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

December 11, 2024

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

Dear Chair Connery:

On behalf of the Secretary, I am responding to your July 25, 2024, letter regarding the Defense Nuclear Facilities Safety Board (DNFSB or Board) review of the Nevada National Security Site (NNSS) Principal Underground Laboratory for Subcritical Experimentation (PULSE) Enhanced Capabilities for Subcritical Experiments (ECSE) Preliminary Documented Safety Analyses (PDSAs). In your letter, the Board identified safety concerns regarding existing and planned safety controls related to uncharacterized faults, the device shipping container, the vessel confinement system, and action and plans to address means of egress in the PULSE facility. The enclosed report addresses the Board's questions.

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) is committed to providing reasonable assurance of adequate protection of the workers, the public, and the environment. DOE/NNSA understands the concerns identified in your letter and continues to evaluate areas to improve safety in our operations. DOE/NNSA will coordinate a briefing to the Board in the coming weeks.

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

Sincerely,

Jill Hruby

Enclosure

Received by the Board 12.13.24

Enclosure
Response to July 25, 2024, Letter from the Defense Nuclear Facilities Safety Board

The Defense Nuclear Facilities Safety Board (DNFSB or Board) recently completed a review of the Nevada National Security Site (NNSS) Principal Underground Laboratory for Subcritical Experimentation (PULSE) safety design basis documents to assess the adequacy of the safety analysis and determine if the safety basis identified appropriate controls to protect workers and the public. The Board's review results are documented in DNFSB Staff Report, *Safety Posture of the Principal Underground Laboratory for Subcritical Experimentation and Associated Major Modification Projects*, dated May 9, 2024, and transmitted to the Department of Energy (DOE) in the Board letter dated July 25, 2024. In response to the Board's letter and associated reporting requirement, this enclosure addresses the requested safety questions.

Safety Question 1 – What actions has NNSA taken or planned to characterize the seismic faults present in the PULSE drifts to ensure that the new seismic-related controls will be able to perform their safety functions?

On July 17, 2024, the Cognizant Secretarial Officer for Safety approved a permanent exemption request to the DOE O 420.1C, Change 3, *Facility Safety*, Seismic Design Category (SDC)-3 design requirements for safety Structures, Systems, and Components (SSC) at PULSE. Specifically, this exemption applies to the design and analysis of underground safety SSCs associated with the current major modifications for the Enhanced Capabilities for Subcritical Experiments (ECSE) Portfolio, the U1a Complex Enhancements Project (UCEP), and the Z-Pinch Experimental Underground System (ZEUS) Test Bed Facility Infrastructure Projects. Accordingly, the safety SSCs associated with the major modifications for ECSE are being designed incorporating a 50 percent seismic load reduction (to account for the depth of the facility) relative to the International Building Code (IBC) version 2015 and follow applicable seismic design requirements provided in DOE Standard (STD) 1020-2016, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*, for SDC-2 SSCs.

The U.S. Geological Survey (USGS) National Seismic Hazard Maps were used to develop the seismic design and analysis criteria for the Seismic Design Category 2 (SDC-2) SSCs. These maps include the four prominent faults (i.e., the Yucca, Mine Mountain, Cane Springs, and Rock Valley faults) within the NNSS. Recent reports indicate that the age of the faults mapped in the PULSE facility could be anywhere between the mid-Neogene period (9-11.5 million years ago) to the Quaternary (past 1.6 million years) period. For fault sources to be included in the USGS Seismic Hazard Maps, there must be evidence of Quaternary activity. The USGS Quaternary Fault and Fold database provides most of the fault sources for the Maps. For inclusion in the USGS Quaternary Fault and Fold database, a fault must have certain characteristics such as the capability to produce M>6 earthquakes, evidence of activity during the Quaternary period, information available in published literature, and geological evidence of co-seismic surface deformation. The PULSE faults do not currently qualify for inclusion in the USGS Quaternary Fault and Fold Database.

The PULSE SSC design considers potential seismic activity in the PULSE vicinity with the use of areal source zones. These are regions where earthquakes have been recorded but cannot be

Received by the Board 12.13.24

attributed to a specific fault source. Areal source zones are used for much of the Central and Eastern United States, where few faults have been mapped and information is limited. This seismicity approach has been incorporated in the PULSE SSC design and the Device Assembly Facility (DAF) probabilistic seismic hazard analysis (PSHA).

The Department of Energy's National Nuclear Security Administration (NNSA) is developing a plan to perform a more detailed investigation of the historic seismic activity of the faults in the PULSE vicinity. NNSS Geologists have developed preliminary proposals to address fault timing and to further characterize faults mapped within PULSE. If additional evidence is gathered confirming that the USGS National Seismic Hazard Maps doesn't adequately characterize estimated ground motions at PULSE, a sensitivity analysis or a site-specific PSHA will be considered.

Safety Question 2 – What is NNSA's plan and schedule for procuring and implementing the new shipping container to ensure safe operations at PULSE as the subcritical experiment (SCE) mission expands?

Once funding for a new shipping container is appropriated, a project plan will be developed to manage the procurement and implementation of a new container that meets the functional requirements identified in the 2019 analysis of alternatives. This will include completing a design and evaluation process to validate that the new shipping container meets the mechanical, thermal, and electrical performance requirements necessary to support crediting the new shipping container as a safety SSC in the PULSE documented safety analysis (DSA).

A new container is not in the authorized scope of work for the major modification projects at PULSE. Use of the current Device Shipping Container occurs under the existing, approved DSAs for PULSE, DAF, and On-Site Transportation. As an existing activity that is not being changed as part of the modification projects, it cannot be included in the scope of the major modifications. Internal NNSA discussions between the Office of Research, Development, Test, and Evaluation (NA-11); Office of Enterprise Stewardship (NA-ESH-10); and the Nevada Field Office included identifying a potential funding office for a new container. Staff from NA-11 and NA-ESH-10 visited the NNSS in October 2024 to discuss the scope of the new container project to support future budget requests.

The current construct of relying on a suite of Specific Administrative Controls (SACs) is evaluated in the PULSE DSA and ECSE project Preliminary DSAs to ensure adequate protection of the public, workers, and the environment through prevention of accident scenarios. The SACs provide acceptable and effective controls to mitigate the risk of accident scenarios at PULSE. When a new container is available, the PULSE DSA will be reevaluated and subsequently revised to incorporate its use.

Safety Question 3 – The design of the Vessel Confinement System (VCS) does not meet all requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, Division 3: *Alternative Rules for Construction of High Pressure Vessels*. For each requirement not met, what equivalent means will NNSA use to demonstrate that

Received by the Board 12.13.24

in total, the vessel will adequately perform its safety function of confining radiological material prior to, during, and after experiment execution?

The Nuclear Weapons Laboratories (NWL), including Los Alamos National Laboratory (LANL) and Lawrence Livermore National Laboratory (LLNL), design and build the SCE assemblies, with mating of special nuclear material and high explosives (HE) occurring at the DAF. Based on the current design of the SCE VCS, certain attributes of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 3: *Alternative Rules for Construction of High Pressure Vessels*, are not met. A tailored approach to code compliance ensures the unique physical aspects of the VCS and its operating environment are accounted for when deviating from specific code requirements. Below is a summary of each code deviation, including alternative implementation methodology and technical rationale that demonstrate the VCS will adequately perform its safety function of confining radiological material prior to, during, and after experiment execution. The PULSE safety basis documents are being revised to address the deviations to the Code.

ASME BPVC Section VIII, Division 3, Part KG – General Requirements

A) User's Design Specifications

Alternate Method and Technical Rationale:

The information required for the User Design Specification (UDS), as specified in KG-311, is included in the weldment UDS for each vessel weldment design (i.e., 3-ft and 6-ft vessel weldments), and the VCS system requirements document(s) (experiment requirements, diagnostic requirements, and the derived engineering requirements) for each vessel system.

B) User's Design Specification (UDS) Certification

Alternate Method and Technical Rationale:

UDSs are prepared, reviewed and approved following the procedures required by NWL's Conduct of Engineering programs.

C) Application of the ASME Certification Mark with U3 Designator

Alternate Method and Technical Rationale:

The Certification Mark indicates that a vessel is certified by the Authorized Inspector and Manufacturer indicating that all applicable requirements of the ASME BPVC VIII-3 have been satisfied. Additionally, it assures the User that a vessel meets all applicable laws and regulations and is afforded personnel protection during operation. SCE VCS construction processes meet the applicable requirements specified in the LANL Facilities Conduct of Engineering Program and the LANL Institutional Quality Performance and Assurance (IQPA) program. Implementing these processes result in a SCE VCS that is compliant with the system technical, procurement, and quality assurance requirements. Successful qualification of the VCS demonstrates that the design will meet the credited Safety Function. This qualification affords a level of protection that would be equivalent to requiring a Certification Mark with U3 designator.

Received by the Board 12.13.24

D) Manufacturer's Design Report

Alternate Method and Technical Rationale:

The LANL Design Agency cited all design information in the VCS Qualification Letter, which references the Technical Baseline Information as defined by the LANL Design Authority Representative (DAR). The Technical Baseline Information includes engineering drawings, calculations, fabrication specifications, test reports, and evaluated non-conformances, and as-builts are recorded as Technical Baseline Information in an Institutional approved Configuration Management program.

E) Manufacturer's Design Report Certification

Alternate Method and Technical Rationale:

The design documents (i.e. drawings, calculations, specifications, testing) are prepared, reviewed and approved according to this process. The NWL VCS Qualification Letter cites the construction documents that contain the information required by KG-323. The LANL DAR approves the VCS Qualification Letter attesting that the construction information is adequate to ensure the Safety Function of the SCE VCS is met.

F) Authorized Inspector

Alternate Method and Technical Rationale:

The LANL Design Agency relies on the LANL Design Authority Representative (DAR) to review and inspect all construction Technical Baseline Information. Additionally, the LANL Design Agency relies on LANL trained and qualified Quality Assurance specialists to perform inspections commensurate with the ASME VIII-3 inspector roles.

ASME BPVC Section VIII, Division 3, Part KM – Material Requirements

A) Fasteners made of SA-574 Steel

Alternate Method and Technical Rationale:

The SCE VCS design requires a bolt material with high yield strength to maintain sufficient clamping (bolt pre-loading) of the covers to ensure the pressure-retaining capabilities are maintained during and post experiment execution to meet the Safety Function. The materials approved in ASME BPVC VIII-3 do not afford the strengths required to meet this requirement for all potential HE loads required by the Nuclear Weapons Programs. The LANL Design Agency evaluated SA-574 and selected it to ensure these bolts maintain the necessary clamping performance to ensure the Safety Function is met. The LANL Design Agency engaged with the ASME BPVC VIII-3 committee to adopt SA-574 as an approved bolt material. SA-574 was added to Part KM of ASME BPVC Section VIII, Division 3 in 2023.

Received by the Board 12.13.24

ASME BPVC Section VIII, Division 3, Part KD – Design Requirements

A) Welded Attachments and Supports

Alternate Method and Technical Rationale:

Article KD-700(a)(3) aims to prevent failures that have occurred in high pressure vessels resulting from cracks that propagated from welds to the pressure boundary that were not full penetration welds. The LANL Design Agency does not require full penetration welds for a support ring welded to the bottom of the 3-foot vessel weldment as a full penetration weld limits free-vibration response of the vessel weldment resulting in excessive strains on the weld. The burst failure mode that Article KD-700(a)(3) is intended to prevent does not apply to the current SCE VCS design. The single use nature of the 3-foot SCE VCS precludes load conditions to initiate a crack and crack propagation resulting in global plastic collapse. LANL Construction specifications require, and LANL's IQPA program verifies, that qualified personnel follow approved procedures to perform the weld operations. Examination and inspection of the weld are also performed to ensure any weld flaws are within acceptance limits established for pressure retaining components.

The welded support ring on the 3-ft SCE VCS design does not contribute to the Safety Function of the VCS. It serves as an attachment point from the vessel weldment to the vessel support stand to provide alignment of the VCS to the radiographic source and detector systems. A structural dynamic analysis indicates that a full penetration weld on this component resulted in plastic strain exceeding the allowable limits established in CC-2564. ILVs rely on the energy dissipating nature of mechanical strain (either elastic or inelastic) to react to the portion of explosive energy transferred from the detonation of the HE to the vessel wall. A full penetration weld of the support ring to the vessel weldment results in a localized constraint that limits free vibration of the vessel wall. This results in excessive strains on the weld observed in the dynamic structural analysis.

The LANL Design Agency qualifies the design of this component using CC-2564 Section 3.2 – *Experimental Design Verification* by executing a 125 percent HE over-test. Additionally, this ring is present on the representative VCS configuration fielded on the Integrated Fragment Test, further demonstrating adequacy of the component design. The 6-ft SCE VCS which will be used for SCEs executed in the ECSE Zero Rooms does not include a bottom support ring. All welds on the 6-foot SCE VCS are pressure retaining, use full-penetration welds, and are ASME BPVC compliant.

B) HSLA-100 Material Usage

Alternate Method and Technical Rationale:

The LANL Design Agency selected an alternate material which is subjected to all code required testing, examinations, and inspections. The vessel weldment is fabricated from HSLA-100 steel that, when compared to ASME VIII-3 compliant steels, provides the required or superior characteristics for protection against ductile failure and brittle fracture for its intended application. HSLA-100 was developed for naval applications where a combination of high

Received by the Board 12.13.24

strength, high low-temperature toughness, and weldability without post-weld heat treat were necessary to ensure safety in extreme environments including blast loading.

C) Fracture/Fatigue Analysis

Alternate Method and Technical Rationale:

The LANL Design Agency has selected to use the methodology identified in CC-2564 Section 3.2 to demonstrate adequate performance of single-use components (i.e., fasteners) in lieu of the fracture and fatigue analysis specified in KD-622. Experimental Design Verification per Section 3.2 assures that the single-use component designs, using materials not permitted by the code, are structurally sound (i.e. minimum 125 percent margin against global collapse failure) and satisfy the safety function.

D) Experimental Design Verification

Alternate Method and Technical Rationale:

a. Instrument Penetrations (feedthroughs) used in SCEs, include non-code materials such as epoxies, fiber-optics or glass in configurations where direct strain measurement is not possible. Numeric analysis cannot predict the dynamic failure mechanisms (e.g., loss of adhesion or spall) of these components since current material models are not well characterized for impulsive-load regimes. Additionally, the strain limits imposed by CC-2564 Section 3.1 (b) may not safely bound these failure mechanisms. The acceptance criteria for the 125 percent overpressure test are not explicitly tied to measurement of stress states in components. The alternate acceptance criterion is a pre- and post-execution helium leak check. Successful leak-tight performance of the SCE VCS during the Helium checks before and after test execution qualitatively demonstrates that an adequate stress state (with margin) of these components has been maintained in an operating environment that exceeds that expected for the SCE and therefore will meet the Safety Function.

b. Diagnostic Covers made of non-code materials may not be safely bounded by the strain limits imposed by CC-2564 Section 3.1 (b). The LANL Design Agency performs dynamic structural analyses to inform the design of these components. The 125 percent over-test then qualifies the design. Successful performance of the diagnostic covers qualitatively demonstrates that an adequate stress state (with margin) of these components has been maintained in an operating environment that exceeds that expected for the SCE and therefore will meet the Safety Function.

ASME BPVC Section VIII, Division 3, Part KF – Fabrication Requirements

A) Under matched weld yield strength

Alternate Method and Technical Rationale:

The SCE vessel weldment is welded with welding consumables which produces an under-matched weld. The under matched weld produces superior toughness leading to increased

Received by the Board 12.13.24

fracture-fatigue performance. Dynamic elastic-plastic analysis performed on the VCS show the under-matched welds comply with the strain limits imposed by CC-2564.

ASME BPVC Section VIII, Division 3, Part KR – Pressure Relief Devices

The LANL Design Agency has not identified any deviations to ASME BPVC Section VIII, Division 3, Part KR. Overpressure protection is compliant with CC-2564 Part 4.

ASME BPVC Section VIII, Division 3, Part KE – Examination Requirements

The LANL Design Agency has not identified any deviations to ASME BPVC Section VIII, Division 3, Part KE.

ASME BPVC Section VIII, Division 3, Part KT – Testing Requirements

A) Hydrostatic Pressure Test

Alternate Method and Technical Rationale:

Per LANL specifications, the manufacturer of the vessel weldment performs a hydrostatic over-pressure test of each vessel weldment using blank covers (flanges) at the manufacturing site. The experiment-specific vent valves, experiment covers, and diagnostic feedthroughs are not subjected to this hydrostatic over-pressure test to ensure that their suitability and integrity for experiment-specific (i.e., SCE) execution use are not adversely affected. This test approach is compliant with requirements specified in 2015 ASME B&PVC VIII-3, Section KT-312, *Upper Limit*, which states “that the designer should use caution that the suitability and integrity of non-cylindrical vessels, end closures, and all other components of the pressure boundary are not adversely affected by the application of the hydrotest pressure.” A hydrostatic over-pressure test of a complete VCS cannot sufficiently bound the dynamic stress states of all components of the VCS when induced by impulsive loads generated from the HE detonation of the SCE. Further, to attempt to use a hydrostatic over pressure test to bound all stress states of all components in the VCS would violate the Upper Limit clause of KT-312.

Another critical VCS testing activity supporting qualification includes:

- Performing a 125 percent HE over-pressure test of a representative VCS configuration used to execute SCEs.

The vent valves, experiment covers, and diagnostic feedthrough designs are qualified by performing a 125 percent HE integrated system over-pressure test. The representative VCS configuration used for this 125 percent HE over-pressure test includes a vessel weldment (hydrostatically pressure tested at the manufacturer’s site), covers, diagnostic feedthroughs, and vent valves whose designs are identical to those items which are used for the execution of an SCE. That is to say, the items are designed, procured, fabricated, inspected, and tested to quality assurance and control requirements for safety significant SSCs. The 125 percent HE overpressure test qualifies the design of the system and not the actual system used for SCE execution. This qualification testing approach is purposely implemented as subjecting the VCS as an integrated system to the 125 percent HE over-pressure test would compromise the

Received by the Board 12.13.24

suitability and integrity of the actual design limiting components (feedthroughs, diagnostic covers, and vent valves) necessary for SCE experiment execution.

Simply stated, subjecting the vent valves, experiment covers, and diagnostic feedthroughs which will be used to execute an SCE to a HE overpressure-test would adversely affect their structural integrity for re-use in executing a SCE. The LANL Design Agency asserts that dynamically over-pressure testing representative vent valves, experiment covers, and diagnostic feedthroughs with the appropriate quality is the more conservative and prudent approach for qualifying these components for SCE use.

ASME BPVC Section VIII, Division 3, Part KS – Marking, Stamping, Reports, and Records

A) Vessel Marking

Alternate Method and Technical Rationale:

A unique serial number is applied to each SCE vessel weldment for configuration management purposes. The Technical Baseline Information includes all the information required by KS-100. Additionally, the LANL Facilities Conduct of Engineering Program for this vessel type does not require stamping of the SCE VCS to indicate certification.

B) Part Marking

Alternate Method and Technical Rationale:

A unique serial number is applied to each VCS component contributing to the SCE VCS Safety Function for Configuration Management purposes. The Technical Baseline Information includes all the information required by KS-120. Additionally, the LANL Facilities Conduct of Engineering Program for this vessel type and application does not require stamping of the SCE VCS to indicate certification.

C) Manufacturer's Data Report

Alternate Method and Technical Rationale:

All Construction information is included in the Technical Baseline Information, which is cited in the VCS Qualification Letter. The VCS Qualification Letter is approved by the LANL DAR. The Technical Baseline Information includes engineering drawings, calculations, fabrication specifications, inspection specifications, test specifications, test reports, and evaluated non-conformances. The Technical Baseline Information and as-built configurations are controlled by following institutionally approved Configuration Management programs. Vendor-supplied products include Certified Material Test Reports, certificates of compliance, or equivalent documentation per institutional quality assurance and procurement requirements.

III.9. ASME BPVC Section VIII, Division 3, Mandatory Appendices

Alternate Method and Technical Rationale:

Received by the Board 12.13.24

Section KR-410 provides the minimum qualifications for the Certified Individual. LANL institutes an ASME NQA-1 Quality program for credited safety systems. LANL IQPA acts as the Certified Individual and meets the minimum qualifications.

<u>Potential Inadequacy of the Safety Analysis (PISA) Status</u>

On July 25, 2024, the DNFSB Chair submitted a letter to the DOE Secretary citing safety issues in safety basis documents for the ECSE projects at the NNSS PULSE facility. One issue relates to the VCS used to execute SCE at the NNSS PULSE facility not dealing with the unevaluated effects from changing the performance criterion for the VCS. This led to ongoing PISAs of the VCS for DAF and PULSE. Mission Support & Test Services, LLC (MSTS) submitted the PULSE and DAF VCS Evaluation of the Safety of the Situation (ESS) on October 29, 2024.

Safety Question 4 – What actions has NNSA taken or planned to improve the means of egress to ensure that workers can adequately evacuate the PULSE facility during accidents or incidents?

Three safety-related issues involving the ability of workers to evacuate the PULSE facility during accidents or incidents were documented in the May 9, 2024, DNFSB Staff Report. Each of the three issues are identified below, followed by specific actions that are being implemented or planned to improve the means of egress to ensure that workers can adequately evacuate the PULSE facility.

Issue 1: *If an accident were to occur in PULSE, workers might not have an adequate means to escape the facility. MSTS should consider options to comply with NFPA 101, such as mining an alternative means of egress or pursuing an equivalency or exemption. MSTS should also update its safety and health program description document [20] to align with the means of egress requirements for industrial occupancies in NFPA 101.*

An adequate means of egress is provided in PULSE during a fire accident scenario. This is accomplished through implementation of the NNSS *Underground Facility Safety and Health Program Description*, PD-P200.002, requirements which allow for safe refuge and escape from the facility. MSTS is currently pursuing fire/egress modeling to further validate the adequacy of portions of the PULSE means of egress system. The goal with respect to life safety in the underground is to meet or exceed the requirements established for use in subterranean facilities. The NNSS *Underground Facility Safety and Health Program Description*, includes requirements derived from other fire protection, life safety, and mining industry specific consensus codes and standards. This program is responsive to 10 CFR 851, *Worker Safety And Health Program*, and is based upon 29 CFR 1910, *Occupational Safety And Health Standards*, and 29 CFR 1926, *Safety And Health Regulations For Construction*. The requirements within PD-P200.002 are a combination of 29 CFR 1910, 29 CFR 1926, and other industry standards such as National Fire Protection Association (NFPA) 520, *Standard on Subterranean Spaces*. NFPA 520 was first developed 25 years ago, with the first addition approved in 1999. Since the inception of NFPA 520, it has been acknowledged that the intent of NFPA 101 did not include uniform application throughout all subterranean spaces. In 2014, DOE recognized the need to develop specific

Received by the Board 12.13.24

guidance on fire protection for its underground facilities. In June 2014, the Subsurface Facility Working Group (SFWG), established by the DOE Fire Safety Committee, issued a report pointing out problems with full application of NFPA, Mine Safety and Health Administration (MSHA), and Occupational Safety and Health Administration (OSHA) through DOE's directives. In November 2015, DOE convened an "Underground Facility Criteria Development Meeting" to develop relevant guidance for incorporation into DOE-STD-1066, *Fire Protection* (Now located in Appendix D).

DOE-STD-1066-2016, Section 1.2, provides an allowance for alternate approaches to be used to achieve acceptable levels of safety when approved by the DOE field element. MSTS has utilized this approach and documented its approval by the Nevada Field Office with the approval of PD-P200.002, which includes the applicable sections of DOE-STD-1066-2016, Appendix D, *Fire Protection for Subterranean Facilities*.

The life safety requirements for the PULSE subterranean facility as noted in PD-P200.002 are implemented by CD-2120.017, the MSTS Fire Protection program, including a discussion on the applicability of NFPA 101, *Life Safety Code*, in subterranean facilities. NFPA 101 applies to rooms, buildings, and structures within subterranean areas defined as Developed Space.

MSTS is also performing fire/smoke and egress modeling to provide a basis for determining ASET/RSET (Available Safe Egress Time/Required Safe Egress Time) as required by NFPA 770, *Standard on Hybrid (Water and Inert Gas) Fire-Extinguishing Systems*, for the design of the Hybrid Extinguishing System that will be installed as part of the UCEP and ZEUS projects. The data and results of these models may be used for other purposes in the future if needed, such as for pursuing a performance-based approach. The position MSTS establishes in PD-P200.002 is consistent with DOE-STD-1066-2016, Appendix D, and states the following:

> "*Developed Space: An area of the underground facility that has been altered for the performance of mission-oriented process operations or experiments, including areas of the underground facility in which materials that are likely to burn with extreme rapidity or from which explosions are likely, are staged or used that is separated from the underground infrastructure or undeveloped space by fire-resistive construction. This excludes basements of surface structures and buildings as defined by NFPA 101, NFPA 520, and the applicable building code.*"

Issue 2: *The single means of egress from the ZEUS Zero Room drifts exceeds what is allowed in National Fire Protection Association (NFPA) 101, Life Safety Code. NFPA 101 states that the maximum common path of travel is 50 feet for non-sprinklered areas and 100 feet for sprinklered areas. The most remote section of the ZEUS Zero Room is more than 100 feet from where two exits are available*.

Because of the unique and legacy nature of the NNSS underground facilities, the principal standards for egress are DOE-STD-1066-2016, Appendix D, and 30 CFR 57, *Safety And Health Standards—Underground Metal And Nonmetal Mines*. Strict implementation of all NFPA 101 egress requirements is not feasible due to the load-bearing nature of necessary alluvium/rock pillars in the drift network as well as other physical and site constraints associated with the

Received by the Board 12.13.24

unique experimental activities conducted in the NNSS underground facilities. Nonetheless, there are important aspects of egress that are already codified in other codes and standards and are deliberately chosen to compliment the requirements of the principal standards. DOE-STD-1066-2016, defines a subterranean facility as "[s]paces that cannot meet NFPA 101, *Life Safety Code*®, NFPA 520, *Standard on Subterranean Spaces*, or the International Building Code (IBC) egress requirements due to the orientation or configuration of parts of the structure below ground level, which may include open and cut excavations." NFPA 520 further reinforces this conclusion by stating that NFPA 101 does not apply to all areas of a subterranean facility.

Accordingly, MSTS PD-P200.002, 5.1.2.1, includes: *Means of Egress – other than those pertaining to travel distances, common paths of travel, number of exits, and dead ends – for rooms, buildings, and structures within subterranean, Developed Spaces shall be in accordance with the applicable occupancy chapter of NFPA 101. Total travel distance from the most remote area of a Developed Space, including common paths of travel and dead ends, shall comply with 5.1.3.5.*

Per PD-P200.002, 5.1.3.5, the maximum travel distance to a portal, hoist, refuge station, or an exit passageway system shall not be more than 2,000 ft. This aligns with DOE-STD-1066-2016, D.3.1.

In addition to applicable PD-P200.002 requirements, MSTS is performing fire/smoke and egress modeling in the Zeus area and will use the results of the models as a basis for ASET/RSET.

Issue 3: *MSTS plans to install a rotary uninterruptible power source in an alcove that is open to the means of egress. DOE Standard 1066-2016, Fire Protection, requires that the room with this system be separated from the means of egress by walls with at least a two-hour fire resistance rating. MSTS should install a fire-rated wall to separate the rotary uninterruptible power source from the means of egress.*

Per MSTS PD-P200.002, 8.3.4 (f), "Storage rooms greater than 150 sq. ft. and secondary power system rooms shall be separated from the remainder of the subterranean spaces by walls with at least a two-hour fire resistance rating. {DOE-STD-1066, D.2.5.2}" This requirement, as referenced in the DNFSB staff report, is applicable in the MSTS program and applicable to the project. The project is aware of the requirement and will comply.

Received by the Board 12.13.24