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

March 14, 2025

The Honorable Thomas A. Summers
Acting Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Ave NW, Suite 700
Washington, DC 20004

Dear Mr. Summers:

On behalf of the Secretary, I am responding to former Chair Connery's August 13, 2024, letter regarding the results of the Defense Nuclear Facilities Safety Board's (DNFSB/Board) review of the use of lithium-ion batteries for uninterruptible power supplies (UPS) in the Device Assembly Facility (DAF) at the Nevada National Security Site (NNSS). The letter requests a briefing and response addressing any actions the Department of Energy (DOE) has taken or plans to take to develop or adopt requirements and provide guidance on hazard analysis and controls for lithium-ion battery energy storage systems (ESSs) at defense nuclear facilities and how DOE plans to address the identified safety issues with the lithium-ion battery UPS now installed at DAF.

The enclosed response identifies DOE's, including the National Nuclear Security Administration's (NNSA), evaluation of the specific emergency lighting condition found at the DAF, as well as DOE/NNSA plans to identify and address the larger issue specific to lithium-ion battery ESSs that are in the process of being evaluated or installed in nuclear facilities across the DOE complex. As the technology continues to evolve and expands in use at DOE/NNSA sites, DOE expects to continuously improve and refine specific safety measures based on technical evaluations supported by industry research and development and best practices.

NNSA is addressing the site-specific issues at the DAF through existing processes as outlined in the enclosure. As a result, NNSS declared a Potential Inadequacy of the Safety Analysis and is currently working through the site-specific process with the Nevada Field Office. With respect to requirements on hazard analysis and controls for lithium-ion battery ESSs at defense nuclear facilities, DOE/NNSA has determined that DOE's existing regulatory framework is adequate, however, additional guidance could be provided specific to lithium-ion battery ESSs.

DOE/NNSA appreciates the DNFSB's review and the feedback provided regarding these concerns. We welcome the Board's perspectives and look forward to continuing positive interactions with you and the DNFSB in the future.

Received by the Board 03.17.25

If you have any questions, please contact Mr. Ahmad M. Al-Daouk, Associate Administrator for Environment, Safety, and Health, at (202) 586-4096.

Sincerely,

Teresa M. Robbins
Acting Under Secretary for Nuclear Security
and Administrator, NNSA

Enclosure

Received by the Board 03.17.25

Response to the Defense Nuclear Facilities Safety Board, Device Assembly Facility Lithium-ion Battery Uninterruptible Power Supply

Members of the Defense Nuclear Facilities Safety Board (DNFSB or Board) staff completed a review of the uninterruptible power supply (UPS) for the Device Assembly Facility (DAF) utilizing lithium-ion batteries at the Nevada National Security Site (NNSS). The DNFSB review results are documented in DNFSB Staff Report, *Use of Lithium-Ion Batteries for Uninterruptible Power Supplies in the Device Assembly Facility at Nevada National Security Site*, dated June 14, 2024, which was transmitted to the Department of Energy's National Nuclear Security Administration (DOE/NNSA) via letter on August 13, 2024.

In response to the Board's letter and associated reporting requirement for a written response and briefing, below is the DOE/NNSA response addressing any actions DOE has taken or plans to take regarding the following concerns:

- Concern 1: *Develop or adopt requirements and provide guidance on hazard analysis and controls for lithium-ion battery energy storage systems at defense nuclear facilities.*
- Concern 2: *Address the identified safety issues with the lithium-ion battery UPS now installed at DAF.*

<u>Concern 1: Requirements and Guidance on Hazard Analysis and Controls for Lithium-Ion Energy Storage Systems (ESSs)</u>

DOE's existing regulatory framework includes requirements for identifying applicable industry codes and standards, identifying and controlling hazards, and evaluating interfaces between safety and non-safety structures, systems, and components (SSCs).

Per DOE Order 420.1C, Change 3, *Facility Safety*, contractors must identify the applicable industry codes and standards for design and construction activities. The applicable standard for new ESSs would be National Fire Protection Association (NFPA) 855, *Standard for the Installation of Stationary Energy Storage Systems*, which was last issued in 2023. The prior edition, issued in 2020, was the first published edition of the new standard. This consensus standard provides requirements for safe design, installation, and operation of ESSs. Use of other consensus standards may also be necessary based on the specific installation.

10 CFR 830.204, *Documented Safety Analysis*, states that documented safety analysis (DSA) will evaluate normal, abnormal, and accident conditions, including consideration of natural and man-made external events, identification of energy sources or processes that might contribute to the generation or uncontrolled release of radioactive and other hazardous materials, and derive the hazard controls necessary to ensure adequate protection of workers, the public, and the environment. Hazards associated with lithium-ion battery ESSs are required to be identified and evaluated in the DSA to derive appropriate controls. For hazards carried through to the DSA,

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DOE Handbook 1224-2024, *DOE Hazard and Accident Analysis Handbook*, provides guidance for analyzing fires and explosions.

DOE O 420.1C, Change 3, states that interfaces—such as pressure retention boundaries, electrical supply, instrumentation, cooling water, and other support systems—may exist between safety SSCs and non-safety SSCs. These interfaces must be evaluated to identify SSC failures that would prevent safety SSCs from performing their intended safety function(s).

DOE has determined that these requirements are applicable to, and inclusive of, issues and hazards related to lithium-ion battery ESSs. DOE recognizes that there is a lack of guidance for lithium battery technologies, including portable electric devices with lithium-ion batteries and in electric vehicles. DOE was in the process of developing guidance through an existing working group prior to the DNFSB review. The draft guidance is anticipated to be submitted to the DOE Fire Safety Committee for discussion and potential inclusion into a future revision to DOE Standard 1066, *Fire Protection*. In addition, DOE issued an Operating Experience Summary, *Consideration of Lithium-Ion Battery Hazards in DOE Nuclear Facilities*, to assist the DOE community in understanding expectations for new systems in nuclear facilities.

Concern 2: Safety Issues with the Lithium-Ion Battery UPS Installed at DAF

When UPS-400-3 was installed in 2020, the system was in compliance with the physical and electrical separation of equipment per the applicable codes and standards published at that time, specifically NFPA 70 (2017), *National Electrical Code*, and NFPA 111 (2016), *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, Section 5.1.1.3, Battery Installation. NFPA 111 (2016) included general provisions that allowed the UPS equipment to be installed in a manner and location recommended by the manufacturer and acceptable to the authority having jurisdiction at the time of installation. Similarly, the DAF UPS system meets NFPA 70 (2017) battery installation and location requirements.

Inadequate Hazard Analysis in DAF Safety Basis – On December 12, 2024, the DAF Facility Manager declared a Potential Inadequacy of the Safety Analysis (PISA). The PISA determination was derived from new information indicating that the existing DAF DSA does not analyze an accident scenario involving a facility wide blackout condition where the Safety Significant UPS system and commercial power are both lost while high explosive (HE) operations are occurring.

The same day the PISA was declared, based on the immediate safety assessment a Timely Order was issued to restrict HE operations to buildings where emergency lighting fixtures (i.e., emergency lighting battery backup tubes) are installed and operable per the applicable DAF Technical Safety Requirements (TSR) Limiting Condition of Operation (LCO). The emergency lighting battery backup tubes automatically activate when the tube loses external power and provide adequate illumination for the required duration.

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The Evaluation of the Safety of the Situation is being developed which will provide safety analysis to further develop and support safety conclusions with or without operational restrictions. The Evaluation of the Safety of the Situation will also document the path forward to address the condition.

Testing Indicates Potential for Thermal Runaway – The UL9540A testing method includes a test methodology for individual battery cells using fault conditions to force the cells into thermal runaway to evaluate the characteristics of the cell while in thermal runaway. This cell level testing was performed on the DAF UPS lithium-ion batteries, and results were provided. However, testing at the module, unit, and installation levels is planned to satisfy additional testing methodologies within UL9540A.

In the installed UPS, the battery parameters, including temperature, voltage, and over current, are continually monitored by the battery management system; and any values outside of set tolerance parameters would cause an immediate alarm, initiating a response from facility personnel. The existing battery management system meets Institute of Electrical and Electronics Engineers and NFPA requirements.

Existing Fire Suppression System is Inadequate – The Fire Suppression System at DAF is credited to provide the flow rate and coverage capable of controlling or suppressing a fire. The performance criterion associated with this safety function is to provide a flow density of at least 0.15 gpm/ft^2 to comply with Ordinary Hazard Group 1 NFPA 13 requirements.

NFPA 855 requires a sprinkler system installed in accordance with NFPA 13 (or equivalent standard) with a minimum sprinkler system design density of 0.3 gpm/ft^2 over the lesser of either a 2,500 ft^2 design area or the entire room housing the lithium-ion battery UPS system. This higher design density equates to an Extra Hazard classification, which as defined in NFPA 13, is for areas where combustibility of contents is very high and rapidly developing fires with high rates of heat release are possible.

It should be noted that industry research is ongoing, which may result in changes to NFPA 855 requirements as well as other relevant industry codes and standards.

The last revision of the DAF Fire Hazard Analysis (FHA) was completed in December 2022. The DAF FHA is currently under revision. Using objective evidence and data currently available, the FHA will document further analysis of the UPS system(s), analysis of the fire protection features provided, and determinations if modifications to existing fire protections features or additional fire protection features are required or necessary to provide an adequate level of safety.

DOE/NNSA, the Nevada Field Office, and NNSS will ensure that the FHA uses the latest available industry information and research as well as the additional UL9540A testing to further analyze the DAF UPS installation and determine if any further engineering modifications or compensatory measures are required based on the analysis.

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