Hadron Energy, Inc.
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July 1, 2025

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555–0001

Subject: First Amended Hadron Energy Microreactor Pre-Application Regulatory Engagement Plan for Standardized Microreactor Design

Dear Mr. Sayoc,

Hadron Energy, Inc. (Hadron Energy) submits the enclosed **First Amended Pre-Application Regulatory Engagement Plan (REP)** for the Hadron Energy Microreactor standardized design.

This amended REP supersedes the initial submission of May 9, 2025, and incorporates two key updates:

1. **Updated Mailing Address:** Our new headquarters address, effective June 2025, is now reflected.
2. **Reactor Design Change (2 MWe to 10 MWe):** This modification reflects strong market preferences for a larger microreactor while maintaining the essential size, weight, and transportability constraints critical to the Hadron MMR design. We have assessed that this change does not alter the fundamental regulatory approach outlined in the original REP.

We recognize this update is close to the upcoming public meeting on July 8, 2025. We prioritized submitting this amendment promptly to ensure the most current information is available to the NRC and to maintain our commitment to transparency. Aside from these two modifications, all other aspects of the REP remain unchanged.

Should you have any questions or require further clarification regarding this submission, please contact our primary point of contact, Samuel Gibson, at sgibson@hadronenergy.com or (605) 929-7913.

Sincerely,

Samuel Gibson
Founder & CEO
Hadron Energy, Inc.

Enclosures:

1. First Amended Hadron Energy Microreactor Pre-Application Regulatory Engagement Plan

Manny Sayoc, New Reactor, Safety Review, and Environmental Review Project Manager
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EXECUTIVE SUMMARY

Hadron Energy, Inc. (Hadron Energy) is developing a standardized, LEU-fueled, light-water cooled and moderated microreactor design for commercial licensing and deployment. This First Amended Regulatory Engagement Plan (REP) outlines Hadron Energy's strategy for interacting with the U.S. Nuclear Regulatory Commission (NRC) staff during the pre-application phase. The primary goal of this REP is to facilitate efficient communication, establish mutual understanding on key regulatory and technical topics, and provide a predictable framework for planned interactions and submittals, ultimately leading to the submission of a high-quality license application.

Hadron Energy intends to pursue a Standard Design Approval (SDA) under 10 CFR Part 52, Subpart E for the standard design, followed by the manufacturing license application under 10 CFR Part 52, Subpart F, together with a license for fuel loading under 10 CFR Part 70 that references the approved SDA. This REP details the planned pre-application activities, including technical exchanges, white paper and topical report submittals, and meetings focused on unique design aspects, potential regulatory challenges, and the proposed licensing pathway.

Key areas identified for early engagement include the regulatory implications of factory manufacturing and testing, transportability, flexible siting approaches, and remote operations. Hadron Energy values NRC staff input and feedback on the information presented herein to refine its approach and ensure alignment with regulatory expectations. Hadron Energy is committed to meeting existing regulatory requirements and anticipates that early engagement will identify areas where modernization of regulatory processes might benefit future applications.

This REP will be periodically updated to reflect project progress and evolving regulatory strategies, in coordination with the NRC staff project manager.

1. INTRODUCTION/PURPOSE OF REP

This First Amended Regulatory Engagement Plan (REP) has been developed by Hadron Energy, Inc. (Hadron Energy) to facilitate communication and collaboration with the U.S. Nuclear Regulatory Commission (NRC) staff regarding the licensing of the Hadron Energy Microreactor standardized design. It documents Hadron Energy's proposed licensing approach, identifies topics for engagement, outlines schedule expectations, and serves as a roadmap for pre-application interactions. The primary purpose is to reduce regulatory uncertainty by fostering early dialogue and establishing mutual understanding.

1.1 Contact Information

For routine communication and coordination, the primary point of contact for Hadron Energy is:

Samuel Gibson
Title: Chief Executive Officer

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Phone: (605) 929-7913
Mailing Address: Hadron Energy, Inc., 3 Twin Dolphin Dr #260, Redwood City, CA 94065

Additional points of contact for specific technical or project management areas will be provided directly to the assigned NRC staff project manager.

1.2 Company/Project Structure

Hadron Energy, Inc. ("Hadron Energy") is committed to a productive and transparent regulatory engagement with the NRC throughout the licensing process. Established in 2024 as a privately held Delaware C-corporation, Hadron Energy is focused on the design, manufacturing, licensing, and deployment of the standardized Hadron Microreactor.

Hadron Energy currently operates as a standalone entity and is not a subsidiary of, nor formally affiliated with, any parent corporation. Ownership is held domestically, and funding is primarily secured through private investment sources, including venture capital and strategic partnerships. Hadron Energy confirms that it is not under foreign ownership, control, or domination (FOCD) as defined by the Atomic Energy Act and relevant NRC regulations (10 CFR 50.38).

The Hadron Microreactor project is managed internally by Hadron Energy personnel. Key management and technical staff possess significant experience in relevant fields, including nuclear engineering, advanced reactor design, regulatory affairs, quality assurance, and project management. Quality assurance programs suitable for the planned activities are under development and will be implemented consistent with regulatory requirements.

Hadron Energy understands the requirement under 10 CFR 50.33(f) and 10 CFR 52.77 to demonstrate financial qualification. Current funding is sufficient for planned pre-application activities, and Hadron Energy has a phased financing strategy aligned with project development and licensing milestones. Detailed financial information demonstrating qualification for the manufacturing activities under the Manufacturing License application will be provided. Financial qualification for construction and operation of deployed reactors, including reasonable decommissioning funding assurance, would be addressed in subsequent site-specific license applications (e.g., Combined Licenses) submitted by customers or partners.

Project schedules and the scope of NRC engagement are dependent on available funding. Hadron Energy is committed to proactive communication with the NRC project manager regarding resource planning and any potential budgetary constraints that could impact agreed-upon schedules (See also Section 9.2). The project currently does not receive U.S. government cost-share funding.

As detailed elsewhere (Sections 4.5.2, 8.6), Hadron Energy anticipates potential regulatory engagement with other entities, including the Canadian Nuclear Safety Commission (CNSC) and the U.S. Department of Energy (DOE).

1.3 Summary Strategic Project Approach/Goals

Hadron Energy's strategic approach centers on the efficient design, manufacturing, and deployment of a standardized, factory-built, transportable 10 MWe light-water microreactor. Our intended regulatory path involves pursuing a Standard Design Approval (SDA) under 10 CFR Part 52, Subpart E for the standard design, followed by the manufacturing license application under 10 CFR Part 52, Subpart F, together with a license for fuel loading under 10 CFR Part 70 that references the approved SDA. We aim to maximize the benefits of standardization through factory production and testing to enhance safety, quality, and regulatory efficiency.

The inherent novelty of our approach—particularly the factory fueling, transportability of the completed reactor, flexible deployment model, and planned remote operations—presents unique considerations for demonstrating compliance with existing regulatory frameworks. Key areas requiring early engagement include establishing the licensing basis for transporting a fueled microreactor, developing flexible and/or bounding site parameter envelopes suitable for varied deployment locations, and demonstrating compliance with operational requirements, including staffing (e.g., 10 CFR 50.54(k)), for remotely monitored facilities.

Recognizing these unique aspects, a cornerstone of our strategy is proactive and staged pre-application engagement with the NRC. We plan to utilize mechanisms such as targeted white papers, topical reports, and potentially a conceptual design assessment to seek early NRC feedback. This collaborative approach is intended to identify and resolve potential regulatory challenges efficiently, supporting a predictable review process for the subsequent SDA, Manufacturing License, and Part 70 license applications pursued by Hadron Energy, as well as for future site-specific Combined License applications submitted by our customers or partners.

1.4 Background

The Hadron Microreactor design is fundamentally based on proven light-water reactor (LWR) technology, leveraging decades of operational experience, established materials data, and validated analytical methods. Grounding the design in established LWR principles minimizes technical risk associated with core reactor technology and allows regulatory review to focus efficiently on the novel aspects of our implementation.

Hadron Energy's primary innovation lies not in the core reactor physics, but in the overall deployment strategy: standardized factory manufacturing, integrated packaging optimized for transportability, enhanced deployment flexibility, and a robust remote operations model. This approach is driven by the strategic goal of providing modular, secure, reliable, and cost-effective carbon-free power for remote communities and critical infrastructure.

To rigorously validate the integrated design, including control systems and operational concepts, Hadron Energy is investing significantly in advanced simulation and testing infrastructure. This includes the development of a high-fidelity digital twin, which will be rigorously qualified and

utilized in conjunction with targeted hardware testing within a robust Quality Assurance program planned for compliance with ASME NQA-1 (Quality Assurance for Nuclear Facility) standards.

1.5 REP Approach

This First Amended Regulatory Engagement Plan (REP) outlines Hadron Energy's proposed framework for proactive and collaborative interaction with the NRC staff during the pre-application phase for the Hadron Microreactor. Our approach is consistent with the principles described in industry guidance, such as NEI 18-06, "Guidelines for Development of a Regulatory Engagement Plan."

Section 9.1 of this document provides a detailed projected schedule for planned regulatory interactions and submittals. Recognizing that project plans and timelines evolve, Hadron Energy views this REP as a living document. We intend to formally review and update this REP, in consultation with the NRC Project Manager, approximately once every six months, or more frequently if significant changes in strategy, scope, or schedule occur. These updates will incorporate NRC feedback and reflect the most current project planning.

Beyond the formal REP updates, any significant deviations from the plans or schedules outlined herein will be communicated promptly to the NRC staff project manager. Hadron Energy welcomes regular communication with the NRC staff and proposes periodic meetings (e.g., quarterly or as needed based on activity levels) to discuss progress and upcoming activities during active pre-application phases.

2 TECHNOLOGY SUMMARY

The Hadron Microreactor is designed as a standardized, transportable power source utilizing established light-water reactor (LWR) principles. The primary innovations relate to its packaging, manufacturing, transportability, and operational model rather than fundamental reactor physics or core technology. This summary provides a high-level overview relevant to regulatory review. More detailed technical information will be provided in subsequent white papers and technical reports identified in Section 9.1.

2.1 Size

- **Thermal Power:** 30-35 MWth (nominal).
- **Electric Output:** 10 MWe net electric output (nominal).
- **Physical Size:** Designed to fit within the dimensional envelope of a standard ISO shipping container to facilitate transport via conventional road, rail, air, or sea logistics.

2.2 Fuel

- **Fuel Type and Form:** The Hadron Microreactor uses High-Assay Low-Enriched Uranium (HALEU) dioxide (UO_2) fuel, fabricated into conventional cylindrical pellets and encased in cladding materials—such as zirconium alloys—that are well-characterized through decades of commercial light water reactor (LWR) operation. This familiar geometry and material selection supports predictable thermal-mechanical behavior, effective heat transfer, and robust fission product retention, while facilitating licensing by leveraging an extensive base of existing fuel performance data.
- **Enrichment:** The uranium will be enriched to less than 20% U-235, consistent with HALEU classification and well below the threshold for highly enriched uranium. This enrichment level allows for extended core life while supporting nonproliferation goals and compliance with 10 CFR Part 50 and relevant DOE/NNSA oversight for HALEU handling.
- **Fuel Qualification Approach:** Fuel performance is expected to be supported in part by applicable data from existing HALEU programs and historic LWR fuel testing. Recognizing the unique configuration and operating environment of the Hadron Microreactor, a dedicated fuel qualification strategy will also be developed. This may include integral effects testing, modeling, and analytical validation in accordance with NRC Regulatory Guides and ANSI/ANS standards.
- **Fuel Handling and Lifecycle:** To enhance operational simplicity, reduce on-site radiological risks, and eliminate the need for specialized handling infrastructure in remote locations:
    - The fuel will be loaded into the reactor core at a certified manufacturing facility prior to shipment.
    - The reactor module will be sealed, tested, and shipped as a self-contained unit with engineered features to preclude criticality during transport and storage in accordance with 10 CFR Part 71.
    - No refueling will occur at the deployment site.
    - At the end of its operational life (10 - 30 years, depending on fuel enrichment and burnup analysis), the entire reactor unit—including spent fuel—will be returned to a licensed facility for defueling, inspection, potential refurbishment, or decommissioning.

  This strategy minimizes site contamination risks, simplifies regulatory oversight, and supports centralized fuel management and disposal planning consistent with DOE and NRC policy initiatives. Hadron Energy recognizes that demonstrating compliance for the fully assembled and fueled reactor module necessitates a detailed approach under 10 CFR Part 71, potentially utilizing alternative criteria. Our planned regulatory engagement includes the submittal of detailed technical justifications supporting this approach, as further described in Section 3.8.3.A.

2.3 Coolant

- **Primary Coolant:** The Hadron Microreactor uses light water (H_2O) as the primary coolant.

2.4 Moderation

- **Moderator:** The Hadron Microreactor uses light water (H_2O) as the neutron moderator.

2.5 Containment/Confinement

Radionuclide retention in the Hadron Microreactor is achieved through a robust, multi-layered defense-in-depth containment strategy. This strategy is designed to ensure the safe confinement of radioactive materials under normal operating conditions and during postulated accident scenarios. The approach incorporates both passive and engineered barriers, including:

- **Fuel Cladding (First Barrier):** The fuel cladding, which encapsulates the fuel pellets and retains the majority of fission products. The cladding material is selected for its high-temperature performance, corrosion resistance, and proven in-reactor behavior. Cladding integrity is maintained under all anticipated operational occurrences and design basis accidents, supported by validated fuel performance modeling.
- **Primary Coolant System Boundary (Second Barrier):** The primary coolant system, including the Reactor Pressure Vessel (RPV) and associated piping and components, forms the second containment barrier. This boundary is constructed from high-grade, corrosion-resistant stainless steel and is designed to retain its structural and sealing integrity under both normal conditions and transients. Comprehensive engineering evaluations, including finite element analysis and fracture mechanics assessments, are conducted to demonstrate performance under thermal, pressure, and seismic loads. The RPV is sized and tested to exceed the stress margins required by ASME Section III standards and relevant NRC guidance.
- **Containment Structure (Third Barrier):** A robust containment structure surrounds the primary system and provides an additional layer of radionuclide retention. This structure is designed to withstand internal pressure from postulated accidents, such as a loss-of-coolant accident (LOCA), as well as external hazards including seismic and transportation-induced loads. The containment may be a sealed metallic or composite enclosure, tailored to the transportable reactor architecture and fully compliant with 10 CFR Part 50 Appendix A General Design Criteria.
- **Functional Containment and Passive Safety Features**: In addition to physical barriers, the Hadron Microreactor leverages functional containment principles—such as pressure suppression, passive heat removal, negative power coefficient, and inherent safety features of the reactor core design—to minimize radionuclide mobilization and potential release. The integrated system design ensures that even in the unlikely event of fuel damage, radionuclide transport is significantly impeded by a combination of thermal-hydraulic, chemical, and material barriers.

All containment barriers will be evaluated through safety assessments using NRC-endorsed tools and methodologies, including deterministic methodologies and/or probabilistic risk assessment and alternatives thereto as directed by section 208(a)(1)(E) of the ADVANCE Act of 2024. These analyses are performed to demonstrate that the design meets or exceeds regulatory dose limits under design basis accidents and beyond design basis events. Supporting documentation, including technical reports, test data, and modeling results, will be provided in the Standard Design Approval (SDA) application. Preliminary results and safety case insights will also be shared with NRC staff during the pre-application engagement phase to support early alignment and transparent regulatory review.

2.6 Usage

- **Primary Use:** Electricity generation (10 MWe).
- **Applications:** The reactor is optimized for deployment in locations where conventional grid power is unavailable, unreliable, or logistically impractical. Primary applications include:
    - Replacement of diesel generators in remote communities, disaster relief zones, and off-grid industrial operations.
    - Power supply for military or scientific installations requiring secure, mobile, and independent energy.
    - Grid support functions such as peak shaving, renewable firming, or backup power in localized high-demand areas (e.g., data centers).
      Scalable deployment: multiple units can be co-located to form modular installations capable of meeting aggregated energy demands of 50 MWe or more.

2.7 Technology Readiness

- **Core Technology:** The Hadron Microreactor is built on mature light water reactor (LWR) technology, with established fuel forms, materials, and safety principles that support a high degree of technical readiness.
- **Innovation:** Focused on areas that enhance deployment and operational flexibility—specifically modular packaging, factory manufacturing, transportability, remote operation, and inherent safety.
- **Validation:** Supported by an advanced digital twin platform and a comprehensive hardware testing program.

2.8 Fuel Cycle Considerations

- **Front-End:** Utilizes existing LEU supply chain, with fueling performed at the factory.
- **Back-End:** Current concept involves returning the entire reactor unit to a centralized facility at the end of life for defueling and decommissioning. Detailed plans will be developed and discussed.

2.9 Other Key Features (Transportability, Production, Operations Model)

- **Transportability:** Designed for standard shipping logistics, minimizing special handling. Post-transport verification methods will be employed.
- **Production:** Assembly-line manufacturing for consistency and cost-efficiency. Factory Acceptance Testing (FAT), including ZPC tests, performed prior to shipment.
- **Operations Model:** Designed for primary monitoring and control from a certified central control facility, minimizing routine onsite staffing needs while ensuring robust oversight. Features high levels of automation and inherent safety characteristics that default the reactor to safe shutdown states upon detection of off-normal conditions or loss of communication. The core safety argument relies on this combination of inherent safety, reliable automation, defense-in-depth in monitoring and control systems, and continuous oversight by qualified remote operators. Detailed justification demonstrating how this model meets the underlying safety intent of NRC operational and staffing regulations will be provided through focused engagement, as described in Section 3.8.3.C.

3 REGULATORY STRATEGY

This section outlines Hadron Energy's planned regulatory strategy for licensing the Hadron Microreactor. Our approach centers on obtaining a standard design approval (SDA) application under 10 CFR Part 52, Subpart E, followed by a 10 CFR Part 52, Subpart F Manufacturing License to produce standardized Hadron Microreactor units at a designated manufacturing facility. This will be coupled with authorizations under 10 CFR Part 70 for the possession and use of special nuclear material (SNM) necessary for factory fueling and testing activities. This strategy reflects current design maturity and regulatory understanding, including insights from NRC staff communications such as SECY-24-0008 (“Rulemaking Plan for Regulatory Framework for Micro-Reactors”) and may evolve based on ongoing technical development and feedback received during pre-application engagement with the NRC Staff.

3.1 Application Type

Hadron Energy plans to utilize a combination of licensing frameworks best suited for our design and deployment model.

3.1.1 Early Site Permit (10 CFR 52 Subpart A)

While Hadron Energy will need a specific site for its manufacturing facility (addressed under the Manufacturing License), an Early Site Permit (ESP) based on deployment site is not needed at this time.

3.1.2 Standard Design Certification (10 CFR 52 Subpart B)

At the current time, Hadron Energy will seek a Standard Design Approval (SDA), rather than a Design Certification (DC).

3.1.3 Combined License (10 CFR 52 Subpart C)

Hadron Energy will not be the primary applicant for Combined Licenses under 10 CFR Part 52, Subpart C. Our regulatory strategy focuses on obtaining a Standard Design Approval, a Manufacturing License, and a Part 70 license. Following the issuance of the SDA and the Manufacturing License, Hadron Energy anticipates that its customers or partners would apply for Combined Licenses (COLs) for specific deployment sites. These COL applications (COLAs) will reference the approved SDA and the reactor unit manufactured under the ML, and will provide site-specific information, including the Final Safety Analysis Report (FSAR), Environmental Report (ER), Emergency Plan (EP), physical security plan, and site-specific Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC), consistent with the requirements of 10 CFR §§52.77, 52.79, and 52.80.

3.1.4 Standard Design Approval (10 CFR 52 Subpart E)

Hadron Energy intends to first seek a Standard Design Approval (SDA) for the standardized Hadron Microreactor design. The SDA application content will meet the requirements of 10 CFR §§52.136 and 52.137. Pursuing an SDA provides a standardized, NRC-approved design basis that can be efficiently referenced in subsequent site-specific license applications, enhancing predictability for deployment. Hadron Energy is currently evaluating whether the SDA application will cover the complete design or major portions thereof, as allowed by §52.135.

3.1.5 Manufacturing License (10 CFR 52 Subpart F)

Consistent with our strategy to factory-build standardized Hadron Microreactor units, Hadron Energy intends to apply for a Manufacturing License (ML) under 10 CFR Part 52, Subpart F. This license will authorize the manufacture of multiple Hadron Microreactor units at a centralized, dedicated manufacturing facility. The ML application will reference the NRC-approved Standard Design Approval (SDA) for the Hadron Microreactor design. Pursuing an ML aligns with the regulatory framework provided in 10 CFR Part 52, Subpart F, which is specific to the manufacture of nuclear power reactors to be installed at sites that are not identified in the application. This approach supports our business model of series production and enhances regulatory efficiency for subsequent deployments.

Coupled with the Manufacturing License, Hadron Energy will also seek necessary authorizations under 10 CFR Part 70, “Domestic Licensing of Special Nuclear Material.” This Part 70 license is essential for the possession, use, and transfer of special nuclear material (SNM) required for factory fueling of the microreactor cores and for conducting necessary testing activities (including potential Zero Power Critical tests) at the manufacturing facility prior

to shipment of the completed and fueled reactor modules. Early engagement with NRC staff on the specifics of the ML application and the integrated Part 70 licensing is planned.

3.1.6 Construction Permit (10 CFR 50)

Not applicable. (See Section 3.1.11 for discussion on why Part 50 pathway for a prototype was not selected).

3.1.7 Operating License (10 CFR 50)

Not applicable. (Hadron Energy is pursuing licensing under 10 CFR Part 52).

3.1.8 Limited Work Authorization (10 CFR 50.10)

Not applicable. (As stated in Section 3.1.11, Hadron Energy is not currently planning to seek an LWA).

3.1.9 Research and Test Reactors (10 CFR 50.21, 50.22)

Not applicable. (The Hadron Microreactor is a commercial power reactor).

3.1.10 Prototype Provisions (10 CFR 50.2, 50.43(e))

Not applicable. (See Section 3.1.11 for discussion on why a prototype demonstration was not selected as the primary path).

3.1.11 Other Considerations

Hadron Energy believes a staged and adaptive regulatory approach is crucial for efficiently navigating the licensing process and achieving regulatory certainty, particularly for aspects involving novel technologies and deployment models. Key elements of our approach include:

- **Early and Frequent Engagement:** Utilizing this REP and the planned interactions detailed in Section 4.2 to foster open communication and gain early feedback on key technical and regulatory matters.
- **Conceptual Design Assessment/PSER:** Within approximately one year, Hadron Energy intends to submit a Preliminary Safety Information Document (PSID) and request a formal conceptual design assessment from the NRC, potentially structured as a Preliminary Safety Evaluation Report (PSER). This aligns with NRC policy encouraging early interactions (e.g., NUREG-1226) and recent agency focus on early reviews to identify key issues and enhance regulatory predictability for advanced designs.
- **Iterative Regulatory Submittals:** Utilizing focused white papers and topical reports (Section 4.2.4) to address specific technical and regulatory topics incrementally, allowing for resolution prior to the main SDA application submittal.

This staged approach is designed to facilitate efficient NRC review and build confidence through collaborative identification and resolution of technical and regulatory topics.

Hadron Energy has evaluated alternative licensing paths. A Combined License (COL) under 10 CFR Part 52 Subpart C was an initially considered regulatory path. However, Hadron Energy has determined that pursuing a Standard Design Approval (SDA) under 10 CFR Part 52 Subpart E, followed by a Manufacturing License (ML) under 10 CFR Part 52 Subpart F and a license for special nuclear material under 10 CFR Part 70, is the most advantageous and appropriate path for our standardized, factory-built microreactor and business model. This strategy allows Hadron Energy to focus on design and manufacturing, while customers or partners would pursue site-specific operational licenses (e.g., COLs) referencing the approved design and manufactured unit. A prototype demonstration under Part 50 was determined to be less beneficial than securing a Standard Design Approval (SDA) and a Manufacturing License (ML). This approach enables the production of standardized units that can then be efficiently referenced in multiple site-specific license applications (e.g., COLAs) by customers or partners. Consequently, Hadron Energy is not currently planning to seek a Limited Work Authorization (LWA) or pursue partial application submittals under 10 CFR §2.101 at this time. We are actively monitoring the development of 10 CFR Part 53; however, based on current NRC schedules, it is not anticipated to be finalized and sufficiently mature with supporting guidance in time for Hadron Energy's planned initial application timeline.

3.2 National Environmental Policy Act (NEPA)

Hadron Energy understands its responsibility under 10 CFR Part 51 to provide comprehensive environmental information supporting the NRC staff's preparation of NEPA documentation (e.g., Environmental Assessment or Environmental Impact Statement). Consistent with 10 CFR §51.22(c)(22), which identifies Standard Design Approval (SDA) issuance as a categorical exclusion, an Environmental Report (ER) is not required for the SDA application itself.

For Hadron Energy's Manufacturing License application under 10 CFR Part 52, Subpart F, an Environmental Report will be developed and submitted. This ER will address the environmental impacts associated with the proposed manufacturing facility and its operations, consistent with 10 CFR Part 51 requirements for such a license.

Each subsequent site-specific Combined License Application (COLA), which would be submitted by customers or partners intending to deploy a Hadron Microreactor, must then include a separate, detailed ER compliant with the requirements of 10 CFR §51.45 and §51.50(c). These site-specific ERs will be prepared using applicable NRC guidance, primarily Regulatory Guide 4.2, "Preparation of Environmental Reports for Nuclear Power Stations."

Recognizing that the Hadron Microreactor's intended rapid deployment capability may differ from prior NRC experience with large light-water reactors where sites are selected years in advance, we anticipate a need for early engagement regarding the site-specific NEPA process. A key aspect to address is efficiently preparing and reviewing ERs when specific deployment sites may not be identified until closer to the deployment date. To address this, Hadron Energy

is designing the reactor for compatibility with a wide range of site conditions and intends to proactively engage with NRC staff on developing agile approaches for these site-specific environmental reviews. As encouraged by NRC guidance for potentially novel approaches, engagement topics will likely include exploring the feasibility and acceptability of using bounding analyses or site parameter envelopes within the ERs to streamline the review process for future COLAs, ensuring timely deployment while fully meeting all NEPA requirements. (This topic relates to the siting strategy discussed further in Section 3.8.2).

Furthermore, acknowledging the comprehensive scope outlined in 10 CFR Part 51 and NRC guidance, these site-specific ERs will fully analyze potential environmental impacts associated with the entire Hadron Microreactor lifecycle. This includes incorporating considerations unique to our approach, such as those related to factory fabrication, transportation, operational characteristics, fuel management, and the planned return-to-facility decommissioning strategy, ensuring a thorough evaluation consistent with NEPA requirements.

3.3 Principal Design Criteria (PDC)

As the Hadron Microreactor is based on Light Water Reactor (LWR) technology, the General Design Criteria (GDC) established in 10 CFR Part 50, Appendix A, provide the fundamental basis for developing the project-specific Principal Design Criteria (PDC). Consequently, guidance developed specifically for non-LWRs, such as Regulatory Guide 1.232, is not considered the primary basis for the Hadron Microreactor PDC.

Hadron Energy recognizes, however, that certain unique aspects of the microreactor design and operational concept – including its small physical size, transportability, reliance on remote operations, and alternative containment strategy – necessitate a careful evaluation of the applicability of each GDC; and appreciate that the NRC has acknowledged that some of the current GDCs may not be applicable to advanced designs. Thus, Hadron Energy will seek early engagement with the NRC on which GDCs Hadron Energy is expected to meet; or what alternative or supplemental criteria are needed to address the specific design features adequately.

Where deviations or alternative criteria are proposed, Hadron Energy will develop robust technical justifications. These justifications will demonstrate how the underlying safety intent of the GDC is met by the proposed approach or explain why a specific GDC may not be applicable. This process may leverage insights from risk-informed and performance-based (RIPB) methodologies where appropriate to support the technical basis.

Consistent with NRC guidance encouraging early dialogue on novel aspects, Hadron Energy plans to proactively engage with NRC staff on the proposed PDC framework during the pre-application phase. This engagement, potentially utilizing white papers, topical reports, or targeted technical meetings, aims to foster mutual understanding and alignment on the PDC well before the formal Standard Design Approval (SDA) application submittal. Establishing clarity on the PDC is considered essential for an efficient licensing process and is linked to the Key Issues discussed further in Section 3.8.

3.4 Selection of Applicable Guidance

Hadron Energy is leveraging key industry and NRC guidance in preparing this REP, notably NEI 18-06. For the development of our Standard Design Approval (SDA) application, Manufacturing License (ML) application, and 10 CFR Part 70 license application, and to support subsequent Combined License (COL) applications by customers or partners under 10 CFR Part 52, we anticipate using the following primary NRC guidance documents. We recognize that guidance developed primarily for large LWRs may require interpretation or adaptation for the Hadron Microreactor, and we are committed to early engagement with NRC staff regarding such cases, consistent with NRC staff encouragement for robust pre-application interactions for advanced reactors.

Guidance Primarily Informing Application Content and Safety Review:

- **NUREG-0800 (Standard Review Plan - SRP):** The SRP will be the primary guide for the technical content, level of detail, and safety review expectations for the SDA FSAR and the ML application. It will also inform the content expected in FSARs for COLs that reference the SDA and manufactured unit. This includes addressing operational programs (SRP Section 13.4), for which we intend to develop standardized approaches suitable for microreactors to support efficient review, potentially seeking early feedback via topical reports or other mechanisms. We will identify and provide technical justification for any areas where SRP sections may not directly apply or where alternative approaches are proposed due to the specific features of the Hadron Microreactor.
- **RG 1.233 / NEI 18-04 (Licensing Modernization Project - LMP):** Hadron Energy intends to utilize the technology-inclusive, risk-informed, and performance-based methodology described in this guidance (endorsed by RG 1.233) to develop the safety case, establish performance requirements, and classify Structures, Systems, and ThComponents (SSCs).
- **NUREG-0933 / GIMCS (Generic Issues):** We will monitor the Generic Issues Program (GIP) and address applicable unresolved safety issues and medium/high-priority generic safety issues relevant to our design in our Part 52 applications, as required.

Guidance Primarily Informing Application Format and Structure:

- **RG 1.206 (COL Applications):** Although primarily focused on COLs and currently under revision, this guidance (or its successor incorporating transitions from RG 1.70) will inform the overall format and content organization of the SDA application FSAR to facilitate efficient development and later referencing in COLAs. It will also directly inform the COLA structure.

Guidance Relevant to Site-Specific COL Applications:

- **RG 4.2 (Environmental Reports) & NUREG-1555 (ESRP):** These documents will guide the preparation of site-specific Environmental Reports (ERs) required only for the COLAs and will inform our understanding of the NRC's environmental review process.
- **RG 4.7 (General Site Suitability Criteria):** This guidance, potentially supplemented by industry approaches like the EPRI Siting Guide, will be considered during site selection and evaluation activities performed in support of future COLA submissions.

Regarding NUREG-1537 (Non-Power Reactors): The Hadron Microreactor is being licensed as a power reactor under 10 CFR Part 52, making NUREG-1537 inapplicable as primary licensing basis guidance. However, we recognize this document contains insights into NRC perspectives on graded safety analysis and proportionate regulatory approaches for smaller reactors, and indeed, SECY-24-0008 presents an option to the Commission to treat microreactors like non-power reactors. Accordingly, we may reference these concepts in future technical discussions with NRC staff regarding potential graded or streamlined approaches within the Part 52 framework, where technically justified for the microreactor scale.

Hadron Energy will proactively engage with NRC staff to discuss the applicability, interpretation, and potential adaptation of existing guidance documents throughout the pre-application and application review phases.

3.5 Use of Standards and Industry Guidance

Hadron Energy recognizes the importance of leveraging established consensus standards and pertinent industry guidance to ensure a robust design basis and facilitate an efficient regulatory review process. We intend to incorporate applicable standards and guidance throughout our design, analysis, quality assurance program, and application development activities. Early engagement with NRC staff is planned where standards might be applied in novel ways or where specific interpretations are key to the design basis.

3.5.1 Consensus Standards

Hadron Energy will reference applicable consensus standards developed by Standards Development Organizations (SDOs) such as the American Society of Mechanical Engineers (ASME), the American Nuclear Society (ANS), and the Institute of Electrical and Electronics Engineers (IEEE). Our approach will prioritize the use of standards endorsed by the NRC (e.g., via Regulatory Guides or incorporation by reference, such as in 10 CFR § 50.55a). These standards will be cited extensively in the Standard Design Approval (SDA) application to demonstrate how regulatory requirements are met. We plan to initiate discussions with NRC staff, potentially via targeted technical meetings early in the pre-application phase (e.g., within the first year), regarding the specific standards and editions intended for use in the licensing basis.

3.5.2 NEI Guidance

We will utilize relevant guidance documents developed by the Nuclear Energy Institute (NEI) where applicable. Key documents informing our regulatory strategy and approach include NEI 18-06 ("Guidelines for Development of a Regulatory Engagement Plan") and NEI 18-04 ("Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," methodology supporting the Licensing Modernization Project, endorsed by RG 1.233). Other NEI technical reports and guidance related to areas such as quality assurance or operational programs will be reviewed for applicability and referenced as appropriate.

3.5.3 EPRI Guidance

Hadron Energy will also review and reference applicable technical reports and guidance documents from the Electric Power Research Institute (EPRI). This includes evaluating the relevance of foundational documents, such as potentially the Advanced Light Water Reactor Utility Requirements Document (ALWR URD) or EPRI's ongoing work related to advanced reactors, materials reliability, or other technical areas pertinent to the Hadron Microreactor design and operation.

3.6 Assessing Alignments/Gaps

Hadron Energy understands that proactively identifying and resolving potential gaps or misalignments between our novel microreactor design, operational concepts, and the existing regulatory framework is crucial for minimizing regulatory risk and achieving an efficient review. Drawing insights from previous industry efforts (e.g., NuScale's gap analyses, NGNP issue papers), we intend to conduct a systematic assessment during the pre-application phase and utilize targeted interactions to achieve mutual understanding with NRC staff on these areas prior to the Standard Design Approval (SDA) application submittal.

Early in the pre-application phase, Hadron Energy will perform and document a focused regulatory assessment. This assessment will identify specific areas potentially requiring dedicated engagement, such as:

- Novel design features (e.g., related to transportability, remote operations, unique safety systems) and their alignment with existing regulations.
- Proposed adaptations or alternative approaches for meeting the intent of Principal Design Criteria derived from 10 CFR 50 Appendix A (linked to Section 3.3).
- Sections of the Standard Review Plan (NUREG-0800) where standard review approaches may need interpretation, supplementation, or tailoring for a microreactor design, potentially leveraging risk-informed insights from our LMP-based safety case (linked to Section 3.4).
- Areas where existing regulatory guidance may lack sufficient detail or may warrant clarification for microreactor applications.

The findings from this assessment will serve as a key input for planning pre-application interactions. Hadron Energy intends to utilize appropriate mechanisms, such as targeted white papers, topical reports, or technical meetings, to proactively engage with NRC staff on the identified topics. The primary objectives of this engagement are to:

- Clearly articulate Hadron Energy's proposed technical and regulatory approach in areas identified during the assessment.
- Discuss the technical basis for any proposed alternative compliance methods or guidance adaptations.
- Seek timely NRC feedback to foster alignment on the path forward for resolving potential issues before the SDA application is finalized and submitted.

3.7 Design-Centered Review Approach

Hadron Energy is familiar with the Design-Centered Review Approach (DCRA) and associated Design-Centered Work Groups (DCWGs) described in NRC guidance, which historically facilitated efficient reviews by coordinating standard content among multiple concurrent Combined License (COL) applicants for large LWR designs using a Reference/Subsequent COLA (R-COLA/S-COLA) model.

As Hadron Energy is initially pursuing a Standard Design Approval (SDA) for its standardized microreactor design, and there are no concurrent COL applicants at this stage, a formal multi-applicant DCWG structure is not currently applicable. However, our SDA-centric licensing strategy inherently embraces the core goals of the DCRA: maximizing design standardization and achieving significant regulatory efficiency for subsequent COL applications that will reference the NRC-approved standard design.

Should multiple customers or partners pursue COLs referencing the Hadron SDA in the future, we remain open to facilitating collaboration, potentially adopting principles similar to a DCWG, to further streamline the licensing process for follow-on deployments, in consultation with the NRC and stakeholders.

3.8 Key Issues

Hadron Energy recognizes that early identification and collaborative resolution of key technical and regulatory topics associated with our novel microreactor design and deployment model are essential for an efficient licensing process. We intend to proactively engage with NRC staff on these topics using mechanisms such as targeted technical meetings, white papers, and topical reports, with the goal of achieving mutual understanding and resolving potential issues prior to the Standard Design Approval (SDA) application submission.

3.8.1 Generic Issues

Hadron Energy will monitor the NRC's Generic Issues Program (GIP) through NUREG-0933 and the online Generic Issue Management Control System (GIMCS). We will assess the

applicability of unresolved safety issues and medium/high-priority generic safety issues to the Hadron Microreactor design and address them as required in our 10 CFR Part 52 applications. We will engage with NRC staff if clarification on the applicability or proposed resolution of a generic issue is needed.

3.8.2 New Reactor Issues

We will actively track policy and technical issue resolution status for Small Modular Reactors (SMRs) and advanced reactors via NRC webpages (e.g., resolved policy issues lists) and engagement with industry groups (e.g., NEI, Nuclear Innovation Alliance). We will incorporate relevant resolved positions into our licensing basis and engage on any emerging policy issues pertinent to our design and licensing strategy.

3.8.3 Selected Specific Topics for Engagement

The following represent key technical and regulatory topics, based on the Hadron Microreactor's specific features and common areas identified in NRC guidance, that we anticipate warranting focused pre-application engagement:

- **(A) Transportation of Fueled Reactor:**
    - *Topic:* Compliance with 10 CFR Part 71 for transporting a factory-fueled microreactor module, where standard testing requirements may be challenging for the integrated unit.
    - *Engagement Approach:* Hadron Energy recognizes that transporting a fueled microreactor presents unique challenges relative to standard Type B packages. Standard physical tests (e.g., drop, puncture, thermal tests specified in 10 CFR Part 71 Subpart F) may be impractical or insufficient for the fully integrated reactor module. Therefore, Hadron Energy plans to seek NRC concurrence on a robust transportation licensing basis likely utilizing the alternative criteria pathway provided under 10 CFR §71.41(c). To support this, we will submit a dedicated white paper, followed potentially by a technical or topical report, providing significant technical detail and justification. This submittal will:
        - Clearly articulate the proposed strategy for meeting Part 71 requirements.
        - Present comprehensive analyses (e.g., structural, thermal, shielding, criticality safety under normal conditions of transport and hypothetical accident conditions) demonstrating that the package design achieves an equivalent level of safety to one tested conventionally.
        - Explicitly address the complexities associated with applying alternative criteria, detailing the analytical methods, modeling codes (including validation), and assumptions used.
        - Incorporate risk-informed insights, where appropriate, to supplement the deterministic analyses and provide a more complete understanding of the safety margins under transport scenarios. Our goal is to achieve early alignment with NRC staff on the sufficiency of this methodology and

technical basis well in advance of the SDA application submission, referencing relevant NRC communications such as “Micro-reactors Licensing Strategies” (ML21235A418) and established precedents where applicable.

- This approach for demonstrating Part 71 compliance is integral to our planned Manufacturing License under 10 CFR Part 52, Subpart F, which will cover factory production and fueling, and our 10 CFR Part 70 license authorizing the possession and use of special nuclear material for these activities.

- **(B) Site Selection & Evaluation / External Hazards:**
  - *Topic:* Reconciling the rapid deployment model with traditional site assessment review timelines; ensuring the design accommodates a wide range of site conditions; addressing site-specific external hazards (Seismic, Flooding, etc.).
  - *Engagement Approach:* Engage NRC staff on the development and acceptance of a bounding site envelope or Plant Parameter Envelope (PPE) approach for the SDA. This would involve defining bounding site characteristics (including external hazards) that encompass potential deployment locations. Subsequent COLAs would demonstrate the specific site falls within the approved envelope. Plan to submit a white paper or topical report on the proposed siting/PPE methodology for discussion.

- **(C) Staffing Needs and Centralized Observation:**
  - *Topic:* Justifying the operational concept for Hadron Microreactors comprising a dual-layered safety and security strategy: a central facility for nationwide reactor observation and monitoring, supported by essential on-site operators at each installation. This model ensures that while comprehensive performance data is aggregated and analyzed centrally, local personnel are always present to verify conditions and manage any immediate safety concerns, guaranteeing secure and reliable operation of each microreactor.
  - *Engagement Approach:* Hadron Energy will submit focused white papers and potentially a topical report to articulate the core safety arguments and present the detailed Concept of Operations (CONOPS) supporting the operations model. These submittals will provide comprehensive justification demonstrating how the integrated system of technology, procedures, and personnel ensures safe operation and meets the underlying safety intent of relevant regulations (e.g., 10 CFR Part 50 requirements related to licensed operators, control room command functions, minimum staffing levels like §50.54(k), and emergency response). Key elements of the justification will include:
    - Detailed description of the CONOPS, including roles and responsibilities of onsite personnel together with centralized observation and monitoring.

        - Analysis of the reactor's inherent safety features and ensuring that the design and operation maintains appropriate safety margins and the capability to execute protective actions.
        - Human Factors Engineering (HFE) analysis supporting the remote observation interface and operator response capabilities.
        - Demonstration of how the proposed approach provides equivalent or enhanced safety compared to historical staffing models in larger reactors (e.g., by centralizing expertise, reducing potential for local human error, ensuring consistent procedural adherence).

- **(D) Emergency Planning (EP):**

    - *Topic:* Establishing an appropriate, scalable Emergency Planning Zone (EPZ) and emergency plan consistent with the microreactor's small size, potential source term, and design features.
    - *Engagement Approach:* Plan to develop the EP approach using risk-informed, performance-based principles, potentially aligning with emerging NRC guidance or rules for SMRs/advanced reactors (e.g., 10 CFR 50.160). Intend to submit a white paper or topical report outlining the proposed EP methodology (including EPZ sizing basis) for NRC feedback.

- **(E) Fuel Qualification:**

    - *Topic:* Confirming the adequacy of the fuel qualification basis, including leveraging existing LWR/HALEU data and identifying any necessary supplemental testing or analysis for the specific fuel design, configuration, and operational parameters.
    - *Engagement Approach:* Plan to submit a Fuel Qualification Topical Report for NRC review and approval, detailing the qualification strategy, data sources, testing plans (if any), and performance criteria.

- **(F) Digital Instrumentation & Control (I&C) / Cyber Security:**

    - *Topic:* Ensuring the digital I&C system meets regulatory requirements for reliability, qualification, independence, and cyber security (per RG 1.152, NEI 08-09, etc.).
    - *Engagement Approach:* Plan to submit a Topical Report or focused white papers addressing the digital I&C architecture, defense-in-depth and diversity, the cyber security program (per RG 1.152, NEI 08-09, etc.), and clearly defining the comprehensive Validation and Verification (V&V) strategy. This V&V strategy description will include:
        - The methodology for qualifying the digital twin, detailing the benchmarking against experimental data and/or higher-order codes,

uncertainty quantification, and the scope of its application in the safety analysis.
    - A description of the planned hardware testing program (including component, system-level, and potentially integral effects tests).
    - A clear explanation of how simulation results will be integrated with, and validated against, data obtained from the hardware testing program to provide a high-confidence basis for the design and safety analysis. We will seek NRC feedback on these approaches to ensure alignment with regulatory expectations for digital systems reliability, qualification, and V&V rigor.

- **(G) Accident Analysis Methodology / PRA:**
    - *Topic:* Defining and justifying the methodologies used for accident analysis (transient and accident sequences) and Probabilistic Risk Assessment (PRA), consistent with the LMP approach (Section 3.4).
    - *Engagement Approach:* Plan to engage via technical meetings and potentially white papers or topical reports on the selection of Licensing Basis Events (LBEs), PRA scope and methodology (addressing microreactor-specific features), and the use of codes and models, ensuring alignment with NRC expectations (e.g., RG 1.203) and the RIPB framework.

- **(H) Quality Assurance (QA) Program:**
    - *Topic:* Ensuring timely NRC acceptance of the QA Program Description (QAPD) governing design, manufacturing, and deployment activities.
    - *Engagement Approach:* Submit the QAPD Topical Report, based on NQA-1 (or other approved basis), for NRC review and approval early in the pre-application phase to support subsequent activities.

- **(I) ITAAC Development:**
    - *Topic:* Developing appropriate Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for the standard design scope included in the SDA.
    - *Engagement Approach:* Plan to discuss the proposed scope and content of standard design ITAAC with NRC staff, potentially submitting a summary or topical report outlining the ITAAC development methodology and key ITAAC examples.

- **(J) Other Topics:**
    - Issues such as Human Factors Engineering (integrated into I&C/Ops development), Aircraft Impact Assessment (likely bounded by robust design/siting), Nuclear Insurance, and Decommissioning Funding Assurance will be addressed at the appropriate stage (primarily within the SDA, Manufacturing

License, or Part 70 application content as applicable to Hadron Energy's scope, or in supporting documentation for COLAs prepared by customers/partners). Decommissioning Funding Assurance for Hadron Energy's manufacturing facility will be addressed in the ML application. For deployed reactors, this assurance will be addressed in the respective COLAs submitted by customers or partners.

3.9 NRC Review Timeframes and Applicant Commitments

Hadron Energy is cognizant of the NRC's historical review schedules, which have historically been influenced by the complexity of large LWR applications (e.g., benchmarks around ~39-42 months post-docketing for Design Certifications or complex Standard Design Approvals (SDAs), and ~30 months for COLs referencing approved designs). Recent activity, however, has shown that a more expedited timeline is feasible with a sufficiently motivated and efficient applicant. Given the recent success of Kairos Hermes 1 (which took under 2 years for a CP) and Kairos Hermes 2(< 18 months), we are confident that a shorter timetable can be accomplished.

By proactively identifying and addressing key technical and regulatory topics before submitting the SDA application, coupled with the utilization of proven LWR technology and the inherently reduced complexity of the Hadron Microreactor design, we aim to facilitate a focused and predictable review process. Based on these factors and relevant precedents (such as aspects of the NuScale SDA review), Hadron Energy proposes a target SDA review duration of approximately 18 months following successful application acceptance and docketing. (Supporting milestones are detailed in Section 9.1 and Section 6.5). Achieving this target is contingent upon successful execution of the pre-application engagement plan and mutual commitment to timely interactions.

Hadron Energy believes this 18-month target review duration for the SDA is ambitious but achievable due to several key factors:

- **Targeted Pre-application Resolution**: This REP outlines a strategy focused on resolving the most significant and novel technical/regulatory issues (e.g., transportation, remote operations, siting methodology) through focused white papers and topical reports before the SDA application submittal. Success in this phase is critical.
- **Leveraging Approved Methods**: Seeking formal NRC approval via Topical Reports for key methodologies (e.g., QAPD, PDC development, potentially fuel qualification or analysis methods) prior to SDA submission streamlines the final review.
- **Technology Maturity**: The design's foundation in proven LWR technology reduces risks associated with fundamental reactor physics, materials, and coolant behavior.
- **Design Simplicity and Standardization**: The microreactor's smaller scale, reduced system complexity compared to large LWRs, and emphasis on a standardized, factory-produced design are expected to simplify the scope of review.
- **Factory Testing**: Comprehensive Factory Acceptance Testing (FAT), potentially including zero-power physics tests, can provide significant data to support ITAAC closure for the standard design scope. Achieving this target is contingent upon the timely submission of high-quality documents by Hadron Energy, the successful execution of the

pre-application engagement plan leading to early resolution of key issues, and the availability of NRC resources. Hadron Energy is committed to proactive communication and collaboration to facilitate this efficient review pathway.

To further support an efficient and predictable review schedule post-submittal, Hadron Energy commits to:

- Providing high-quality, complete responses to Requests for Additional Information (RAIs) within 30 days of receipt, unless a different timeframe is mutually agreed upon with the NRC project manager based on the complexity of the request.
- Facilitating NRC staff access to supporting technical information, calculations, procedures, test data, and analyses through mechanisms such as an electronic reading room, audits, or other agreed-upon methods, to support efficient verification and validation of application content.

4 PRE-APPLICATION ENGAGEMENT

This section details Hadron Energy's plan for interacting with the NRC staff prior to submitting the SDA application. The goal is to facilitate mutual understanding, identify and resolve key issues early, and support an efficient formal review process.

4.1 Identification of Topics

Effective pre-application engagement requires a clear focus on the most critical technical and regulatory topics. Based on the Regulatory Strategy (Section 3) and the Key Technical and Regulatory Topics identified (Section 3.8), Hadron Energy has prioritized the following areas for focused engagement with NRC staff. This prioritization considers factors such as regulatory significance, potential impact on the project schedule, design novelty requiring early alignment, resource implications, and overall licensing risk, consistent with NRC guidance. The prioritization may be adjusted based on NRC feedback and evolving project needs.

High Priority Engagement Topics:

- **Licensing Path Confirmation:** Ongoing dialogue to confirm alignment on the planned licensing pathway for Hadron Energy, which includes a Standard Design Approval (SDA), followed by a Manufacturing License (ML) and a 10 CFR Part 70 license. This includes discussing how these licenses will interface with subsequent site-specific Combined Licenses (COLs) pursued by customers or partners (Ref: Sec 3.1).
- **Remote Operations & Staffing Approach:** Achieving alignment on the safety justification and regulatory compliance path for the proposed remote operations concept and staffing levels (Ref: Sec 3.8.3.C).
- **Principal Design Criteria (PDC) Basis:** Detailed discussion and alignment on the proposed PDC, including the application and interpretation of 10 CFR 50 App A GDC,

and the justification for any proposed alternative or supplemental criteria (Ref: Sec 3.3, 3.8.3).

- **Transportation Licensing Approach:** Resolution of the regulatory approach for 10 CFR Part 71 compliance for transporting fueled modules, including the technical basis for any proposed alternative criteria (Ref: Sec 3.8.3.A); as well as consideration of 10 CFR Part 70 relating to the transfer of special nuclear material.
- **Siting Methodology:** Agreement on the methodology and acceptance criteria for the proposed bounding site envelope / Plant Parameter Envelope (PPE) approach to address flexible siting needs (Ref: Sec 3.2, 3.8.3.B).
- **Quality Assurance Program:** Timely review and acceptance of the Quality Assurance Program Description (QAPD) Topical Report to support regulated activities (Ref: Sec 3.8.3.H).
- **Licensing Modernization Project (LMP):** Discussing the application and implementation of the LMP methodology (per NEI 18-04 / RG 1.233) for developing the risk-informed, performance-based safety case (Ref: Sec 3.4, 3.8.3.G).

Other Important Engagement Topics:

- **Validation & Verification (V&V) Methodology:** Discussing and seeking feedback on the comprehensive V&V strategy for the design, including the specific methodology for qualifying the SimEngine digital twin and the planned integration of simulation with hardware testing programs.
- **Specific Technical Subjects:** Addressing detailed technical topics via planned white papers and topical reports as outlined in Section 3.8.3 (e.g., Fuel Qualification, Digital I&C/Cyber, EP Approach, Accident Analysis/PRA, ITAAC development) and scheduled in Section 9.1.
- **Standards and Guidance Application:** Confirming the applicability and interpretation of specific consensus standards and NRC guidance documents (Ref: Sec 3.5).
- **Generic & Policy Issue Monitoring:** Maintaining awareness and discussing the applicability of relevant NRC Generic Issues (GIP) and evolving New Reactor Policy Issues (Ref: Sec 3.8.1, 3.8.2).

4.2 Types and Frequency of Interactions

Hadron Energy proposes a variety of interaction methods to facilitate effective communication, timely issue resolution, and efficient knowledge transfer during the pre-application phase. The specific type and frequency of interactions will be coordinated with the NRC Project Manager and may evolve based on project needs, complexity of topics, and resource availability for both Hadron Energy and the NRC staff.

4.2.1 Routine Project Management Discussions

We plan to hold regular (preferably monthly) project management discussions with the assigned NRC staff project manager(s). The primary purpose of these meetings will be to discuss project

status, review progress against the REP schedule (Section 9.1), coordinate upcoming activities and submittals, manage action items, and discuss resource planning. These formal meetings may be supplemented by informal phone calls and emails for routine coordination.

4.2.2 Project Management "Drop-Ins"

Hadron Energy understands the potential utility of periodic, non-public 'drop-in' meetings with the NRC project management team, potentially including NRC management, for high-level strategic discussions, forward planning, and schedule coordination, distinct from detailed technical reviews or regulatory decisions. We will coordinate with the NRC PM regarding the appropriateness and scheduling of any such meetings.

4.2.3 Technical Discussions

Focused technical meetings involving relevant NRC staff reviewers and management will be requested, typically aligned with the submittal and review of white papers and topical reports (see schedule in Section 9.1). These meetings are crucial for in-depth discussion of specific technical and regulatory topics identified in Section 4.1. We also intend to request pre-submittal meetings prior to the formal submission of major reports (like Topical Reports) to discuss scope, objectives, content, and review expectations, aiming to enhance the quality and reviewability of submittals. These technical meetings will generally be public unless specific proprietary or sensitive information necessitates closure in accordance with NRC procedures.

4.2.4 NRC Staff Familiarization

We are committed to providing opportunities for NRC staff to gain familiarity with the Hadron Microreactor technology, design features, operational concepts, and project status. This may include focused technical presentations, tailored briefings, responses to informal questions, access to technical experts, and potentially coordinated visits to Hadron Energy facilities or key testing sites, as deemed appropriate and beneficial by the NRC project manager.

4.2.5 Written Submittals

Proactive and well-structured written submittals are central to our pre-application engagement strategy, providing formal documented input for NRC staff review and feedback.

- **White Papers (WPs):** These will be used frequently as a primary mechanism for proactively addressing the most critical technical and regulatory topics identified in Section 4.1 early in the pre-application phase. They are intended to introduce technical concepts, present detailed proposed regulatory approaches and their justification (including core safety arguments where applicable), frame potential challenges associated with novel design features or operational concepts (e.g., transportation, remote operations, V&V), present preliminary analyses, and solicit timely, focused NRC staff feedback. By providing substantive technical detail and proposed resolution paths in these focused documents, Hadron Energy aims to facilitate efficient NRC review, reduce

regulatory uncertainty, and resolve key issues prior to investing resources in formal Topical Reports or the final SDA application.

- **Topical Reports (TRs):** These will be used more selectively for seeking formal NRC review and approval (via a Safety Evaluation Report - SER) on significant methodologies, analyses, or program descriptions intended for direct reference in the license application (e.g., Quality Assurance Program Description, PDC development methodology, specific analysis methods). We understand TRs undergo a formal review process (per LIC-500) and require significant time and resources.
- **Technical Reports (TeRs):** These may be developed and submitted as needed to provide detailed background information, data, or complex analyses supporting specific points made in White Papers, Topical Reports, or future application sections. We will discuss NRC expectations regarding the review and docketing status (auditable vs. formal submittal) for such reports.

4.2.6 Early ACRS Engagement

Hadron Energy recognizes the statutory role of the Advisory Committee on Reactor Safeguards (ACRS) in the licensing process. As the SDA development progresses and key technical approaches mature, we will coordinate proactively with NRC staff regarding the appropriate strategy, timing, and scope for engaging with the ACRS on the Hadron Microreactor design and safety case.

4.2.7 Escalation of Issues

While our goal is a fully collaborative relationship, Hadron Energy understands that disagreements on complex technical or regulatory issues can occur. To ensure timely resolution, we intend to work with the assigned NRC Project Manager early in the engagement process to establish a clear, mutually agreeable, tiered pathway for escalating differing views. This process will aim to address issues efficiently and professionally at the appropriate technical and management levels within both organizations.

4.3 NRC Feedback

Hadron Energy seeks clear, timely, and constructive feedback from the NRC staff throughout the pre-application phase to inform design development, refine regulatory approaches, and minimize uncertainty prior to application submission. We understand that the nature and formality of feedback vary depending on the interaction type and submittal maturity, and we aim to establish clear, mutual expectations for each major engagement activity.

4.3.1 Feedback as a Function of Submittal Type

Based on NRC guidance and practice, our expectations for the primary forms of feedback are:

- **Topical Reports (TRs):** Formal NRC technical review culminating in the issuance of a Safety Evaluation Report (SER) documenting the staff's findings and approval basis for the specific scope reviewed.
- **White Papers (WPs) & Technical Reports (TeRs):** Written feedback, typically via official correspondence (e.g., letters), summarizing NRC staff's preliminary assessment, observations, comments, and questions, identifying areas potentially needing further development, clarification, or future regulatory review.
- **Technical & Project Management Meetings:** Publicly available meeting summaries issued by NRC staff documenting attendees, key topics discussed, information exchanged, action items, and any significant agreements or preliminary conclusions reached.

Recognizing the value of iterative dialogue during design development, Hadron Energy anticipates utilizing White Papers frequently to obtain timely preliminary feedback before committing resources to more formal Topical Reports requiring extensive review time.

4.3.2 "Finality"

Hadron Energy understands the importance of appropriately interpreting the regulatory significance, or "finality," of pre-application feedback. We acknowledge that:

- Feedback on early-stage concepts, preliminary analyses, or informal submittals like White Papers is generally considered preliminary, non-binding, and intended to inform the applicant's ongoing work. Such feedback may evolve as the design matures, additional information becomes available, or relevant NRC policy develops.
- Formal feedback, such as an SER issued for an approved Topical Report, provides a higher degree of regulatory certainty specifically for the scope and technical basis reviewed, contingent upon the stability of the underlying information referenced in the application.

We are committed to open communication with the NRC project manager regarding the intended scope of review, the expected form and timing of feedback, and the associated regulatory significance for each major interaction and submittal.

4.4 Schedule Considerations

The detailed proposed schedule outlining planned pre-application interactions and submittals is presented in Section 9.1 of this REP. Hadron Energy recognizes that successful execution of this schedule requires commitment and coordination from both Hadron Energy and the NRC. We understand schedules are dynamic and depend significantly on factors including applicant progress in providing high-quality information, the complexity of technical and regulatory topics, and NRC staff resource availability amidst competing priorities.

To foster predictability and manage the pre-application schedule effectively, Hadron Energy proposes a collaborative approach centered on:

- **Mutual Schedule Alignment:** Seeking agreement with the NRC Project Manager on the planned timing for key submittals and interactions, establishing a shared understanding of the near-term roadmap, and adjusting proactively based on readiness and resource considerations.
- **Review Duration Expectations:** Discussing and aligning with NRC staff on realistic, projected review durations for major submittals (e.g., Topical Reports, White Papers), acknowledging that these are estimates and may be influenced by the content quality, emerging technical issues, or resource availability.
- **Proactive Communication:** Committing to promptly and transparently communicating any significant anticipated delays or changes to the planned schedule originating from Hadron Energy's activities. We anticipate open dialogue regarding potential impacts arising from NRC resource allocation or review findings.
- **Periodic Performance Review:** Regularly reviewing progress against the REP schedule baseline during routine project management discussions (Ref: Sec 4.2.1) to identify potential issues early and make necessary adjustments.

This collaborative approach to schedule management is intended to support the overall goal of an efficient and predictable pre-application engagement process.

4.5 Relation to Other Proceedings and Reviews

4.5.1 Related NRC Reviews

At this time, Hadron Energy is not aware of other ongoing NRC reviews or proceedings that directly conflict with or procedurally impact the planned pre-application activities for the Hadron Microreactor Standard Design Approval (SDA). We recognize that future Combined License (COL) applications referencing the Hadron SDA might be submitted and reviewed concurrently with, or shortly after, the SDA review itself. Should this occur, Hadron Energy is committed to working collaboratively with NRC staff to coordinate these reviews efficiently, potentially establishing protocols for handling Requests for Additional Information (RAIs) or other matters related to standard design content that may arise during the COL review, consistent with NRC practice.

4.5.2 Other Review Bodies and Consultations

Hadron Energy anticipates potential interactions or coordination with the following other entities:

- **U.S. Department of Energy (DOE):** Hadron Energy does not currently anticipate a formal DOE regulatory role in the commercial licensing under 10 CFR Part 52. Coordination on non-regulatory matters (e.g., related to siting, security, or emergency planning) could occur if future deployments involve DOE facilities.
- **Canadian Nuclear Safety Commission (CNSC):** Hadron Energy is actively evaluating the potential for licensing the Hadron Microreactor design in Canada and plans parallel pre-licensing engagement with the CNSC. Recognizing the similarities in technical

areas, we intend to proactively explore opportunities under the existing Memorandum of Cooperation (MOC) between the NRC and CNSC. Our goal is to identify possibilities for leveraging technical reviews or sharing information to potentially enhance efficiency for both regulators, possibly beginning with engagement on a single joint technical topic to assess process viability.

- **Other U.S. Agencies and Consultations (Relevant to Future COLAs):** While the SDA application is not site-specific, Hadron Energy acknowledges that subsequent site-specific COL applications will require coordination and potential permits or consultations with various other federal, state, local, and Tribal entities. This will include necessary interactions with agencies such as the U.S. Army Corps of Engineers (USACE) concerning water resources and permits, the Federal Emergency Management Agency (FEMA) regarding offsite emergency preparedness findings, the U.S. Fish and Wildlife Service (US FWS) and relevant state agencies under NEPA and the Endangered Species Act, State Historic Preservation Officers (SHPOs), and affected Federally-recognized tribes. Engagement with these entities will be planned and initiated as part of the COLA development process.

4.6 Pre-Application Site Visits, Audits, and Inspections

Hadron Energy understands the value of NRC staff audits, inspections, and observations during the pre-application phase to facilitate regulatory understanding, verify key program implementations, and identify potential issues early. We welcome opportunities for such interactions where appropriate and beneficial, and commit to coordinating closely with the NRC Project Manager on the objectives, scope, logistics, and scheduling of any planned visits, audits, or inspections.

4.6.1 Quality Assurance

As detailed in the project schedule (Section 9.1), Hadron Energy plans to submit its Quality Assurance Program Description (QAPD) as a Topical Report early in the pre-application phase. We anticipate and welcome a subsequent NRC audit or inspection focused on the development and initial implementation of our QA program. This provides an opportunity to demonstrate compliance with regulatory requirements (e.g., 10 CFR Part 50, Appendix B, or NQA-1 standards) before significant safety-related design, procurement, or fabrication activities commence.

4.6.2 Testing

Hadron Energy has a comprehensive testing program planned to provide critical data for design validation and the licensing basis, with key milestones outlined in Section 9.1.2. We welcome opportunities, coordinated through the NRC Project Manager, for NRC staff observation of key tests (such as passive safety system demonstrations or critical component qualification tests) or audits related to testing facilities, methodologies, data acquisition, and quality controls.

4.6.3 Site-Related Visits and Audits

Since the Standard Design Approval (SDA) application is not site-specific for reactor deployment, NRC activities primarily focused on deployment locations – such as site visits supporting environmental reviews or detailed audits of site characterization data for those sites – are not anticipated during the SDA pre-application phase. Such site-specific interactions for deployment would be relevant to future Combined License (COL) applications submitted by customers or partners. However, site-related visits and audits pertaining to Hadron Energy's proposed reactor manufacturing facility may be relevant during the pre-application and review phases for our Manufacturing License application.

4.6.4 Security/Critical Infrastructure

Similarly, since the SDA application is not site-specific for reactor deployment, Department of Homeland Security (DHS) assessments related to site-specific security infrastructure for deployment sites are not anticipated during the SDA pre-application phase. These would be relevant to future Combined License (COL) applications submitted by customers or partners. However, security assessments related to Hadron Energy's proposed reactor manufacturing facility may be pertinent during the pre-application and review phases for our Manufacturing License application.

4.6.5 Vendor/Supplier Audits/Supply Chain

Dedicated NRC audits or inspections focused specifically on individual vendors or suppliers are not anticipated during the early SDA pre-application phase. Should specific circumstances warrant NRC review at a vendor facility later in the design, testing, or procurement process, Hadron Energy will coordinate such activities fully with the NRC Project Manager.

5 APPLICATION PROCESS

This section outlines Hadron Energy's planned approach for transitioning from the pre-application engagement activities described in Section 4 to the formal Standard Design Approval (SDA) application review process, including key steps leading up to and immediately following application submission.

5.1 Readiness Assessment Audit

To maximize the likelihood of the submitted application being accepted for formal review, Hadron Energy intends to request an NRC pre-application readiness assessment audit approximately six months prior to our target SDA application submittal date. Based on the current schedule (Section 9.1), this request is targeted for February 2026, with the audit potentially occurring in March 2026. We plan to provide a substantially complete draft SDA application, representing the intended final content and format, for NRC staff review during this audit.

5.2 Application Submittal

- **Target Date:** Hadron Energy plans to submit the SDA application (SDAA) by September 2026. We commit to communicating any necessary changes to this target submittal date to the NRC staff as early as possible.
- **Format and Access:** We intend to submit the formal application electronically via the NRC's E-Submittal system, coordinating with NRC staff on specific requirements. Supporting, non-docketed information required for NRC review (e.g., detailed calculations, analyses, procedures) will be made readily available to NRC staff via a secure electronic reading room or other mutually agreed-upon method.
- **Licensing Sequence:** The Standard Design Approval Application (SDAA) will be submitted first. Hadron Energy's applications for the Manufacturing License (MLA) under 10 CFR Part 52, Subpart F, and the 10 CFR Part 70 license for special nuclear material are planned to follow or be submitted for parallel review with the SDA, as determined through ongoing engagement with the NRC (see Section 9.1 for indicative timelines). The first site-specific Combined License Application (COLA) by a customer or partner referencing the SDA and manufactured unit is currently anticipated for submission at a later date.

5.3 Acceptance Review and Docketing

Hadron Energy understands that upon receipt, the NRC staff will conduct a formal acceptance review of the SDAA, primarily based on 10 CFR § 2.101 and the content requirements of 10 CFR §§ 52.136 and 52.137. Hadron Energy is committed to submitting a high-quality, complete application designed to meet the criteria for acceptance and facilitate docketing, which is currently targeted for October/November 2026. We will provide responsive support to the NRC staff as needed during the acceptance review period.

5.4 NRC Processes

Hadron Energy acknowledges and will actively monitor the standard NRC administrative and regulatory processes initiated following successful application acceptance and docketing.

6 POST-APPLICATION ENGAGEMENT

This section briefly outlines planned engagement following the acceptance and docketing of the SDA application. Details will be refined closer to the application submittal date and documented in future REP updates.

6.1 Technical Meetings

Hadron Energy anticipates an increased frequency of technical meetings with NRC staff during the formal review phase to delve into specific technical details, clarify application content, and

resolve emerging issues identified during the review. We commit to making our technical subject matter experts readily available to participate effectively in such meetings (whether held in-person, via telephone, or web conference). We understand most technical meetings require public notification (typically 10 working days in advance) unless specific sensitive information warrants closure, and we will coordinate all scheduling through the assigned NRC project manager.

6.2 Audits and Inspections

We expect and welcome focused NRC audits and inspections during the application review as crucial mechanisms for efficiently verifying detailed technical information, calculations, Quality Assurance (QA) program implementation fidelity, test results, and potentially vendor oversight activities. Hadron Energy will work collaboratively with NRC staff to plan and schedule these interactions to minimize disruption while providing necessary access.

6.3 Submittal of Additional Information

6.3.1 Supplemental Information

Hadron Energy is committed to maintaining the accuracy and completeness of the docketed application. We will submit supplemental information promptly as needed to update the application due to significant design evolution finalized during the review, relevant organizational changes, or to provide substantive clarifications identified through interactions with NRC staff. We will notify the NRC project manager in advance regarding the timing and content of planned supplemental submittals.

6.3.2 Requests for Additional Information (RAIs)

We understand the Request for Additional Information (RAI) process is a primary tool for the NRC's detailed technical review. We will utilize the electronic RAI (eRAI) system and are committed to providing high-quality, complete, and timely responses. Our goal is to submit responses within the standard 30-day timeframe referenced in NRC guidance (e.g., NRO-REG-101, "Processing Requests for Additional Information"), unless the technical complexity of a specific RAI necessitates proactive discussion and agreement with the NRC staff on an alternative, mutually acceptable response schedule. RAI responses will clearly identify any resulting impacts on the application text.

6.3.3 Application Revisions/Updates

Hadron Energy will prepare and submit formal updates to the SDA application (e.g., revised FSAR chapters) periodically during the review cycle. These updates will incorporate responses to RAIs, supplemental information, and any other necessary changes to ensure the application accurately reflects the current design and licensing basis. The specific frequency and timing of

these formal updates will be discussed and agreed upon with the NRC staff, potentially aligning with the completion of major review phases or other key schedule milestones.

6.4 Frequency of Interactions

To ensure consistent communication, alignment on priorities, and proactive management of the review process, Hadron Energy proposes to continue regular (at least monthly is preferred) project management meetings with the NRC project manager and key staff throughout the application review phase.

6.5 Review Phases and Schedule

Following application docketing, Hadron Energy anticipates the NRC staff will develop and issue the official, detailed review schedule, including specific review phases and target milestone dates. While acknowledging this schedule is determined by the NRC and contingent on factors such as review findings, resource availability, and application complexity, Hadron Energy proposes the following illustrative schedule milestones for planning purposes. These are based on our target 18-month review duration (Section 3.9) and typical review phase structures observed in prior SDA/DC reviews:

Phase	Milestone Description	Proposed Target Date
Submittal	SDA Application Submittal	September 2026
Acceptance	Application Accepted/Docketed	November 2026
Submittal	Manufacturing License Application Submittal	February 2027
Submittal	Part 70 Application Submittal	February 2027
Acceptance	Manufacturing License Application Accepted / Docketed	April 2027
Acceptance	Part 70 Application Accepted / Docketed	April 2027
Final Action	Manufacturing License Issued	June-July 2028
Final Action	Part 70 License Issued	October-December 2028

This schedule will be updated in future REP revisions based on the formal schedule established by the NRC staff post-docketing.

6.6 Relation to Other Proceedings/Reviews

No other related NRC proceedings are anticipated to directly impact the reviews for Hadron Energy's Standard Design Approval, Manufacturing License, or Part 70 license, or the initial COLA reviews by customers/partners, beyond their inherent interdependencies as part of our overall licensing strategy.

7 WITHHELD INFORMATION

Hadron Energy is committed to transparency and will minimize the amount of information withheld from public disclosure to the greatest extent practicable. However, protection of proprietary commercial information (trade secrets) and security-sensitive information is necessary. This REP itself does not contain proprietary or security-sensitive information requiring withholding.

7.1 Classified Information

Hadron Energy does not anticipate the need to generate, receive, or handle classified information (National Security Information or Restricted Data) for the planned commercial microreactor Standard Design Approval (SDA), Manufacturing License (ML), 10 CFR Part 70 license, or subsequent COL applications by customers/partners. Low-enriched uranium (LEU) will be used.

7.2 Safeguards Information (SGI)

Hadron Energy recognizes that aspects of the physical security design and potentially material control and accounting may constitute SGI. An SGI protection program compliant with 10 CFR Part 73 and associated guidance (e.g., RG 5.79) will be established early in the project timeline (target within the first 12 months of pre-application engagement) to ensure proper handling procedures are in place before such information is generated or potentially received (e.g., design-basis threat information).

7.3 SUNSI and SRI

Hadron Energy acknowledges the category of Sensitive Unclassified Non-Safeguards Information (SUNSI), including Security-Related Information (SRI), and will handle such information appropriately if generated or received, consistent with NRC guidance and 10 CFR §2.390.

7.4 10 CFR 2.390 and Withholding Information from Public Disclosure

Where necessary to protect trade secrets or confidential commercial/financial information, Hadron Energy will request withholding from public disclosure pursuant to 10 CFR §2.390. Such requests will include the required affidavit and justification. A detailed review of §2.390 requirements will be conducted, and any necessary clarifications sought from NRC staff.

7.5 Other Information Control Requirements

Hadron Energy does not currently anticipate needing to handle information subject to other specific control requirements relevant to NRC interactions, such as Export Control information (10 CFR Part 110/Part 810), Applied Technology (AT), or Official Use Only (OUO), as the project is currently focused on domestic commercial deployment and does not involve government contracts stipulating such controls.

8 PARTNERSHIPS AND INDUSTRY PARTICIPATION

Hadron Energy engages with various industry organizations and government bodies.

8.1 Design-Centered Work Group

Not applicable at this stage.

8.2 Nuclear Energy Institute (NEI)

Hadron Energy participates in relevant NEI working groups and task forces (e.g., Advanced Reactor Working Group) and utilizes NEI guidance documents where appropriate.

8.3 Standard Development Organizations (SDOs)

Hadron Energy relies on consensus standards from SDOs (ANS, ASME, etc.) and participates in standards development activities relevant to microreactors where feasible.

8.4 Department of Energy (DOE)

Hadron Energy will coordinate with DOE as needed, particularly if future activities involve DOE sites or funding mechanisms impacting NRC interactions.

8.5 Other Organizations (EPRI)

Hadron Energy coordinates with and references guidance from the Electric Power Research Institute (EPRI) where applicable to its LWR technology base.

8.6 International Considerations (CNSC)

As noted in Section 4.5.2, Hadron Energy is evaluating licensing in Canada and plans to engage with CNSC, potentially leveraging the NRC-CNSC MOC for collaborative review efforts on specific topics.

9 OTHER TOPICS

9.1 Schedule

The following schedule represents Hadron Energy's current planning basis. It outlines an ambitious but achievable timeline that is predicated on the successful and efficient execution of the pre-application engagement strategy, including timely development of high-quality submittals by Hadron Energy and responsive feedback and review by the NRC staff. Key dependencies include the early resolution of high-priority technical topics (as identified in Section 4.1) and the availability of resources for both parties. Hadron Energy is committed to the periodic review and update of this schedule in collaboration with the NRC staff (as described in Section 1.5) to reflect project progress, technical findings, and any necessary adjustments.

Planned Date	Activity	Type
April 2025	Submission of Letter of Intent to Engage in Pre-Application Activities	Submittal (Done)
May 2025	Submission of Initial Regulatory Engagement Plan	Submittal (Done)
July 2025	Submission of Topical Report 1: Quality Assurance Program Description	Topical Report Sub.
July-Sep 2025	Potential Review of Topical Report 1 by NRC Staff	NRC Review (Formal)
August 2025	Public Meeting with NRC on Regulatory Engagement Plan	Meeting
October 2025	Submission of Topical Report 2: Principal Design Criteria	Topical Report Sub.
Oct-Dec 2025	Potential Review of Topical Report 2 by NRC Staff	NRC Review (Formal)
Nov 2025	Submission of Updated Regulatory Engagement Plan	Submittal
Jan 2026	Submission of PSID for Conceptual Design	Request Submittal

	Assessment Request	
Feb-Apr 2026	Potential Conceptual Design Assessment by NRC Staff (PSER issued)	NRC Review
May 2026	Submission of White Paper 1: Transportation Approach Details	White Paper Sub.
May-June 2026	Potential Review of White Paper 1 by NRC Staff	NRC Review
June 2026	Submission of Updated Regulatory Engagement Plan	Submittal
June 2026	Submission of White Paper 2: Siting Strategy / Plant Parameter Envelope	White Paper Sub.
June 2026	Public Meeting with NRC on White Paper 1	Meeting
July 2026	Submission of White Paper 3: V&V Strategy & Digital Twin Qualification	White Paper Sub.
July-Aug 2026	Potential Review of White Papers 2 & 3 by NRC Staff	NRC Review
July 2026	Submission of Readiness Assessment Audit Request (SDAA focused)	Request Submittal
Aug 2026	Public Meetings with NRC on White Papers 2 & 3	Meeting
Aug 2026	Potential Readiness Assessment Audit (SDAA focused) by NRC Staff	NRC Audit
Sep 2026	Submission of Standard Design Approval Application (SDAA)	Application Sub.
Oct 2026	Submission of White Paper 4: Mfg. Facility Siting & Env. Considerations	White Paper Sub.
Oct-Nov 2026	Potential Review of White Paper 4 by NRC Staff	NRC Review
Nov 2026	Potential Acceptance/Docketing of SDAA	NRC Action
Nov 2026	Public Meeting with NRC on White Paper 4	Meeting
Dec 2026	Submission of White Paper 5: SNM Handling & Part 70 Licensing Basis	White Paper Sub.
Dec 2026-Jan 2027	Potential Review of White Paper 5 by NRC Staff	NRC Review
Jan 2027	Submission of Updated Regulatory Engagement Plan	Submittal
Feb 2027	Submission of Manufacturing License Application (MLA)	Application Sub.
Feb 2027	Submission of 10 CFR Part 70 License Application (SNM for Mfg.)	Application Sub.

Feb 2027	Public Meeting with NRC on White Paper 5	Meeting
Apr 2027	Potential Acceptance/Docketing of MLA	NRC Action
Apr 2027	Potential Acceptance/Docketing of Part 70 License Application	NRC Action
May 2028	Potential Issuance of Standard Design Approval (SDA)	NRC Action
June-July 2028	Potential Issuance of 10 CFR Part 70 License	NRC Action
Dec 2028	Submission of Combined License Application (COLA) - First Site (by Customer/Partner)	Application Sub.
Oct-Dec 2028	Potential Issuance of Manufacturing License (ML)	NRC Action
Feb 2029	Potential Acceptance/Docketing of COLA (by Customer/Partner)	NRC Action

Note: "Potential Review" indicates estimated NRC staff review periods following submission.

9.2 Budget

Hadron Energy understands that NRC review activities are typically fee-recoverable under 10 CFR Part 170. We plan to engage with the NRC staff project manager to understand estimated review costs associated with planned interactions (meetings, report reviews, audits) and the formal application review. Budgetary considerations and resource planning will be part of ongoing project management discussions to ensure alignment and predictability. We will inquire about any applicable fee waiver opportunities, although none are currently anticipated for this commercial project.

10 REFERENCES

U.S. Code of Federal Regulations, Title 10, Part 52, Subpart E, “Standard Design Approvals.” (10 CFR 52 Subpart E)

1. Nuclear Energy Institute, NEI 18-06, Rev. 0, “Guidelines for Development of a Regulatory Engagement Plan,” June 2018.
2. U.S. Code of Federal Regulations, Title 10, Part 52, Subpart C, “Combined Licenses.” (10 CFR 52 Subpart C)
3. U.S. Nuclear Regulatory Commission, NUREG-1226, “Development and Utilization of the NRC Policy Statement on the Regulation of Advanced Nuclear Power Plants,” June 1988.
4. U.S. Code of Federal Regulations, Title 10, Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants.” (10 CFR 50 Appendix A)
5. U.S. Nuclear Regulatory Commission, NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition.” (SRP)

6. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.206, Rev. 1, “Combined License Applications for Nuclear Power Plants,” October 2018.
7. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.233, "Guidance for a Technology-inclusive, Risk-informed, and Performance-based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors."
8. Nuclear Energy Institute, NEI 18-04, Rev 1, "Risk-Informed Performance-Based Guidance for Non-Light Water Reactor Licensing Basis Development."
9. U.S. Nuclear Regulatory Commission, NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors."
10. U.S. Nuclear Regulatory Commission, NRO-REG-100, Rev. 2, “Acceptance Review Process for Early Site Permit, Design Certification, and Combined License Applications,” December 18, 2014 (ADAMS ML14078A152).
11. U.S. Code of Federal Regulations, Title 10, Part 71, “Packaging and Transportation of Radioactive Material.”
12. U.S. Nuclear Regulatory Commission, "Micro-reactors Licensing Strategies," (ADAMS ML21235A418).
13. U.S. Code of Federal Regulations, Title 10, Part 73, “Physical Protection of Plants and Materials.”
14. U.S. Nuclear Regulatory Commission, Regulatory Guide 5.79, “Protection of Safeguards Information.”
15. U.S. Code of Federal Regulations, Title 10, Section 2.390, “Public inspections, exemptions, requests for withholding.” (10 CFR 2.390)
16. Memorandum of Cooperation on Advanced Reactor and Small Modular Reactor Technologies between the United States Nuclear Regulatory Commission and the Canadian Nuclear Safety Commission (ADAMS ML19275D578).
17. U.S. Nuclear Regulatory Commission, NRO-REG-104, “Pre-Application Readiness Assessment.”
18. Nuclear Energy Institute, NEI 11-04A, Rev 0, "Nuclear Generation Quality Assurance Program Description."
19. Electric Power Research Institute, “Advanced Nuclear Technology: Advanced Light Water Reactor Utility Requirements Document,” Revision 13, December 2014.
20. U.S. Code of Federal Regulations, Title 10, Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.” [1]
21. U.S. Nuclear Regulatory Commission, Regulatory Guide 4.2, "Preparation of Environmental Reports for Nuclear Power Plants."
22. U.S. Nuclear Regulatory Commission, NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants." (ESRP)
23. U.S. Code of Federal Regulations, Title 10, Part 2, “Agency Rules of Practice and Procedure.”
24. U.S. Code of Federal Regulations, Title 10, Part 110, “Export and Import of Nuclear Equipment and Material.”
25. "U.S. Code of Federal Regulations, Title 10, Part 52, Subpart F, “Manufacturing Licenses.” (10 CFR 52 Subpart F)

26. "U.S. Code of Federal Regulations, Title 10, Part 70, “Domestic Licensing of Special Nuclear Material.” (10 CFR Part 70)