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**Subject:** Final RAI 348 on Shutdown Rod Reliability and Defense in Depth  
**Date:** Monday, August 08, 2022 4:54:00 PM

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Darrell, Drew, Jim, and Marty,

The Request for Additional Information (RAI) below was transmitted as draft on August 2, 2022. Part 2 of the RAI was clarified to indicate that qualification testing plans are desired. This RAI is now final. You stated in the clarification call that you expect to respond to this request within 30 days of August 2, 2022.

Regards,  
Ben

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**REQUEST FOR ADDITIONAL INFORMATION  
OFFICE OF NUCLEAR REACTOR REGULATION**

**Issue Date:** 8/2/2022

**Hermes Construction Permit Application**

Kairos Power, LLC

**Dockets:** 05007513--Hermes Non-Power Test Reactor

**EPIDS:** L-2021-NEW-0011

**RAI 348 QUESTION 408**

Section 50.34 of Title 10 of the *Code of Federal Regulations* (10 CFR 50.34), "Contents of applications; technical information," provides requirements for information to be provided in a Construction Permit (CP). 10 CFR 50.34(a)(4) states that a CP shall contain a preliminary analysis and evaluation of structures, systems, and components (SSCs) to determine margins of safety during normal operations and transient conditions and the adequacy of SSCs provided for prevention and mitigation of the consequences of accidents.

As given in the Kairos topical report on principal design criteria for the KP-FHR, criterion 29,

which is referenced in the Hermes Preliminary Safety Analysis Report (PSAR), states, "The protection and reactivity control systems shall be designed to assure an extremely high probability of accomplishing their safety-functions in the event of anticipated operational occurrences." For the Hermes test reactor "anticipated operational occurrences is replaced by postulated events" per PSAR Section 3.1.

NUREG-1537, Part 2, Section 4.2.2, "Control Rods," states that the staff should determine that reasonable assurance exists that the scram features designed for this reactor will perform as necessary to ensure fuel integrity and to protect the health and safety of the public.

Preliminary Safety Analysis Report Section 13.1.10.1, "Recriticality and Unprotected Events" states, "Unprotected events, or events where reactor shutdown is not achievable, are excluded from the design basis." In addition, Section 13.1.10.1 states, "The RCSS [reactivity control and shutdown system] is designed ... with sufficient independence, diversity, and redundancy from detection and actuation to element insertion to ensure reactor shutdown when necessary." To reach a reasonable assurance finding that the RCSS has sufficient reliability to preclude unprotected events, the staff is requesting additional information regarding the following:

1. Please describe any instrumentation and control design features which provide defense-in-depth or reduce the probability of a common cause failure to preclude an unprotected event.
2. What mechanical qualification testing of the RCSS system will be performed to ensure element insertion, including the insertion of the shutdown elements into the pebble bed and control elements into the graphite reflector?
3. If control and shutdown elements (beyond the assumed highest worth stuck element) fail to insert, partially insert, or suffer neutron absorber loss (e.g., through the loss of element cladding integrity), are other means of reactivity control available to mitigate postulated events? If other means are not available, please describe how there is sufficient diversity or reliability to justify excluding unprotected events from the design basis.