DEFENSE NUCLEAR FACILITIES SAFETY BOARD
Washington, DC 20004-2901

February 25, 2013

The Honorable Neile L. Miller
Acting Administrator
National Nuclear Security Administration
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0701

Dear Ms. Miller:

The Defense Nuclear Facilities Safety Board (Board) reviewed the fire protection program at the Pantex Plant and is concerned about the number of deficiencies and the high rates of failure for fire protection systems in recent years. Continued failures, if not addressed, could lead to non-availability of the fire protection systems during normal operations and accident conditions involving nuclear explosives and special nuclear material. Thus, failures of the fire protection systems pose a risk to worker and public health and safety. More can be done to assess known deficiencies, place greater emphasis on timely correction of the problems, and ensure proper operability and reliability of fire protection systems at the Pantex Plant.

The review conducted by the Board revealed a number of significant issues including less than adequate operability of the fire suppression systems; poor practices relative to the inspection, testing, and maintenance of fire protection systems; errors in application of the Unreviewed Safety Question process during the replacement of the High Pressure Fire Loop; and areas lacking automatic sprinkler protection. Of particular concern is an apparent lack of urgency in addressing impairments to components of the High Pressure Fire Loop despite the fact that it is a credited safety-class system.

The issues discussed above and detailed in the enclosed report need to be resolved to ensure safe and reliable operations at the Pantex Plant. Pursuant to 42 U.S.C. § 2286b(d), the Board requests a report and briefing within 90 days of receipt of this letter by the National Nuclear Security Administration regarding plans and schedules for actions to ensure the proper operability and reliability of fire protection systems at the Pantex Plant.

Sincerely,

Peter S. Winokur, Ph.D.
Chairman

Enclosure

c: Mr. Steven C. Erhart
Mrs. Mari-Jo Campagnone

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

December 17, 2012

MEMORANDUM FOR: T. J. Dwyer, Technical Director

COPIES: Board Members

FROM: W. Futrell

SUBJECT: Fire Protection Systems, Pantex Plant

Introduction. The staff of the Defense Nuclear Facilities Safety Board (Board) performed a review of elements of the Pantex Plant's fire protection program during July 24–26, 2012, a follow-on review of additional documents provided during and subsequent to the review, and a teleconference on September 13, 2012. Representatives of the National Nuclear Security Administration's (NNSA) Production Office (NPO) and the site contractor, Babcock & Wilcox Pantex, LLC (B&W), participated in the review. The Board's staff focused this review on the upgrade, maintenance, and impairment of fire protection systems. While the B&W fire protection program for the Pantex Plant showed excellence in many areas, the staff noted that other areas reflected the need for significant improvement.

The fire protection systems at Pantex are key safety-class systems that help protect the workers and the public. The Sitewide Safety Analysis Report notes that the safety-class High Pressure Fire Loop (HPFL) is designed to provide a continuous water supply to facilities where nuclear explosive operations and associated activities involving special nuclear material are conducted. The HPFL in combination with other fire protection features and systems is relied on to address a variety of fire scenarios that could impact thermally sensitive components of nuclear weapons. These fire scenarios might result in large explosions (high explosive violent reactions) with consequences that challenge Evaluation Guidelines.

Fire Protection System Operability. B&W has experienced an increasing number of failures of the HPFL and the ultraviolet flame detection systems. The staff reviewed B&W's plans to address ongoing reliability and system replacement.

High Pressure Fire Loop Upgrades—B&W personnel have nearly completed the line-item-funded HPFL project to replace approximately 17,850 feet of underground ductile iron piping (approximately 33 percent of the total HPFL) with high density polyethylene piping. The project also included replacement of post indicator valves, fire hydrants, and the addition of three diesel-driven fire pumps, which are safety-related, and two safety-related fire water tanks. Only

one sprinkler lead-in was replaced under the HPFL replacement project. B&W management will maintain one of the two existing fire water supplies, thus increasing the number of water supplies that would normally be available to three.

Fire Protection System Upgrades—B&W management is coordinating the upgrade of fire protection systems with other upgrades of the bays and cells in an effort to minimize down-time for the facilities. The sprinkler lead-in upgrade effort is replacing the degraded piping between the HPFL piping and each building's fire suppression systems. This piping has experienced the bulk of the underground failures (22 events) since 1995. The flame detection upgrades include replacement of the existing 1980s-vintage ultraviolet detection systems that operate the deluge systems in the nuclear explosive bays and cells. The manufacturer will stop supporting the existing detection system in the near future when the current stock of repair parts is exhausted. In addition, B&W personnel have identified single point failures in the safety-class fire protection systems that are being addressed, such as the solenoid valves that operate the deluge valves.

An extended replacement schedule for HPFL and lead-ins will require reliance on the existing older piping that continues to fail. Spare parts for the existing fire detection system are projected to be exhausted in 2017. Beyond this, reliance on salvaged parts will void the equipment's Underwriters Laboratory listing and result in questionable reliability. National Fire Protection Association (NFPA) 72, *National Fire Alarm and Signaling Code*, requires that fire alarm equipment be "listed" for its intended purpose. Other consequences of an extended replacement schedule may include the need to coordinate the installation of new equipment with continued operation of existing obsolete equipment pending its replacement, the need to accommodate the installation of a multiplicity of equipment models due to changes in technology over an extended replacement project, the need to maintain a greater variety of spare parts, and the need to train maintenance technicians on each of the various types and models of equipment in use.

These projects are ongoing and will take years to complete at the anticipated rate under the Capability Based Facilities and Infrastructure (CBFI) program. The staff is concerned that use of the CBFI funding source may result in a replacement schedule extending 10 or more years and may result in diminished fire safety. These concerns would be mitigated by more timely replacement of aging fire protection systems and associated components.

Fire Protection System Inspection, Testing, and Maintenance (IT&M). The staff identified the following concerns with the IT&M of fire protection systems and the actions taken during recent system impairments:

Maintenance of Fire Protection Equipment—On November 11, 2011, in support of contractor work on a new explosives facility, maintenance personnel closed two isolation control valves on the safety-class HPFL piping that provides fire water for nuclear facilities. The two closures, in combination with two other previously closed valves, led to the total loss of fire protection water to 10 non-nuclear facilities in Zone 11, and loss of outside fire hydrant service. Maintenance personnel did not notify the affected facility managers that the fire suppression systems were impaired so appropriate compensatory measures could be implemented. The

condition went undetected until the system was returned to service later that day. One of the previously closed valves was broken in the closed position for more than 16 months.

As a result of this failure, B&W personnel conducted a causal factors analysis. Based upon the results of the analysis, B&W maintenance personnel are revising post-maintenance testing requirements and ensuring more rigorous adherence to maintenance procedures. B&W management appears to be working to address all of the corrective actions identified in the causal factors analysis, as well as additional concerns related to safety systems.

Recent Fire Water Supply Impairments—Two safety-class fire water supply systems currently supply water to fire suppression systems and fire hydrants. Each of the current systems consists of a safety-class diesel-driven fire pump rated at 2,500 gallons per minute (gpm) and a general-service electrically-driven fire pump rated at 1,500 gpm, supplied by a common suction tank. Each set of pumps and tank can provide an independent supply of firefighting water, although the electric pumps are not designated as safety-related and will not meet the maximum site demand. The redundant supply ensures that fire water is available should one of the two systems fail to operate on demand. The fire water supply arrangement meets the requirements for redundancy specified by Department of Energy (DOE) Order 420.1B, *Facility Safety*.

On July 10, 2012, after maintenance on one fire pump, the discharge valve failed, requiring one of the two redundant water supplies to be taken out of service. Operators entered the associated Limiting Condition for Operation (LCO), which requires that the safety-class pump be restored to service within 14 days. The LCO required no compensatory actions even though the safety-class water supply was reduced to a single fire water supply (redundancy was lost). B&W failed to return the pump to service within the 14-day time period. As required by the LCO, B&W submitted a recovery plan to the NPO, requesting extension of the LCO for an additional 14 days. NPO approved the extension without identifying or requiring any compensatory measures to manage the additional risk due to loss of redundancy and potential for equipment failure on demand associated with the extended outage.

In a subsequent event, on August 13, 2012, B&W personnel impaired the safety-class fire pump located in Building 15-25 for repairs. This impairment again resulted in the site operating with a single safety-class water supply without compensatory measures. The lack of spare parts to complete the repair in combination with delays in ordering repair parts resulted in a 10-day outage.

This series of events indicates that B&W may not be treating the operation and maintenance of safety-class fire protection systems with an appropriate level of priority, and in accordance with the requirements of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, Chapter 15, Impairments. Chapter 15 of NFPA 25 requires that increased risks during an impairment be minimized, that the duration of the impairment be limited, and that for emergency (unplanned) impairments, emergency action be taken to minimize potential injury and damage. Actions taken by B&W to address the impairment of safety-class fire water supplies in July and August 2012 did not meet the intent of NFPA 25. B&W did not take emergency action to limit the duration of the impairments or limit the risks associated with the impairments. These concerns indicate that the LCO may not be adequate to manage the safety-class fire protection system in an appropriate manner.

The staff discussed the apparent lack of urgency in repairing the water supplies, the potential for extended outages, the loss of water supply redundancy, and the lack of compensatory measures with NPO and B&W personnel. Neither organization acknowledged the additional risk that existed during the impairments due to the potential failure on demand of the remaining single supply. The Board's staff is evaluating these incidents as part of a complex-wide review of how technical safety requirements and LCOs address impairments to fire protection and other credited safety systems.

Unreviewed Safety Question (USQ) Process for HPFL Design. B&W personnel completed the USQ process as required by Title 10 of the Code of Federal Regulations, Part 830, Subpart B, *Nuclear Safety Management*, for the design and replacement of key components of the HPFL. B&W found the project did not represent a positive USQ. The staff reviewed the USQ process used by B&W personnel and identified a number of serious issues, including:

1. The negative USQ determination was based, in part, on the use of components "equivalent" to the existing components. This may be inappropriate because:

    - The two new suction tanks for fire water are taller than the existing tanks, which will result in higher tank suction head pressure, which in turn may result in higher pump discharge pressure. In addition, the new fire pumps are capable of producing higher discharge pressures than the existing pumps. Both of these conditions could potentially subject the existing older HPFL and lead-in piping to higher water pressure than they can withstand.

    - The relief valve for each of the new diesel-driven fire pumps releases water to a drain instead of returning water to the tank. Thus, should the relief valve open for an extended period of time, water normally available for fire control would be lost. This condition could result in the volume of water available for fire control being less than that required for successful fire suppression.

2. B&W designers did not perform hydraulic calculations to ensure that modifications to the system (elbows, tees, new piping) did not negatively affect hydraulic performance. Instead they made the unsubstantiated assumption that hydraulic performance must improve since the high density polyethylene replacement piping has less friction loss than the existing ductile iron piping.

3. The USQ process did not address the potential for single-point failures. The B&W USQ author listed all questions in the USQ analysis regarding single-point failure as not applicable. The Board's staff identified two cases in the design and piping layout where single-point failures could result in degradation of the fire water system's performance. First, failure of the relief valve to operate properly on the diesel-driven fire pump could result in either system overpressure or loss of water. Second, failure of the discharge check valve for any non-operating pump could result in system pressure loss (i.e., water would backflow through the failed check valve into the fire water tank). In discussions with the Board's staff, B&W and NPO personnel

indicated that these potential failures are not a concern; however, B&W has not performed or documented an analysis of these or any other potential single-point failures.

B&W personnel are preparing a transition plan for bringing the new fire pumps on-line that will include testing and hydraulic calculations to show the capabilities of the new water supplies and develop operating set points. As transition begins, at least one issue has already been identified. The diesel-driven fire pumps that have been delivered were found to have an operating pressure higher than that specified in design documents. Their actual operating pressure in fact exceeds the existing HPFL's safe operating pressure. While this problem was identified and fixed, any design deficiencies that are identified after installation may affect the operability and reliability of credited fire protection systems.

Areas Lacking Automatic Sprinkler Protection. DOE Order 420.1B, *Facility Safety*, requires the installation of automatic fire extinguishing systems in all significant facilities. During field observations, the Board's staff identified a ramp area that lacked automatic fire sprinklers. B&W personnel subsequently provided documentation that identified seven unsprinklered ramps, at least three of which are open to a sprinklered ramp that is used to transport nuclear explosives. Since all ramps are interconnected without fire rated separations, all ramps must be considered part of the same fire area and be protected by an automatic fire extinguishing system.