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

August 3, 2026

Mr. Mark Chitty
Deep Fission, Inc.
2381 Garber St
Berkeley, CA 94705

SUBJECT: RESPONSE TO DEEP FISSION'S "CONCEPTUAL DESIGN DESCRIPTION OF THE GRAVITY REACTOR" WHITE PAPER

Dear Mr. Chitty:

By letter dated April 22, 2026 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML26112A158), Deep Fission submitted a white paper, "Conceptual Design Description of the Gravity Reactor." This white paper provided an overview of the Gravity Reactor Design. The staff reviewed the white paper and provided observations and comments in Enclosure 1. These observations and comments are not comprehensive and do not encompass all information that could be required to support any future licensing action pursued by Deep Fission. Further, additional clarity on the planned licensing pathway (10 CFR Part 50, 52, 53 or 57) would assist with staff in providing more relevant feedback, including the use of risk information to support the licensing process. The staff does not require a response to this letter.

Sincerely,

/RA/

Ricky Vivanco, Lead Project Manager
Advanced Reactor Licensing Branch 3
Division of Advanced Reactor Licensing
Office of Advanced Reactors

Docket No.: 99902126

Enclosure:

cc: Deep Fission via GovDelivery

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Enclosure 1 – Observations

	White Paper Section	Topical Area	Observation/comment
1	Section 5.3	SSC Classification	The white paper discusses both passive safety features and other systems relied upon for reactor operation. Clearly distinguishing between safety-related and non-safety-related SSCs, and providing the rationale for their classification would help support a future review. Additionally, acknowledging any active backup systems that provide defense-in-depth to passive safety features could clarify their role in the safety strategy. Additional information related to how the criteria included in the 10 CFR 50.2 safety-related definition was applied to the design would also be useful to facilitate understanding of the classification process (e.g., reactor coolant pressure boundary and safe shutdown)
2	Sections 2.4.1 2.4.2,4, 4.5, and 6.5	Applicability of Drilling Industry Operating Experience	The white paper notes the use of remote sensor and control technologies, such as those directing valves and pumps from a surface building to a reactor located one mile underground, that leverage remote inspection and drilling industry practices. In future pre-application submittals, consider addressing any significant differences between oil well and nuclear reactor operations that may necessitate different reliability and design features for sensors and controls, particularly to ensure the timely and reliable detection and response to adverse reactor conditions. While the white paper references proven technologies used in millions of boreholes and established drilling industry practices, it would be helpful to provide relevant operating experience specifically for large-diameter boreholes (e.g., ~38 inches as described in Section 2.1), including aspects such as geometry, stability, effectiveness of borehole casing, and retrievability of components. Clarification would be helpful on whether the expected borehole characteristics fall within the scope of existing codes and standards (e.g., API standards, Kansas Administrative Regulations), and, if not, how any potential gaps will be addressed.
3	Sections 2.1, 2.4.1 and 3.3	Siting (seismic design and geologic investigation)	In future pre-application submittals, consider providing additional detail on site characterization and seismic considerations for the proposed borehole reactor concept. While the white paper notes that “seismic-induced casing damage is highly unlikely,” clarification of what constitutes "highly unlikely" and how this relates to the reliability of safety components (e.g., sensors, pumps, valves, and communication systems) would be helpful. Understanding the types of information that will be used to demonstrate both the site's seismicity and the reliability of passive and active safety systems and systems needed for reactor operations would inform the review. Describing how the approach to site geologic investigation comprehensively assessed site suitability would be beneficial. The limited information gained from drilling a single borehole may not be sufficient to fully characterize the subsurface environment at depth. Collecting and analyzing additional geologic data, potentially from multiple boreholes, could provide a better understanding of subsurface conditions, including the stability of the geologic environment, potential displacement hazards along the borehole casing, and the depth at which bedrock may no longer move as a coherent block. Such information could help address the potential for irreparable borehole displacement that may strand the reactor at depth and inform design considerations for borehole casing materials, taking into account site-specific geologic conditions that may degrade the casing over time. Additional information about subsurface conditions that could challenge the integrity of the borehole and/or casing to perform their specified functions would also better inform the pre-application review. Clarification if the borehole would penetrate aquifers, and if so, how the affected aquifers would be protected from radiological hazards, would better inform pre-application activities. Addressing other geophysical and geotechnical properties of the site material relevant to borehole design and casing selection, would also inform future review activities.

			Section 2.1 indicated multiple boreholes are expected to meet customer demand for any given site. To accommodate multiple reactors, information on site requirements for borehole spacing would be helpful. Clarification would be helpful regarding the approach to borehole site characterization for this design, where the site characterization sample well borehole serves as the operating location for the reactor unit. Specifically, information on whether boreholes drilled for site characterization would be considered part of construction, or if a preliminary pilot borehole would be used and then expanded for reactor deployment, would be helpful. Additionally, specifying the types of data that would be collected from a sample well borehole to demonstrate its suitability for reactor deployment would inform the review.
4	Sections 2.1, 2.4 and Table 5-2, Step 3	Siting (external hazards)	In future pre-application submittals, consider providing additional information on how external hazards, such as high winds, external fires, flooding, intense precipitation, and kinetic impacts (i.e. missile hazards and other potential manmade hazards), will be evaluated and addressed for the reactor's surface systems including control systems, borehole closure system, secondary heat exchanger, tertiary coolant system, power conversion, overhead rigging, and support facilities. Clarifying whether these hazards will be managed through siting or mitigation measures would inform the staff's understanding of the approach to external hazard protection for the geologically isolated configuration.
5	General	Operating Conditions	An overview of the expected normal operating conditions for the Deep Fission reactor concept would assist staff review. This could include information on normal operating parameters, thermal-hydraulic conditions in key components and along the length of the borehole, plant response during transients, and general heat balance data (e.g., thermal-hydraulic conditions in the primary and secondary cooling loops, heat losses, and heat transferred to the power conversion system).
6	Sections 2, 2.4, and 3.2	Borehole Design Characteristics	Additional information on how potential interactions between the borehole and surrounding groundwater or aquifers are addressed (e.g., measures to prevent borehole leakage into groundwater or degradation of the borehole and/or casing), would inform the review. Clarification of the parameters for borehole dimensions, integrity, and tolerance requirements (e.g., allowable deviation from vertical), as well as any preliminary requirements or criteria used to verify borehole integrity prior to reactor installation, would inform the staff's understanding of the design and its safety considerations.
7	Sections 2.1, 2.5, and 4	Licensing Pathways (spent fuel and decommissioning)	Section 2.5 of the white paper refers to managing spent fuel either by "(1) storing the reactor canister in place within the borehole with the nominally mile deep column of water becoming its spent fuel pool, or (2) removing the reactor canister from the borehole and storing the spent fuel using conventional methods currently employed by operating PWRs." Section 4 refers to defined "approaches for retrieval, maintenance, or decommissioning activities". In future pre-application submittals, consider providing additional detail on the defined approaches for spent fuel management, retrieval, and decommissioning. For example, information on anticipated off-normal conditions and their mitigation and the feasibility of retrieval in the event of damage to the reactor module or borehole internals would also inform the review. It would be useful to describe the anticipated licensing pathways for spent fuel management and decommissioning, including whether decommissioning will involve removal of used fuel for long-term storage at an approved facility (e.g., under 10 CFR 72) or support long-term interim storage of used fuel in the borehole. The white paper indicates that the unit can be licensed using the borehole as a spent fuel storage location and also notes the potential for refueling operations. Further explanation of how refueling operations would be performed using either of the spent fuel management strategies described in Section 2.5 would also be helpful.

8	Section 2.1	Licensing Pathways (multiple reactors)	In future pre-application submittals, consider clarifying the anticipated number of reactors to be licensed in a single application under the Deep Fission fleet-wide licensing approach. If more than one reactor is expected to operate at a site (as indicated in Section 2.1), providing information on multi-module considerations and potential interactions between reactors would further inform the review.
9	Sections 3.2, 6.2, 6.3, and Table 5-1	Condition Monitoring (inspection and testing) of SSCs	In future pre-application submittals, consider providing additional detail on the borehole environmental control, inspection, and condition monitoring strategies for both the reactor canister and the heat exchangers. Clarification on how condition monitoring and inspections of subsurface components will be performed, the extent to which these methods have been validated by Deep Fission, and whether inspections will align with ASME BPV Code or require approval of alternative requirements would inform the review. Given the challenges in accessing subsurface components, information on how performance and reliability will be ensured, particularly for a first-of-a-kind design, would further inform the review. This could include discussion of any degradation assessments, design provisions for performance monitoring to address uncertainties, and whether borehole integrity will be periodically reverified throughout the reactor's operational life, especially considering the reliance on the borehole water column as a passive safety feature.
10	Sections 3.2, 4.1.2, 4.3.2, 5.1, 5.2, 5.4, Figure 4-1, and Table 5-1	Principal Design Criteria	In future pre-application submittals, consider providing additional detail on the application of 10 CFR 50, Appendix A, General Design Criteria (GDC) and the development of Principal Design Criteria (PDC) for the Gravity Reactor. Clarification on which specific GDC will require design-specific PDC, and how the PDC will be tailored to the reactor's unique features and operating environment, would inform the review. Additional information on the evaluation of lengthy piping carrying secondary coolant from the primary heat exchanger to the surface for potential water hammer issues during transients or off-normal conditions (e.g., see NUREG-0927, NRC IN 85-76, IN 91-50 and GL 96-06) would inform the review. Clarification on how separation and independence of critical safety functions, particularly for instrumentation and control cables within the borehole, will inform the review. (Figure 4-1 of the white paper shows only one electrical cable bundle in the borehole cross-section). Details on operational considerations for remote monitoring and control from the surface, including what facilities and safety-related SSCs will be present, would be helpful. If a control room is used, information on dose evaluation for operators and whether guidance such as Regulatory Guide 1.183 will be applied would support the review. Fission Product Barriers: Further explanation of the SSCs necessary to support the borehole's radioactive material barrier function, including the roles of geological isolation and the hydrostatic water column, and how these SSCs will be classified would be useful. LOCA Mitigation: Clarification on how the hydrostatic column of water in the borehole communicates with the reactor coolant system to provide core cooling during accident conditions (particularly for break locations that may not communicate directly with the borehole environment, such as heat exchanger tube ruptures) would be beneficial. Reactivity Control: Additional information on inherent negative reactivity feedback and whether it presents any operational challenges for mitigating excess cooling events or maintaining long-term safe shutdown conditions would be helpful. Clarification on the active equipment required to support the primary coolant control (PCC) system and other reactivity control systems, as well as which systems will be credited for achieving and maintaining shutdown during design basis events, would inform the review.

			<u>Ultimate Heat Sink:</u> Additional detail on the function of the borehole water as the ultimate heat sink, including expected conditions during postulated events, whether active cooling is needed or credited prior to an event, the maximum temperature of borehole water, and whether the borehole cover requires or credits over-pressurization protection, would support the review. <u>Reactor Coolant System Boundary (Primary Heat Exchanger Integrity):</u> Information on the safety significance of primary-to-secondary leakage, the definition and maintenance of primary heat exchanger integrity, and lessons learned from tube integrity issues in U.S. LWR steam generators (including wear and corrosion) would support the review.
11	Sections 2 and 6.2	Codes and Standards	Clarification would be helpful regarding the terminology used in the white paper, specifically whether "reactor canister" is synonymous with "reactor vessel" and whether it will be treated the same with respect to compliance with 10 CFR 50.55a and the ASME Boiler and Pressure Vessel (BPV) Code. Since the reactor canister appears to function as a pressure vessel designed for both internal and external pressure loading, consistent terminology and clear identification of applicable design codes would help determine the correct regulatory requirements. Additionally, given the inclusion of piping, tubing, pumps, valves, sensors, instrumentation, and controls—whose performance may affect safety analyses—it would be useful to specify the codes and standards that will be applied to their design, fabrication, testing, and maintenance. Clarification on which codes, standards, and guidelines will govern materials performance and water chemistry control, both of which are important to the safety case, would inform the review.
12	Table 5-2, Step 1 and Reference 8.3.5	Maximum Credible Accident	The white paper references RG 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors,” but does not describe how this document would be used. Clarification on how the guidance in RG 1.183 will be applied to the Deep Fission design would be helpful. Information on the radiological source terms that will be used and how a maximum credible accident will be defined would inform the staff’s evaluation of accident analyses for this concept.