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

REQUEST FOR CONFIRMATION OF INFORMATION
OFFICE OF NUCLEAR REACTOR REGULATION
HERMES 2 CONSTRUCTION PERMIT APPLICATION
DOCKET NOS. 50-611 AND 50-612
EPID L-2023-CPS-0000

Request for Confirmation #1

Title 10 of the *Code of Federal Regulations* (10 CFR) 50.34(a) provides requirements for the information that shall be included in the preliminary safety analysis report (PSAR) submitted as part of a construction permit (CP) application. Paragraph 50.34(a)(3)(ii) states that the PSAR shall contain a description of the proposed facility's design bases and the relation of the design bases to the principal design criteria (PDC).

Hermes 2 preliminary safety analysis report (PSAR) Section 1.2.3, "Design Features and Design Bases," provides the following definition for safety-related structures, systems, and components (SSCs):

> Those SSCs that are relied upon to remain functional during normal operating conditions and during and following design basis events to assure:
> - The integrity of the portions of the reactor coolant boundary relied upon to maintain coolant level above the active core (see below);
> - The capability to shut down the reactor and maintain it in a safe shutdown condition; or
> - The capability to prevent or mitigate the consequences of accidents which could result in potential exposures exceeding the limits set forth in 10 CFR 100.11.

Analyses will be performed for the intermediate heat transport system (IHTS) to demonstrate that under all postulated events, including a superheater tube rupture event, the intermediate heat exchanger (IHX) tubes would not need to be classified as a safety-related SSC, based on the Kairos-provided definition above. At a minimum, these analyses will consider the following effects:

- The potential for significant water or steam from the postulated superheater tube rupture to reach the IHX and interact with Flibe,
- The potential for Flibe from the primary heat transport system (PHTS) to enter the IHTS in significant quantities and interact with steam in the IHTS, and
- The potential for BeNaF ingress into the PHTS that could affect the thermophysical properties of Flibe such that there could be an impact on natural circulation within the reactor vessel that could challenge the decay heat removal function.

Alternatively, if the IHX tubes are relied upon to remain functional during and after a postulated event, Kairos will demonstrate that their failure is not credible considering all relevant factors, such as the time history of postulated events, margin between tube design pressure and stress in the postulated event, potential tube degradation in service, and any augmented quality standards that would be applied to the design, construction, operation and maintenance of the IHX.

Request for Confirmation #2

Title 10 of the *Code of Federal Regulations* 50.34(a) provides requirements for the information that shall be included in the PSAR submitted as part of a CP application. Paragraph 50.34(a)(3)(ii) states that the PSAR shall contain a description of the proposed facility's design bases and the relation of the design bases to the PDC.

Section 3.1.1, "Design Criteria," of the Hermes 2 PSAR references topical report KP-TR-003-NP-A, "Principal Design Criteria for the Kairos Power Fluoride-Salt Cooled, High Temperature Reactor," Revision 1, for the Hermes 2 test reactor facility PDC. The NRC staff is evaluating the Hermes 2 PHTS against the following PDC from KP-TR-003-NP-A:

- KP-FHR PDC 10, "Reactor design," requires the reactor core and associated heat removal systems to have appropriate margin to ensure radionuclide release limits are not exceeded.
- KP-FHR PDC 14, "Reactor coolant boundary," requires the safety related portions of the boundary to have an extremely low probability of abnormal leakage, rapid failure, or gross rupture.
- KP-FHR PDC 16, "Containment design," requires a functional containment to control release of radioactivity.
- KP-FHR PDC 31, "Fracture prevention of reactor coolant boundary," requires safety related portions of the reactor coolant boundary to be designed to account for coolant composition, including contaminants.
- KP-FHR PDC 70, "Reactor coolant purity control," requires systems to maintain the purity of the reactor coolant within specified design limits.

To demonstrate how the design bases for the reactor coolant satisfy the PDC listed above for the Hermes 2 design, confirm that the final safety analysis report (FSAR) submitted as part of a future operating license application will demonstrate that the contamination of Flibe in the PHTS by a postulated BeNaF ingress from the IHTS (bounding all postulated events and normal operation) will remain within the purity specification for sodium impurities in topical report KP-TR-005-P-A, "Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor," or Kairos will provide justification in the FSAR for exceeding the purity specification.