Department of Energy
Under Secretary for Nuclear Security
Administrator, National Nuclear Security Administration
Washington, DC 20585

National Nuclear Security Administration

August 29, 2016

The Honorable Joyce L. Connery
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue NW, Suite 700
Washington, D.C. 20004

Dear Madam Chairman:

This letter is in response to your May 12, 2016, letter requesting the National Nuclear Security Administration's (NNSA) assessment of vulnerabilities of the Fire Suppression System (FSS) for the Plutonium Facility (PF-4) at the Los Alamos National Laboratory. Based on the discussion below, I have determined that the Los Alamos Field Office (NA-LA) has established proper operating limits on the FSS and is taking appropriate actions to address FSS vulnerabilities.

NNSA appreciates the thoroughness and time dedicated by your staff in developing the Staff Issue Report, *Seismic Qualification of Fire Suppression System at the Plutonium Facility, Los Alamos National Laboratory*, dated January 29, 2016, which was enclosed in your May 12, 2016, letter. NNSA also agrees with the conclusion from this report: specifically, that additional information is required to demonstrate that the PF-4 FSS can meet its credited safety function for seismically-induced fire scenarios.

When the FSS vulnerabilities were identified, Los Alamos National Security, LLC (LANS), declared a potential inadequacy of the documented safety analysis (PISA). An evaluation of the safety of the situation (ESS) was developed and approved by the NA-LA, keeping in place an already established material-at-risk (MAR) compensatory measure. The ESS concluded that these MAR limits, along with other controls already in place, provide reasonable assurance of adequate protection to the worker, public, and the environment. These MAR limits keep doses below the Evaluation Guideline for postulated seismically-induced fire scenarios.

The enclosed report, *Response to DNFSB Safety Concerns Regarding the Fire Suppression System*, provides a summary of actions taken and planned to address the concerns raised in the Staff Issue Report. NNSA is committed to completing these actions in a safe and expeditious manner. I have requested NA-LA and LANS to work with your site representatives and cognizant staff in providing updates quarterly on the status of potential upgrades to the FSS and progress in implementing actions to address the report's concerns.

Sincerely,

Frank G. Klotz

Enclosure

Enclosure

Response to DNFSB Safety Concerns Regarding the Fire Suppression System

References:

1) Memorandum for Acting Deputy Administrator for Defense Programs, *Scope of Analysis of Alternatives (AoA) for Technical Area 55 Reinvestment Project, Phase III (TRP III) at Los Alamos National Laboratory*, June 22, 2016.
2) AD-NHHO-16-093, *ESS for Potential Non-conservatism in PF-4 Fire Suppression System Seismic Capacity Calculation*, June 15, 2016.
3) CAL-16-TA55-STR-012-S, *Allowable Collateral Load for PF-4 Ceiling Framing*, February 29, 2016, R.0.
4) AD-NHHO-15-258, Transmittal of FY15 TA-55 Project Execution Strategy, December 23, 2015.

Background

The Technical Area 55 (TA-55), Plutonium Facility, Building 4 (PF-4) Documented Safety Analysis (DSA) credits the fire suppression system (FSS) to limit the duration and spread of fires for operational events. The FSS operates in the first floor laboratories, the vault, and areas of the basement during a fire, and shall fulfill its safety function during and after a performance category-2 (PC-2) seismic event.

During a Defense Nuclear Safety Facilities Board (DNFSB) Staff review of PF-4 performed between November 30 and December 1, 2015, it was noted that the original specification for pipe fittings for the FSS called for either cast or malleable iron with dimensions larger than that of the piping. This differs from the assumptions made in the most recent analysis for the facility. Cast iron fittings have been identified as the limiting component for fire suppression systems experiencing seismic loads. However, the material construction for the PF-4 pipe fittings is not documented.

The finite-element analyses that established the capacity of the FSS at PC-3 seismic loads assumed the fittings were carbon steel with dimensions equivalent to the piping. The analyses indicated a Demand/Capacity ratio close to one for a PC-3 level seismic event in certain areas of PF-4. Cast and malleable iron have much lower allowable stress limits than that of the carbon steel pipe analyzed in the calculations. A simple ratio of allowable stresses indicates that the seismic capacity of the FSS may not meet PC-3 or PC-2 requirements. However, larger dimension pipe fittings (as-built) will experience lower imposed stresses for similar loads than smaller pipe fittings (as analyzed). The impact of these two offsetting factors on the determination of the seismic capacity of the FSS at both the PC-3 and PC-2 level is uncertain.

An initial evaluation of the analyses from the Seismic Analysis of Facilities and Evaluation of Risk (SAFER) study shows that a tensile strength greater than 40 ksi (kip per square inch) for FSS fittings is required to demonstrate the system would meet PC-2 criteria. Literature reviews indicate that gray cast iron comes in a variety of classes, with tensile strength ranging from 20 to 60 ksi. Site walk downs and review of construction records do not provide evidence that the installed fittings meet the SAFER study's 40 ksi requirement, although tensile testing of existing fittings in the system will quantify ultimate stress.

On February 10, 2016, the PF-4 Facility Operations Director declared a potential inadequacy of the documented safety analysis (PISA), due to concerns with adequate seismic capacity of cast iron fittings in the PF-4 FSS. The operational restrictions from the TA-55 DSA Seismic Addendum (TA-55-DSA-2011-R1.2 Addendum 1, R.1) were maintained and carried forward as compensatory measures in the Evaluation of the Safety of the Situation (Ref. 2). These limits are:

1. 1,800 kg Plutonium Equivalent (Pu-EQ) in all of the first floor.
2. 5,000 kg Pu-EQ in the vault rooms, excluding heat source plutonium (HS-Pu) in the vault water baths.

In May 2016, an outage was conducted for the vault room portion of the PF-4 FSS. Representative couplings and fittings were removed to allow for tensile testing. Initial results from this testing were conducted during the week of July 11. Preliminary test results indicate that the fittings do not meet the 40 ksi requirement. As a result, the Material at Risk (MAR) limits specified above will remain in place until upgrades can be made to the PF-4 FSS. Potential upgrades include the following or any combinations thereof:

1. Install carbon steel couplings and fittings with tensile strength greater than 40 ksi.
2. Wrap the couplings and fittings with carbon fiber reinforced plastic (CFRP) to increase their strength.
3. Install flexible sprinkler drops to absorb seismic stresses.
4. Install additional bracing

The Los Alamos Field Office (NA-LA) will provide DNFSB staff with a copy of the Final Testing Report when it is available.

The following table provides Los Alamos National Security, LLC (LANS) and NA-LA responses to the specific safety concerns regarding the FSS identified in the Staff Issue Report (pages 2 and 3):

DNFSB Staff Concern	LANS/NA-LA Response
1. Seismic interaction hazards exist between seismically qualified structures, systems, and	Because completion of the walkdowns of the FSS to evaluate two-over-one seismic issues (the interaction of non-seismically qualified systems with seismically

DNFSB Staff Concern	LANS/NA-LA Response
components (SSCs) and SSCs with lower seismic performance requirements	qualified systems) have been delayed, NA-LA will provide direction to LANS to revise the TA-55 Project Execution Strategy to complete a FSS walkdown to evaluate seismic interaction hazards. The direction will include a requirement to maintain the MAR controls specified in Ref. 2 until the evaluation is performed and necessary upgrades are complete, and will be provided to LANS by August 31, 2016.
2. FSS seismic analysis assumptions regarding the use of steel pipe fittings instead of cast or malleable iron fittings	LANS submitted the Evaluation of the Safety of the Situation on the Fire Suppression System cast iron fittings to NA-LA, which includes controls that ensure offsite consequences at less than the Evaluation Guideline (EG) (Ref. 2). Material testing of the removed cast iron fittings is ongoing. The preliminary results of this testing and corrective actions are being analyzed as identified in the Background section above.
3. Configuration changes made to the PF-4 laboratory ceilings after they were upgraded for higher seismic performance	LANS installed aluminum planking with a loading of 2.5 pounds per square foot (psf). The planking allows workers to safely traverse the areas above the lab ceiling. The allowable collateral loading of the ceiling framing varies throughout the facility. The allowable collateral loading to the ceiling framing including the aluminum was evaluated in CAL-16-TA-55-STR-012-S (Ref. 3). This calculation takes into account the aluminum planking and presents an actual allowable loading for each bay above and beyond the installed planking. In all cases, there is additional allowable capacity.
4. Incomplete in-service inspections (ISIs) due to a need for confined-space permits for inspections of significant portions of the FSS and a decision to forego inspections rather than obtain the permits	NA-LA will provide direction to LANS to further develop a risk-based approach and pursue alternative inspection methods for areas that are not readily accessible. The results and recommendations of this analysis will be concurred on by NA-LA. This direction will be provided to LANS by August 31, 2016.
5. An acknowledged vulnerability in the safety class firewater loop (the inclusion of flow paths to non-safety-related facilities) that	It is a recognized vulnerability that the firewater loop also services non-seismically qualified buildings. One of the options that has been evaluated is the separation of those buildings from the safety class firewater loop and installation of another source of firewater to service

DNFSB Staff Concern	LANS/NA-LA Response
has no engineered resolution and will rely indefinitely on a compensatory measure involving operator actions during an emergency	those buildings. This conceptual design was included in the TA-55 Reinvestment Project, Phase III (TRP III) estimate. The action to address this vulnerability has been changed. The Technical Safety Requirement (TSR) completion time to restore the West pump house operability has been reduced from 14 days to 12 hours (Mode 1-operational); if not completed within 12 hours, the facility must be in Mode 2 (shutdown) in 2 hours. At the program level, an AoA for TRP III was completed June 22, 2016 (Ref. 1). The AoA recognized that prior subprojects executed over the past decade have strengthened glovebox support systems; replaced confinement doors, ovens, and criticality alarm systems; and constructed a new building to house a safety class uninterruptable power supply system, enhancing the overall safety and reliability of PF-4. Separation of non-nuclear facilities from the PF-4 fire water loop was being considered within the TRP III scope to further reduce offsite consequences in post-seismic accident scenarios. However, the analysis in the Plutonium Modular Approach AoA to determine broader infrastructure changes needed to support future pit production requirements is still ongoing. The on-going MAR reduction efforts will continue to provide safety enhancements. Looking into the future when the Plutonium Modular Units are available and even greater MAR reductions in PF-4 have been attained, new, more cost-effective options may become available for addressing fire safety issues at PF-4.
6. Incomplete estimates of post-seismic FSS hydraulic demands	While it cannot be quantitatively determined how many sprinklers will actuate during a seismic with fire accident, the FSS was designed to meet Ordinary Hazard Group 2 requirements (0.20 gallons per minute (gpm)/ft^2 over the most hydraulically remote 1,500 ft^2, with an added hose stream of 300 gpm that is available inside or outside the facility plus an additional 103.4-gpm flow to the filter plenum cool-down spray). In the vault, the FSS was designed to meet Ordinary Hazard Group 1 (0.15 gpm/ft^2 over the most hydraulically remote 500 ft^2). Based on

DNFSB Staff Concern	LANS/NA-LA Response
	probability analysis of past post-seismic fires, a post-seismic fire is not expected in PF-4. The DSA conservatively assumes one fire based on this analysis. Further, the consensus standard used to design fire sprinkler systems, National Fire Protection Association 13, *Standard for the Installation of Sprinkler Systems*, does not require the design of fire sprinkler systems to account for two or more fires simultaneously. However, the DSA acknowledges that processing molten metal in gloveboxes is not an operation conducted in many of the facilities involved in the seismic data base and, therefore, the glovebox stands for these operations have been upgraded to PC-3 seismic requirements. This deterministic approach justifies the DSA position that only one post-seismic room fire must be controlled. Testing will be performed to verify the performance capacity of the FSS.

Summary

The DNFSB staff review team concluded that "considering the number of these issues, the staff review team concludes that the current condition of the PF-4 FSS does not support crediting it to perform safety functions for a fire following a PC-3 seismic event at this time." LANS and NA-LA concur with this conclusion. The bounding accident scenario for PF-4 is a post-seismic fire following a PC-3 seismic event. In this event, the current DSA does not credit the FSS. The consequences for this bounding accident are below the EG. The following excerpts are from the approved and implemented PF-4 DSA:

> The FSS limits the size, temperature, and duration of fires. Once the sprinklers are actuated, they will provide a cooling effect of the hot layer, thus reducing the driving force for transport of radioactive aerosol from the fire room and reducing the temperature of the combustion gases that may be drawn into the ventilation exhaust systems. The FSS is not credited for a floor-wide PC-3 (evaluation-basis earthquake) seismically induced fire, but will provide its safety function during lesser seismic events.
>
> The FSS for the individual 100, 200, 300, and 400 Area laboratories (excluding the west entrance freeze-protection branch-lines) and the basement (excluding the freeze protection branch-line serving the north exterior loading dock) is designated as safety class for certain operational fires ... and safety-significant—not safety-class—for seismically induced fires.

LANS and NA-LA Conclusion for Continued Safe Operations

The first floor MAR operational restrictions, defined in Ref. 2, along with controls already in place, provide reasonable assurance of adequate protection to the worker, the public, and the environment without crediting the PF-4 fire suppressions system as a safety-significant system, structure, or component (SSC) for fires following earthquakes.