. The staff was provided some preliminary information suggesting that the thickness of soils at DAF may be as great as 1,000 feet.

LLNL staff reviewed the original DAF static seismic design completed in the mid 1980's, and results from a dynamic analysis completed in 1996. The Board's staff noted that the 1996 dynamic analysis provided insufficient information to judge the overall DAF seismic structural adequacy. LLNL staff agreed that significant improvements should be made to the dynamic analysis. LLNL plans to complete a dynamic soil structure interaction analysis using results from the PSHA update.