

From: Samuel Cuadrado de Jesus
Sent: Monday, September 25, 2023 3:29 PM
To: KairosPower-PreAppPEM Resource
Subject: NRC Staff Clarification Questions Regarding Kairos Power Instrument Setpoint Methodology Topical Report
Attachments: NRC Staff Clarification Questions Regarding Kairos Power Instrument Setpoint Methodology Topical Report.pdf

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Hearing Identifier: KairosPower_PreApp_Public
Email Number: 10

Mail Envelope Properties (SA1PR09MB73925925DF530AE49B3CA56688FCA)

Subject: NRC Staff Clarification Questions Regarding Kairos Power Instrument Setpoint Methodology Topical Report
Sent Date: 9/25/2023 3:29:18 PM
Received Date: 9/25/2023 3:29:22 PM
From: Samuel Cuadrado de Jesus

Created By: Samuel.CuadradoDeJesus@nrc.gov

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Tracking Status: None

Post Office: SA1PR09MB7392.namprd09.prod.outlook.com

Files	Size	Date & Time
MESSAGE	333	9/25/2023 3:29:22 PM
NRC Staff Clarification Questions Regarding Kairos Power Instrument Setpoint Methodology Topical Report.pdf	157098	

Options
Priority: Normal
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:

September 19, 2023

NRC Staff Clarification Questions Regarding Kairos Power LLC Topical Report, “Instrument Setpoint Methodology for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor” (KP-TR-021-NP)

Purpose: The NRC staff is currently reviewing Kairos Power LLC (Kairos) topical report (TR) KP-TR-021-NP. The instrument setpoint methodology outlined in this TR would be applicable to safety-related setpoints for non-power and power reactors using Kairos’s Fluoride Salt Cooled, High Temperature Reactor (KP-FHR) technology. As part of this review, the staff has identified three items where additional clarification on the content of the TR would assist the staff in completing its safety evaluation of the TR.

1. TR Section 1.2, “Regulatory Information”

Section 1.2, “Regulatory Information,” of the TR describes several regulations and Principal Design Criteria (PDC) “which either rely on or credit safety-related instrument setpoints.” The staff is unclear on the purpose for including these regulations and PDC. There is insufficient information in the TR for the staff to evaluate compliance with the regulations and PDC that have been described in this section and it is not clear how these regulations and PDC apply for making a finding on setpoint methodology. By listing these regulations and PDC, it may present challenges for staff in developing a safety evaluation since there would be an expectation that the staff evaluate compliance with each and/or ensure acceptability such that the setpoint methodology satisfies the listed regulations and PDC.

The staff would expect a list of regulations, guidance, standards, and PDC directly applicable to instrument setpoint methodology, to include, at a minimum:

- Title 10 of the *Code of Federal Regulations* (10 CFR) 50.36(c)(1)(ii)(A);
- Regulatory Guide (RG) 1.105, “Setpoints for safety-related instrumentation,” Revision 4;
- American National Standards Institute (ANSI)/International Society of Automation (ISA)-67.04.01-2018, “Setpoints for Nuclear Safety Related Instrumentation”;
- ANSI/American Nuclear Society 15.8–1995 (R2005), “Quality Assurance Program Requirements for Research Reactors;” and
- PDC 13 and PDC 20 from Kairos TR “Principal Design Criteria for the Kairos Power Fluoride Salt Cooled High Temperature Reactor”

RG 1.105 lists the regulations and requirements that staff would consider applicable when reviewing a setpoint methodology, including General Design Criteria (GDC) 13 and 20 from 10 CFR Part 50 Appendix A, “General Design Criteria for Nuclear Power Plants,” and 10 CFR Part 50 Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.” The staff requests clarification on the applicability of those regulations and PDCs listed in TR Section 1.2 to the Kairos instrument setpoint methodology, with a focus on those that are not consistent with the regulations and design criteria listed in RG 1.105.

2. TR Section 1.3, “Regulatory Guidance”

Section 7.1.2 of the Preliminary Safety Analysis Reports (PSARs) for Hermes 1 and Hermes 2 state “Setpoints for safety-related instrumentation will be calculated in accordance with the guidance of ANSI/ISA 67.04.01-2018 [...]. The setpoint nomenclature as defined in the Regulatory Information Summary RIS-2006-17 [...], will be applied to setpoint calculations developed to support licensing activities.”

RG 1.105, Revision 4, is not listed in either PSAR and Regulatory Issue Summary (RIS) 2006-17, “NRC Staff Position on the Requirements of 10 CFR 50.36, ‘Technical Specifications,’ Regarding Limiting Safety System Settings During Periodic Testing and Calibration of Instrument Channels,” is not listed or discussed in the TR methodology. References to either should be consistent across these documents.

As stated in RIS 2016-17:

10 CFR 50.36(c)(1)(ii)(A) also contains requirements for a general class of [limited safety system settings (LSSSs)]; LSSSs related to variables having significant safety functions but which do not protect [safety limits (SLs)]. All plant operating licenses have [technical specifications] for LSSSs that are not related to SLs. For these LSSSs, 10 CFR 50.36(c)(1)(ii)(A) also requires that a licensee take appropriate action if it is determined that the automatic safety system does not function as required.

Will the KP-FHR design have any of this type of LSSSs and, if so, how will the methodology establish a setpoint without having a SL/analytical limit (AL) as a starting point?

3. TR Section 2.2.4, “Correction”

The staff understands that Kairos has not yet procured the instruments or established its instrument calibration procedures. Therefore, the staff does not understand how TR Section 2.2.4 can state, “[f]or KP-FHRs, errors or offsets that are of a known direction and magnitude are corrected for in the calibration of the module and are not included in the setpoint calculation. The fact that these corrections are made during calibration is identified in the setpoint uncertainty calculation.” The staff notes that this appears to be in conflict with the Kairos methodology algorithm in TR Section 2.4, “Calculating Instrument Uncertainties,” which reflects these positive and negative types of uncertainties, consistent with the algorithm in ANSI/ISA-67.04.01-2018. Although calibration may be the desired way of dealing with these types of errors, it may not always be possible. Provide information to substantiate or clarify this claim and discuss how the process will be controlled to ensure double accounting will not occur for non-random bias.