



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

**KAIROS POWER LLC – PLAN FOR AN AUDIT OF THE HERMES CONSTRUCTION PERMIT
PRELIMINARY SAFETY ANALYSIS REPORT CHAPTER 7 ON INSTRUMENTATION AND
CONTROL
(CAC/EPID NO. 000955/05007513/L-2021-NEW-0011)**

APPLICANT INFORMATION

Applicant: Kairos Power LLC

Applicant Address: 707 W. Tower Ave, Alameda, CA 94501

Plant Name(s) and Unit(s): Kairos – Hermes Test Reactor
RPS

Docket No(s).: 50-7513

Background:

By letter dated September 29, 2021, Kairos Power LLC submitted the Hermes Part 50 construction permit application and corresponding preliminary safety analysis report (PSAR) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21272A375). PSAR Chapter 7, "Instrumentation and Control Systems," describes the instrumentation and control (I&C) systems that monitor and control plant operations during normal operations and planned transients and also monitor and actuate protection systems in the event of unplanned transients.

Purpose:

The purpose of this audit is for the U.S. Nuclear Regulatory Commission (NRC) staff to gain a better understanding of Chapter 7 of the PSAR. The audit achieves a more effective and efficient review by allowing the staff to review and discuss supporting material with the objective of improving communication and eliminating unnecessary requests for additional information. Reviewing underlying documentation and engaging in audit discussions about I&C systems will facilitate the staff's understanding of the Hermes design. If the NRC staff identifies information that is needed to support a finding, Kairos will need to submit that information on the application docket.

Regulatory Audit Basis:

The bases for the audit are the regulations of Title 10 of the *Code of Federal Regulations* (10 CFR), 50.34(a)(1)(i), 50.34(a)(3), and 50.34(a)(4).

Regulatory Audit Scope

This audit will focus on information provided by Kairos on the online reference portal and during virtual meetings. If a site visit is determined to be beneficial, review topics will be provided to Kairos and mutually agreeable dates will be established.

Information and Other Material Necessary for the Regulatory Audit

Kairos should be prepared to provide documents, drawings, reports, calculations, and other material, as applicable, supporting the analyses documented in the PSAR. The NRC staff may request that Kairos make these additional materials available in the online reference portal and/or during a site visit if one is conducted. The NRC staff initially requests material that will address the questions below.

7.1-1	Section 7.1, Reference 2, states the version used for Institute of Electrical and Electronics Engineers (IEEE) 7-4.3.2 is 2003. Clarify why the 2003 version is used instead of a more recent version.
7.1-2	Section 7.1.2 states that for both plant control system (PCS) and reactor protection system (RPS) "activation and actuation" setpoints are calculated. What is the difference between "activation" and "actuation" setpoints?
7.1-3	Describe the methodology and rigor used to establish non-safety setpoints.
7.2-1	Is there any redundancy in the PCS platform or non-safety sensors? This is in conjunction with request number 7.2-5 in this section, concerning PCS failure modes.
7.2-2	Figure 7.1-1 does not identify the subsystems in the PCS to which the RPS sensors input.
7.2-3	For the one-way data diode shown in Figure 7.1-1, there is no information that discusses how the data diode is implemented into the architecture and whether it will be controlled via hardware or software.
7.2-4	The four subsystems of the PCS shown in Figure 7.1-1 do not reflect the reactor auxiliary heating system (RAHS) and there is no discussion of the RAHS in Section 7.2. Update Figure 7.1-1 and provide a discussion for the RAHS in Section 7.2.
7.2-5	Section 7.2 does not discuss PCS failure modes. Please describe the PCS failure modes.
7.3-1	Regarding Section 7.3, clarify if the RPS technology platform will be based on an NRC-approved topical report platform and if plant-specific action items will be addressed.
7.3-2	Figure 7.1-1 shows safety-related isolation devices. A bullet in Section 7.3.1 lists the gateways as two non-safety RPS gateways. The gateways are shown in Figure 7.1-1 as part of the main control room (MCR) and the PCS. Please clarify whether the gateways provide isolation from the RPS and if so, why are the gateways not safety related.

7.3-3	There is no discussion of function allocation in Section 7.3, which needs to be considered for defense in depth. Please describe RPS function allocation.
7.3-4	Regarding Figure 7.1-1, it is not clear if the post-accident monitoring (PAM) displays in the remote onsite shutdown panel are non-safety related or safety related (based on the color in the figure). As stated in Section 7.4, the remote onsite shutdown panel (ROSP) is not safety related. Later in Section 7.4, it is stated that no operator actions are needed, thus no PAM A variables are provided and PAM displays can be non-safety related and should have a diode to isolate them from the RPS. This topic should be addressed by Kairos as part of the application for an Operating License. Specifically, the final safety analysis report needs to discuss how they are planning to implement this one-way communication.
7.3-5	The isolation between manual trips and RPS seems to conflict with how it is shown in 7.4-1. (In Figure 7.1-1 an isolation device is shown and Figure 7.4-1 shows a gateway.) The arrow that shows that the signal goes both ways from the RPS in Figure 7.4-1. Please clarify.
7.3-6	Regarding Figure 7.1-1, if PAM displays in the ROSP are non-safety related, then please clarify why they aren't isolated from the RPS.
7.4-1	PSAR Section 7.4.3.1 states that the "MCR is located at a distance from the Reactor Building such that the radiological consequences of unfiltered air in the MCR during postulated events does not exceed 5 rem TEDE for the duration of the event." PSAR Section 3.5.1 states that the main control building is a stand-alone building on the site that contains the plant control system and reactor protection system human system interface consoles (main control room). However, PSAR Table 3.6-1 indicates that the main control room is in the Auxiliary Building and PSAR Section 7.4 also states that the main control room is in the Auxiliary Building. Environmental Report Figure 2.2-3 gives the expected site layout and shows that the location of the Auxiliary Building is attached to the Reactor Building. Clarify the location of the main control room and relationship to the Reactor Building. Provide information on potential radiological release locations and control room HVAC intakes and access openings for the MCR.
7.5-1	Section 7.3.2 states that the "RPS is designed in accordance with IEEE Std 603-2018." Please discuss the use of IEEE Std 603-2018 for safety sensors rather than other versions. Also, if there are any digital safety-related sensors, then common cause failure needs to be addressed along with other IEEE criteria.

Team Assignments

Ben Beasley Project Manager, responsible for audit logistics
Joe Ashcraft Electronics Engineer, Audit Lead responsible for audit summary report preparation
Calvin Cheung Electronics Engineer
Additional audit team members may be added as needed.

Logistics

Entrance Meeting April 12, 2022
Exit Meeting June 2022, precise date and time are to be determined

Audit meetings will take place in a virtual format, using Microsoft Teams or another similar platform. Audit meetings will be scheduled on an as-needed basis after the entrance meeting and once the NRC staff has had the opportunity to review any documents placed in the online reference portal. The audit duration is anticipated to be approximately 8 weeks with activities occurring intermittently during that period.

Special Requests

None.

Deliverables

The audit team will issue an audit summary within 90 days after the exit meeting but will strive for a shorter duration. The audit summary will be declared and entered as an official agency record in ADAMS and be made available for public viewing.

References

Title 10 of the *Code of Federal Regulations CFR*

If necessary, any issues related to the conduct of the audit should be communicated to Ben Beasley at 301-415-2062 or by email at Benjamin.Beasley@nrc.gov.

Date: April 8, 2022



Signed by Kennedy, William
on 04/08/22

William Kennedy, Acting Chief
Advanced Reactor Licensing Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

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DATED: APRIL 8, 2022**

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DATE	3/31/2022	3/31/2022	4/5/2022	4/8/2022

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