Enclosure 1

**Kairos Power Response to NRC Requests for Confirmation of Information
for the Review of the Hermes 2 PSAR Chapter 5**

(Non-Proprietary)

Kairos Power Hermes 2 Test Reactor

Construction Permit Application

Preliminary Safety Analysis Review

Chapter 5 Requests for Confirmation of Information

Regulatory Basis:

Construction permit (CP) requirements are specified in Title 10 of the Code of Federal Regulations (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities." 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). Kairos Power submitted a Preliminary Safety Analysis Report (PSAR) as part of its CP application in accordance with 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

On October 3, 2023, the NRC issued its plan for conducting a preliminary safety audit (ML23268A446) related to the Kairos Power Hermes 2 CP application. As part of the audit, the staff reviewed documents on the applicant electronic information portal (ML20014E6412), provided in response to the staff Information Needs outlined in Attachment 1 of the audit plan. Additionally, the staff held discussions with Kairos Power related to these audit items. To the best of the staff's knowledge, some of the information reviewed is not on the docket or accessible in the public domain; therefore, the staff requests that Kairos Power submit confirmation that the information listed below is correct or provide the associated correct information.

RCI-01

Hermes 2 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 ensure:

- *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.*

Request for Confirmation of Information

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.

Kairos Power Response

This information has been confirmed to be correct as stated.

RCI-02

<u>Background Provided by the NRC</u>

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.*

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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.

Kairos Power Response

This information has been confirmed to be correct as stated.