



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

March 11, 2024

MEMORANDUM TO: William Jessup, Chief
Advanced Reactor Licensing Branch 1
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

FROM: Cayetano Santos Jr., Senior Project Manager
Advanced Reactor Licensing Branch 1
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF FEBRUARY 20, 2024, MEETING WITH KAIROS
ON CRITICALITY SAFETY FOR THE HERMES 1 TEST
REACTOR AND A DRAFT CORE DESIGN METHODOLOGY
TOPICAL REPORT

Meeting Information:

Applicant: Kairos Power LLC (Kairos)

Project No.: 99902069

Meeting Type: Partially Closed Observation Meeting

Public Meeting Notice: Agencywide Documents Access and Management System (ADAMS)
Accession No.: ML24039A165

Applicant Presentation Slides: ML24046A145 and ML24046A146

Contact: Cayetano Santos, NRR/DANU
(301) 415-7270

Meeting Summary:

On February 20, 2024, a partially closed observation meeting was held between the U.S. Nuclear Regulatory Commission (NRC) staff and representatives of Kairos Power, LLC (Kairos) at NRC Headquarters, One White Flint North, 11555 Rockville Pike, Rockville, Maryland. The purpose of the meeting was to discuss: (1) criticality safety analysis methods for the Hermes non-power reactor and (2) a draft topical report (TR) on core design methods for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor.

Topic 1: Criticality Safety Analysis Methods for Hermes 1 Test Reactor Facility

Kairos representatives provided an overview of the Hermes 1 pebble handling and storage systems and summarized the criticality safety analyses methods that will be used to ensure subcriticality of the fuel handling and storage operations at the Hermes 1 test reactor facility (ML24046A145).

Below is a summary of the comments and discussions:

- The NRC staff noted that the review of an upper subcritical limit (USL) of 0.90 may be difficult without formal code validation, especially given the limited data applicable to high-assay low-enriched uranium (HALEU) fuel. Kairos representatives stated the technical justification is expected to show that the 10% margin is sufficient.
- The NRC staff asked about the fuel pebble packing fraction assumed in the analysis model. Kairos representatives stated that the analysis model assumes a random spherical packing fraction of 65%. A typical value of spherical random packing fraction in the scientific literature is 64%, while the maximum theoretical ordered packing fraction is 75%.

Members of the public were in attendance but voiced no comments or questions.

Discussions between the NRC staff and Kairos representatives continued during a closed meeting to discuss proprietary information.

Topic 2: Draft Core Design Methodology Topical Report

Kairos representatives provided an outline of the draft TR, identified the three methods used to analyze the physical behavior of the core (i.e., discrete element methods, neutronics, and thermal hydraulics), and described the various tools used to implement each of these methods. Kairos plans to submit the core design TR for the NRC staff review by the end of the first quarter of 2024 with a requested approval date within one year. Kairos also plans to submit another TR on safety analysis methods (ML24046A146).

Below is a summary of the comments and discussions:

- The NRC staff asked about the startup testing process for the Hermes test reactor facility. Kairos representatives stated that initially, the core will be loaded with graphite pebbles in a molten salt coolant (Flibe). The first criticality would be accomplished by slowly replacing graphite pebbles with fuel pebbles. The reactor

would then be shut down and filled with the ratio of fuel and graphite pebbles needed to achieve the first criticality. Next, the reactor will be restarted by pulling control rods. During this second approach to criticality, various startup tests will be conducted.

- The NRC staff noted that a clear description and explanation of how the various tools used in core design analyses interact and communicate with one another would be helpful. Kairos representatives stated that they would consider this comment in preparing the final report.

Members of the public were in attendance but voiced no comments or questions.

Discussions between the NRC staff and Kairos representatives continued during a closed meeting to discuss proprietary information.

Enclosure:
List of Attendees

cc: Kairos Power FHR
Kairos Power Hermes
Kairos Power Hermes 2 via GovDelivery

W. Jessup

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CRITICALITY SAFETY FOR THE HERMES 1 TEST REACTOR AND A DRAFT
CORE DESIGN METHODOLOGY TOPICAL REPORT
DATED: March 11, 2024

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ADAMS Accession Number: ML24061A113

NRR-109

OFFICE	NRR/DANU/UAL1:PM	NRR/DANU/UAL1:LA	NRR/DANU/UAL1:BC	NRR/DANU/UAL1:PM
NAME	CSantos	DGreene	WJessup (SDevlin-Gill)	CSantos
DATE	3/1/2024	3/6/2024	3/7/2024	3/11/2024

OFFICIAL RECORD COPY

List Of Attendees

Summary of February 20, 2024, Meeting with Kairos on Criticality Safety for the Hermes 1 Test Reactor and a Draft Core Design Methodology Topical Report

February 20, 2024

Name	Organization
Cayetano Santos	U.S. Nuclear Regulatory Commission (NRC)
Pravin Sawant	NRC
Alex Siwy	NRC
Andrew Bielen	NRC
Michael Orenak	NRC
Matthew Hiser	NRC
Andrew Barto	NRC
Ben Adams	NRC
Benjamin Parks	NRC
Candace de Messieres	NRC
Jason Schaperow	NRC
Jeremy Munson	NRC
Joshua Kaizer	NRC
Lance Kingsbury	NRC
Roel Brusselmans	NRC
William Jessup	NRC
James Tomkins	Kairos Power, LLC (Kairos)
Nicole Schlichting	Kairos
Drew Peebles	Kairos
Nader Satvat	Kairos
Brandon Haugh	Kairos
Giacomo Busco	Kairos
Richard Hernandez	Kairos
Chris Campbell	Kairos
Darrell Gardner	Kairos
Etienne Demarly	Kairos
Fanny Vitullo	Kairos
Jeff Schmidt	Kairos
Michael Ellett	Kairos
Brian Jackson	Kairos
Jana Bergman	Member of the Public
Shane Scanlon	Member of the Public
Matthew Presson	Member of the Public
Kris Cummings	Member of the Public
Max Fratoni	Member of the Public
Carol Campbell	Member of the Public
Pat Everett	Member of the Public

Enclosure