UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

DEPLOYABLE ENERGY LIMITED – SUMMARY OF THE OBSERVATION AUDIT OF THE U.S. DEPARTMENT OF ENERGY AUTHORIZATION ACTIVITIES FOR THE UNITY NUCLEAR BATTERY AT THE IDAHO NATIONAL LABORATORY SITE (EPID NO. L-2026-LLL-0003)

Applicant:	Deployable Energy Limited (DE)
Applicant Address:	6900 Thrustmaster Drive Houston, TX, 77041
Plant Name and Units:	Unity Nuclear Battery (UNITY)
Project No.:	99902155

1.0 BACKGROUND

By letter dated March 11, 2026 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML26070A411), DE requested that the U.S. Nuclear Regulatory Commission (NRC) staff conduct an audit to observe DE's products and interactions pertaining to the U.S. Department of Energy (DOE) authorization activities for DE's UNITY at the site of the Idaho National Laboratory (INL).

In the letter dated March 11, 2026, DE stated that the demonstration of the UNITY at the INL site is being conducted under a Strategic Partnership Project and will test a range of criticality experiments at the Materials and Fuels Complex's Neutron Radiography (NRAD) cell. In parallel with the DOE authorization process, DE plans to submit a construction permit (CP) application to the NRC for the UNITY. Additionally, DE will also potentially submit topical reports on topics within the scope of the DOE observations. Gaining awareness of the DOE submittals and supporting information through an electronic reading room (ERR) and overserving key interactions between DE and DOE will allow NRC staff to provide feedback to DE on the application documents and effectively leverage that information in future application reviews.

This audit was consistent with the NRC's process discussed in "Expectations for NRC Staff Involvement with Prospective NRC License Applicants Planning to Refer to DOE and [U.S. Department of War] Authorizations Processes" (ML25322A208) and followed the guidance in the Office of Nuclear Reactor Regulation's Office Instruction LIC-111, "Regulatory Audits," Revision 1 (ML19226A274).

The NRC staff audit plan is dated March 16, 2026 (ML26075E850). The audit was conducted from March 19, 2026, through August 2026, during virtual meetings and using DE's ERR.

Enclosure

On March 19, 2026, via Microsoft Teams, the NRC staff observed DOE's preliminary design review (PDR) meeting for DE's UNITY zero-power critical experiment.

On April 21, 2026, via Microsoft Teams, the NRC staff observed DOE's Final Design Review (FDR) kickoff meeting for DE's UNITY zero-power criticality experiment. DE and DOE covered the following topics during this meeting: design status and changes since PDR; nuclear concept of operations; mechanical, electrical, and control drawings; post-design activities, safety basis; and preliminary documented safety analysis (PDSA) comments discussion.

On June 22, 2026, DE received DOE approval of its documented safety analysis (DSA) and on June 30, 2026, DE's UNITY zero-power criticality experiment demonstration went critical at INL under DOE authorization with the DOE Idaho Office and DOE-Northeast present for the criticality event. The documentation of DE's UNITY zero-power criticality experiment DSA and DOE approval of the DSA were not provided to the NRC for audit.

2.0 AUDIT REGULATORY BASES

The basis for the audit is:

- The regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Parts 50 pertinent to the NRC staff's review of a non-power production and utilization facility permit application, and
- "Expectations for NRC Staff Involvement with Prospective NRC License Applicants Planning to Refer to DOE and DOW Authorization Processes," (ML25322A208).

The codes, standards, regulations, and DOE orders that DE identified as applicable to the UNITY critical experiment are:

- The regulations in 10 CFR 830,2 "Nuclear Safety Management,"
- NE O 420.1, "Facility Safety," DOE, issued August 2025,
- DOE-STD-3009-2014 "Preparation of Nonreactor Nuclear Facility Documented Safety Analysis," DOE-STD-3009-2014, U.S. Department of Energy, Washington, DC (2014),
- American Nuclear Standards Institute (ANSI)/American Nuclear Society (ANS) ANSI/ANS-15.21-2012, "Format and Content for Safety Analysis Reports for Research Reactors,"
- ANSI/National Fire Protection Association (NFPA)-70, "National Electrical Code," and
- ANSI/ANS-1-2000, "Conduct of Critical Experiments", American National Standards Institute/American Nuclear Society, October 2007.

3.0 PURPOSE

The purpose of the audit was for the NRC staff to gain a better understanding of the anticipated DE UNITY CP application by providing an opportunity to view the documents submitted to DOE, the questions and responses developed as part of the DOE review, and the results of DOE's review of the preliminary design, final design, PDSA and DSA page-turn reviews as well as on-site review of the operational readiness review. The NRC staff sought to observe the DOEs review process for the DEs UNITY Zero-Power Critical Experiment and provide feedback to support development and preparation for future NRC licensing applications.

The NRC staff observations are focused on existing NRC regulations and their applicability to a future NRC licensing application and should not be construed as an evaluation of the technical adequacy of the safety basis for the DE's UNITY zero-power criticality experiment. No

regulatory decisions are made as a result of information that supports DOE authorization being shared with the NRC for the purpose of pre-application engagement on a future licensing action.

4.0 REGULATORY AUDIT SCOPE

This audit focused on information provided by DE in the ERR and during meetings and interactions between DE and DOE. The audit provided the NRC staff with information related to the DOE review of the UNITY zero-power critical experiment.

Members of the audit team included the following NRC staff:

- Ayesha Athar, Technical Lead UNITY
- Joseph Bass, Materials Engineer
- Stephanie Devlin-Gill, Project Management Lead UNITY
- John Matrachisia, Nuclear Engineer
- Alexandra Terres, Reactor Systems Engineer
- Jadin Swarts, Reactor Systems Engineer
- Scott Tonsfeldt, Technical Assistant, Audit Support

The NRC staff did not acquire any documents during the audit. The documents provided in the ERR by DE for the NRC staff to conduct the observation audit are:

- SAR-406, “Safety Analysis Report for the Neutron Radiography Reactor Facility,” Revision 3, July 2025,
- SAR-406-ADD-01, “UNITY Critical Experiment Safety Analysis Report Addendum for the NRAD Facility,” Revision 0, June 2026,
- NSDA-488, “Nuclear Safety Design Agreement for Deployable Energy UNITY Zero-Power Critical Experiment,” Revision 0, March 2026,
- Enclosure 1 of PDSA-488, Revision 0, “[DE: PDSA],” March 2026, and
- Presentation slides for the May 21, 2026, DOE FDR kickoff meeting for DE’s [UNITY] zero-power criticality experiment, May 2026.

5.0 AGENDA TOPICS

The NRC staff observed the following portions of the PDSA for the UNITY zero-power criticality experiment:

- Site Characteristics
- Facility Description
- Hazard and Accident Analysis
- Safety Structures, Systems, and Components
- Derivation of Technical Safety Requirements
- Prevention of Inadvertent Criticality
- Safety Management Programs

6.0 REGULATORY AREAS OF INTEREST

6.1 Quality Assurance

The NRC staff issued separate feedback on DE’s “Quality Assurance Program Description” white paper on August 12, 2026 (ML26215A486).

6.2 Licensing Basis Events Selection and Structures, Systems and Components Classification and Safety Analysis

PDSA section 4 addresses the safety classification of structures, systems and components. NRC staff acknowledges the difference between the DOE safety classification approach and that for the equivalent NRC regulations, and **[[**

]]. There appear to be conceptual similarities to the NRC categories of safety related and non-safety related equipment. SAR-406 and the addendum SAR-406-ADD-1 discuss the relevant safety-significant SSC's, the safety function, functional requirements, and performance criteria based on the results of the hazard analyses in chapter 8, "Hazard and Accident Analysis," and chapter 10, "Prevention of Inadvertent Criticality." NRC staff expects any relevant observations or lessons learned related to classification of SSC's to be considered in developing a CP application, in addition to relevant guidance, including NUREG-1537[1], chapter 3, "Design of Structures, Systems, and Components," chapter 6, "Engineered Safety Features," and chapter 13, "Accident Analysis."

PDSA section 2.5.3 describes the core support structures. **[[**

]]. For an NRC licensing application, the level of detail to be provided about structural elements will depend on their safety classification and design criteria. Relative to the PDSA, this may require additional information about the material specification, operating parameters, assessment of potential degradation modes, and use of consensus codes and standards for design and analysis.

6.3 Principal Design Criteria

PDSA section 2.5.4 states that the **[[**
]]. DE should consider the regulatory requirements for reactivity control systems, such as Advanced Reactor Design Criterion 26 described in NRC Regulatory Guide (RG) 1.232, "Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors" (ML17325A611), Revision 0, which references two reactivity control systems. The NRC staff issued feedback on DE's white paper "UNB Facility Principal Design Criteria Program," on May 28, 2026 (ML26148A387).

6.4 Source Term

The PDSA section 3.4.3.1.2, "Source Term Analysis," references ECAR-9143, "UNITY Zero-Power Critical Experiment Hazard Evaluation," for the development of the accident source term. For NRC licensing, an application should justify the source term method used in lieu of a mechanistic source term (MST), which is the preferred approach for non-LWR technologies. This consideration is particularly important if DE intends to implement a functional containment strategy rather than relying on a traditional physical containment building. Functional containment is a set of barriers that taken together, effectively limit the physical transport of radioactive material to the environment. Generally, design-specific MST modeling is used to evaluate retention of radionuclides by barriers and the transport of radionuclides for all barriers and pathways to the environs. Principles and guidance for MST development can be found in:

[1] https://www.nrc.gov/regulations-legislation/nureg-series-publications/publications-prepared-by-nrc-staff/nureg-1537

- SECY-93-092, “Issues Pertaining to the Advanced Reactor (PRISM, MHTGR, and PIUS) and CANDU 3 Designs and Their Relationship to Current Regulatory Requirements” (ML040210725),
- DG-1425, “Alternative Radiological Source Terms For Evaluating Design Basis Accidents at Nuclear Power Reactors,” (ML24185A179),
- RG 1.247, “For Trail Use – Acceptability of Probabilistic Risk Assessment Results for Non-Light Water Reactor Risk-Informed Activities,” Revision 1 (ML26132A266), and
- Chapter 13 of NUREG-1537 provides guidance on the development of accident source terms and the maximum hypothetical accident (MHA).

6.5 Consequence Analysis

Chapter 3 of the PDSA, “Hazard and Accident Analysis,” contains the quantitative consequence analyses of postulated representative, bounding, and unique accidents selected from the hazard analysis. Section 3.3.2.3, “Hazard Evaluation,” references unmitigated dose consequence in ECAR-9070, “Evaluation of the UNITY Zero-Power Critical Experiment Dose Consequences," summarized in section 3.4, “Accident Analysis.” Additionally, SAR-406-ADD-1 provides hazard and accident analysis for execution of the UNITY critical experiment and supplements SAR-406 by providing information and analysis specific to the UNITY critical experiment. For CP applications using a predominantly deterministic approach, the guidance in NUREG-1537, chapter 13 describes the postulated MHA approach and provides guidance for research and test reactor accident and consequence analyses that may be useful when seeking a Class 104 license. Furthermore, the application should discuss the analysis methods and assumptions for the total calculated radiological consequence dose at the exclusion area boundary, the outer boundary of the low population zone, and the control room. Important information relevant to this chapter includes, but is not limited to, the facility design features, safety limits, limiting safety system settings, and limiting conditions for operations that have been selected to ensure no credible accident could lead to unacceptable radiological consequences to people or the environment.

6.6 Emergency Preparedness

The PDSA references chapter 15 of SAR-400 chapter, “Emergency Preparedness Program,” which describes provisions for the INL emergency preparedness program, applicable to the UNITY critical experiment. This document was not made available for NRC review. A CP application for a research and test reactor should follow the guidance in ANSI/ANS 15.16-2015, “Emergency Planning for Research Reactors,” which is endorsed by RG 2.6, “Emergency Planning for Research and Test Reactors” Revision 2 (ML17263A472), and consider NUREG-0849, “Standard Review Plan for the Review and Evaluation of Emergency Plans for Research and Test Reactors,” (ML062190191).

6.7 Security

The PDSA does not include a description of the facility security plan. SAR-406 lists the general design requirements established by DOE O 5480.30 and evaluates the NRAD design basis in section 5.2.1.11, “Safeguards and Security.” An application for a CPA must include a physical security plan, a training and qualification plan, and a cyber security plan in accordance with the applicable 10 CFR Part 73, “Physical Protection of Plants and Materials,” criteria. NRC staff issued feedback on DE’s “Applicability of NRC Regulations to UNITY Nuclear Battery Non-Power Utilization Facility Construction Permit and Operating License Applications” white paper regarding Part 73 on May 28, 2026 (ML26148A387).

6.8 Fire Protection Requirements

Section 7.2 of the PDSA references SAR-400, chapter 11, “Operational Safety,” section 11.4, “Fire Protection,” which describes provisions for the INL fire protection program applicable to the UNITY critical experiment. Section 5.3 of the NSDA, “Fire Prevention and Mitigation,” discusses the plans for fire hazard analysis during the preliminary design phase and the final design phase. These plans were not made available to the staff for review. For research and test reactor CP application under 10 CFR Part 50 Class 104, the fire hazards analysis should describe the systems and programs designed to protect the reactor facility from damage by fire and discuss how the facility meets all local building and fire codes. As stated in NUREG-1537, section 9.3, “Fire Protection Systems and Programs,” ANSI/ANS 15.17-1987, “Fire Protection Program Criteria for Research Reactors,” contains general information on fire protection.

6.9 Technical Specifications

PDSA section 5 states that **[[**

]]. The UNITY critical experiment TSRs will be identified in the final DSA. NRC staff relate the TSRs to what are referred to in NRC regulations as Technical Specifications (TS). The NRC licensing framework will inform the details for TS required in a license application. Identification of variables and conditions that are likely subjects of TS would be sufficient for a CP application, whereas essentially complete TS would be required for an operating or combined license.

6.10 Site Characterization and Design for External Hazards

NUREG-1537 chapter 2, “Site Characteristics” discusses the definitions, designs, and analyses expected in this chapter of the SAR. Non-power research reactors are exempt from the prescriptive siting rules of 10 CFR Part 100, “Reactor Site Criteria.” Siting approval for a Class 104 “Research Reactor” path is instead established via dose-based performance criteria under 10 CFR 50.34(a)(1)(i). A non-power “testing facility” is expected to be in compliance with the requirements of 10 CFR Part 100. The regulations in 10 CFR Part 100 require an application for testing facility license to include a description of the processes and techniques used for site investigation and characterization, including justification for the suitability and applicability of information derived from previous analysis or for a site different than the reactor location. Further engagement with NRC staff on the licensing approach is encouraged.

6.11 Code and Standards

The codes and standards applied to SSCs should be commensurate with the significance of their safety functions (safety related or non-safety). While the safety classification for SSCs in for the UNITY critical experiment facility is recognized to be much more limited than what would be expected for an NRC CP application, early alignment in this area during pre-application engagements is important—particularly if DE intends to leverage codes and standards from the reactor pilot program.

7.0 ADDITIONAL STAFF OBSERVATIONS

The NRC staff acknowledges that the UNITY critical experiment will have a limited resemblance to the final design expected for the UNITY. As such, the NRC staff focused its review on technical and programmatic areas that could be extrapolated to the NRC application. The information presented in the PDSA generally aligns with the regulatory areas of interest for an

NRC application, however, the limited availability of supporting documentation limits the scope of this review.

The NRC staff notes that realizing the additional efficiencies in the NRC application review relies primarily on the applicant's description of how prior authorizations and testing address associated NRC requirements and could thus be potentially "leveraged" by the NRC staff when performing its application reviews. DE is encouraged to continue engaging with the NRC staff to optimize this pathway.