From:	Beasley, Benjamin
To:	"gardner@kairospower.com"; "peebles@kairospower.com"; "Jim Tomkins"; "Martin Bryan"
Cc:	Helvenston, Edward; Cuadrado de Jesus, Samuel; Chereskin, Alexander; Audrain, Meg
Subject:	Final RAI 350 for Air Ingress into the Primary Heat Transport System
Date:	Monday, August 08, 2022 4:46:00 PM

Darrell, Drew, Jim, and Marty,

The Request for Additional Information (RAI) below was transmitted as draft on August 2, 2022. Since no changes were made as a result of the clarification call, this RAI is final. Please respond to this request within 30 days of August 2, 2022.

Regards,
Ben

Benjamin Beasley
Senior Project Manager
Advanced Reactor Licensing Branch 1
Office of Nuclear Reactor Regulation
301-415-2062
Benjamin.Beasley@nrc.gov

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 350 QUESTION 410

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 SSCs provided for mitigation of the consequences of accidents to determine margins of safety during normal operations and transient conditions during the life of the facility.

Section 3.1.1, "Design Criteria," of the Kairos Power (KP) Hermes Preliminary Safety Analysis Report (PSAR) references document KP-TR-003-NP-A, "Principal Design Criteria [PDC] for the Kairos Power Fluoride-Salt Cooled, High Temperature Reactor," Revision 1, to provide the PDC for the Hermes test reactor. KP-FHR PDC 14, "Reactor coolant boundary," states that safety significant elements of the reactor coolant boundary shall

have an extremely low probability of abnormal leakage, rapidly propagating failure, and gross rupture. KP-FHR PDC 31, "Fracture prevention of the reactor coolant boundary," states that the reactor coolant boundary shall be designed to consider service degradation of material properties including effects of contaminants. KP-FHR PDC 35, "Passive residual heat removal," states that a system shall be provided to remove residual heat during and after postulated accidents. KP-FHR PDC 74, "Reactor vessel and reactor system structural design basis," states that the vessel and reactor system shall be designed to ensure integrity is maintained during postulated accidents to ensure the geometry for passive heat removal and allow for insertion of reactivity control elements. Section 4.3 of the PSAR, "Reactor Vessel System," describes the components that form the natural circulation flow path needed to provide residual heat removal during and following postulated events. These include portions of the graphite reflector as well as metallic components such as the core barrel, reactor vessel, and fluidic diode. This section of the PSAR describes how these components are needed to meet PDCs 14, 31, 35, and 74.

Section 5.1.3 of the PSAR, "System Evaluation," states that "significant" air ingress into the primary heat transport system (PHTS) is excluded by design basis. In an event with postulated air ingress into the PHTS, the components that comprise the natural circulation flow path will need to perform their safety functions (i.e., maintain the natural circulation flow path) to meet the PDC listed above. The staff notes that air ingress into the PHTS can cause oxidation of the graphite reflector as well as corrosion of metallic components in the primary system, and such degradation could potentially challenge natural circulation flow. In order to evaluate effects of air ingress, the staff needs to understand the amount of air ingress that will be allowed and how the limitation of ingress will be achieved.

Therefore, the NRC staff requests the following information:

1. Define what constitutes "significant" air ingress into the PHTS and the basis for determining what is "significant."
2. Describe how component integrity is ensured if the duration of an air ingress event is longer than the duration covered by the materials qualification testing.
3. In an event such as a salt spill or heat radiator tube rupture, how is further air ingress prevented after a heat rejection blower trip?