

## Enclosure 3

### Exemptions (Non-Proprietary)

#### 1. 10 CFR 50.34(a)(4) and 10 CFR 50.34(b)(4) Analysis of ECCS Performance

##### Introduction

Kairos Power requests an exemption from the requirements of 10 CFR 50.34(a)(4) and 10 CFR 50.34(b)(4) that require an analysis of emergency core cooling system (ECCS) performance and high point vents following postulated loss of coolant accidents. The underlying purpose of these requirements is based on light water reactor designs that utilize an emergency system to inject cooling fluids as a result of coolant loss due to coolant pipe breaks and to prevent the accumulation of noncondensable gases that may this cooling function. The Kairos Power fluoride salt-cooled, high temperature reactor (KP-FHR) design removes heat from the core without reliance on makeup fluid injection from an emergency core cooling system. Heat is removed passively from the reactor vessel and does not rely on fluid addition to replace coolant that losses from pipe breaks. Such events are not considered “accidents” for the KP-FHR technology. Therefore, the requirement for an analysis of emergency core cooling system (ECCS) performance and high point vents following postulated loss of coolant accidents is not technically relevant to the KP-FHR design.

##### Regulatory Requirements

10 CFR 50.34(a)(4) requires that the Preliminary Safety Analysis Report (for a construction permit application) include:

*A preliminary analysis and evaluation of the design and performance of structures, systems, and components of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility and including determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility, and the adequacy of structures, systems, and components provided for the prevention of accidents and the mitigation of the consequences of accidents. Analysis and evaluation of ECCS cooling performance and the need for high point vents following postulated loss-of-coolant accidents must be performed in accordance with the requirements of § 50.46 and § 50.46a of this part for facilities for which construction permits may be issued after December 28, 1974. [emphasis added]*

10 CFR 50.34(b)(4) requires that the Final Safety Analysis Report (for an operating license application) include:

*A final analysis and evaluation of the design and performance of structures, systems, and components with the objective stated in paragraph (a)(4) of this section and taking into account any pertinent information developed since the submittal of the preliminary safety analysis report. Analysis and evaluation of ECCS cooling performance following postulated loss-of-coolant accidents shall be performed in accordance with the requirements of § 50.46 for facilities for which a license to operate may be issued after December 28, 1974. [emphasis added]*

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#### Exemption Sought

Pursuant to 10 CFR 50.12(a), Kairos Power LLC requests an exemption from the requirements contained in 10 CFR 50.34(a)(4) and 10 CFR 50.34(b)(4) requiring the analysis and evaluation of ECCS performance and high point venting following a loss of coolant accident.

Specifically, Kairos Power requests exemption from the last sentence in 10 CFR 50.34(a)(4) which states:

*Analysis and evaluation of ECCS cooling performance and the need for high point vents following postulated loss-of-coolant accidents must be performed in accordance with the requirements of § 50.46 and § 50.46a of this part for facilities for which construction permits may be issued after December 28, 1974.*

and from the last sentence in 10 CFR 50.34(b)(4) which states:

*Analysis and evaluation of ECCS cooling performance following postulated loss-of-coolant accidents shall be performed in accordance with the requirements of § 50.46 for facilities for which a license to operate may be issued after December 28, 1974.*

#### Effect on Regulatory Conformance

As a result of this exemption, neither the Preliminary Safety Analysis Report required by 10 CFR 50.34(a), nor the Final Safety Analysis Report required by 10 CFR 50.34(b), will include an evaluation of ECCS performance and high point venting following postulated loss of coolant accidents.

#### Justification for Exemption

The underlying purpose of these requirements is to demonstrate, by analysis, the capability of the emergency core cooling system to remove decay heat from the reactor core by the injection of makeup cooling fluid to replace fluids lost as a result of coolant piping breaks. The KP-FHR design supports passive decay heat removal directly from the reactor vessel and reactor core without reliance on makeup fluid injection from an emergency core cooling system. Additionally, the loss of coolant fluids in connected piping (pipe breaks) are not considered “accidents” and are postulated to occur during plant operations. Therefore, the requirements in the last sentence of both 10 CFR 50.34(a)(4) and 10 CFR 50.34(b)(4) are not technically relevant to the KP-FHR design.

#### Technical Basis

The KP-FHR design utilizes a passive decay heat removal system that relies on direct heat rejection to an external set of thimbles to absorb heat as described in Section 6.3 of the safety analysis report. Natural circulation of fluid in the reactor core to support the heat removal occurs entirely within the reactor vessel and does not rely on externally connected coolant system piping. The design of the reactor vessel and connected piping includes siphon breaks which preclude a loss of vessel inventory should there be a break in connected coolant piping as described in Section 4.3 of the safety analysis report. A loss of the vessel integrity to maintain fluid over the active core is not a credible event by design. As a result, the safety strategy for the KP-FHR design does not rely on the injection of make up coolant nor does it need a high point that could be opened in an emergency to remove gases. Postulated events analyzed in

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Chapter 13 of the safety analysis report do not result in the accumulation of noncondensable gases in the reactor vessel and coolant lines. Noncondensable gases are minimized during normal operation via the inert gas system described in Section 9.1 of the safety analysis report.

Therefore, the requirements in these portions of the rules for which exemption is requested is not technically relevant to the KP-FHR design.

#### **Regulatory Basis**

The exemption requirements for license applications under 10 CFR 50 regulations are specified in 10 CFR 50.12. These requirements are addressed below:

With respect to 10 CFR 50.12(a)(1), the requested exemption is authorized by law. This exemption is not inconsistent with the Atomic Energy Act of 1954, as amended. The NRC has authority under 10 CFR 50.12 to grant exemptions from the requirements of this regulation. Therefore, the proposed exemption is authorized by law. Additionally, the requested exemption will not present an undue risk to the public health and safety. This exemption will not impact the consequences of any design basis event and will not create new accident precursors. The design does not rely the addition of replacement coolant inventory from emergency core cooling systems nor does it rely on high point vents to accomplish core decay heat removal safety functions for postulated events. Therefore, the exemption will not present an undue risk to the public health and safety. Similarly, the requested exemption is consistent with the common defense and security. Exemption from this rule does not affect the design, function, or operation of structures, systems, or components that are necessary to maintain the security of the plant or on safeguards procedures. Therefore, the requested exemption is consistent with the common defense and security.

Special circumstances exist which support NRC approval of this exemption, consistent with 10 CFR 50.12(a)(2)(ii)). The specific requirements of these regulations are not technically relevant to the KP-FHR design nor are they necessary to achieve the underlying purpose of the rule. The KP-FHR design does not rely on the addition of makeup fluid from an emergency core cooling system to maintain adequate core cooling nor does it rely on a venting system to precludes the accumulation of noncondensable gases that may inhibit the core cooling during natural circulation. The requested exemption removes language specific to light water reactor technologies, but does not alter the remaining language of these regulations which requires an analysis of the design and performance of structures, systems, and components of the facility with the objective of assessing the risk to public health and safety. As such, the underlying purpose of the rule remains.

#### **Conclusion**

On the basis of the information presented, Kairos Power requests that the NRC grant an exemption from the last sentence of the requirements in both 10 CFR 50.34(a)(4) and 10 CFR 50.34(b)(4).