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

July 16, 2020

Mr. Peter Hastings
Vice President, Regulatory Affairs
and Quality
Kairos Power LLC
707 W Tower Ave
Alameda, CA 94501

SUBJECT: SAFETY EVALUATION FOR KAIROS POWER LLC TOPICAL REPORT "REACTOR COOLANT FOR THE KAIROS POWER FLUORIDE SALT COOLED HIGH TEMPERATURE REACTOR" (REVISION 1) (EPID NO. L-2019-TOP-0010/CAC NO. 000431)

Dear Mr. Hastings:

By letter dated March 8, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19079A325), Kairos Power LLC (Kairos Power, the applicant) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review, "Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor," (reactor coolant report). The NRC staff provided initial feedback and questions to Kairos Power on January 10, 2020 (ADAMS Accession No. ML20013G733). In response to these questions and following a teleconference between the NRC staff and Kairos Power, the applicant submitted an updated topical report (Revision 1) by letter dated January 16, 2020 (ADAMS Accession No. ML20016A486), on which this safety evaluation (SE) is based.

The NRC staff documented its review in the enclosed SE which was previously provided to you for comments only related to the identification of proprietary information and factual errors on February 7, 2020 (ADAMS Accession No. ML20035E009, non-public). You provided comments to the NRC staff on February 13, 2020 and confirmed the proprietary information in the SE on February 25, 2020 (ADAMS Accession No. ML20134J000). The NRC staff has incorporated your comments, as appropriate, in the enclosed SE. In addition, the Advisory Committee for Reactor Safeguards (ACRS) was briefed on this topical report on February 21, 2020, and April 9, 2020. The ACRS endorsed the publication of this SE in a letter dated June 1, 2020 (ADAMS Accession No. ML20148M230).

The enclosed SE is final, and a redacted version will be made publicly available as specified in your comments.

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|---|
| The Enclosure to this letter contains Proprietary information. When separated from the Enclosure, this document is DECONTROLLED. |

In accordance with the guidance provided on the NRC website, we request that Kairos publish accepted proprietary and non-proprietary versions of this TR within three months of receipt of this letter. The accepted versions shall incorporate this letter and the enclosed final SE after the title page. The accepted versions shall include an "-A" (designating accepted) following the TR identification symbol.

If you have any questions, please contact Stewart Magruder at 301-348-5766 or by e-mail at Stewart.Magruder@nrc.gov.

Sincerely,

Benjamin Beasley, Chief
Advanced Reactor Licensing Branch
Division of Advanced Reactors and Non-Power Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Project No. 99902069

Enclosure:
Final SE

SUBJECT: SAFETY EVALUATION FOR KAIROS POWER LLC TOPICAL REPORT "REACTOR COOLANT FOR THE KAIROS POWER FLUORIDE SALT COOLED HIGH TEMPERATURE REACTOR" (REVISION 1) (EPID NO. L-2019-TOP-0010/CAC NO. 000431) DATED JULY16, 2020

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO "REACTOR COOLANT FOR THE KAIROS POWER FLUORIDE SALT

COOLED HIGH TEMPERATURE REACTOR"

KAIROS POWER, LLC

PROJECT NO. 99902069

## 1.0 INTRODUCTION

By letter dated March 8, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19079A325), Kairos Power LLC (Kairos Power, the applicant) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review, "Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor," (reactor coolant report). On August 9, 2019 (ADAMS Accession No. ML19221B585), the NRC staff found that the material presented in the Topical Report (TR) provides the technical information in sufficient detail to enable the staff to conduct a detailed technical review.

Kairos Power requested NRC staff review and approval of the reactor design characteristics represented by the thermophysical properties provided in Table 1, "Thermophysical Properties of the KP-FHR Primary Coolant," and the reactor coolant specification provided in Table 4, "Design Specification for the KP-FHR Reactor Coolant," of the reactor coolant report. This is to be used by applicants of the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor (KP-FHR) design for future licensing submittals under Title 10 of *Code of Federal Regulations* (10 CFR) Parts 50 or 52. As part of the review, the NRC staff provided initial feedback and questions to the applicant on January 10, 2020 (ADAMS Accession No. ML20013G733). In response to these questions and following a teleconference between the NRC staff and Kairos Power, the applicant submitted an updated TR (Revision 1) via letter (ADAMS Accession No. ML20016A486), on which this safety evaluation (SE) is based.

## 2.0 REGULATORY EVALUATION

Section 50.34(a) of 10 CFR, "Preliminary safety analysis report," requires applicants for construction permits under 10 CFR Part 50 to provide a preliminary safety analysis report (PSAR) which describes reactor design characteristics. Additionally, applicants for a limited work authorization (LWA) are required to submit a safety analysis meeting 10 CFR 50.34 for the scope of the LWA in accordance with 10 CFR 50.10(d)(3)(i), "Request for limited work authorization."

Enclosure

Specifically, the following regulations apply to the Reactor Coolant TR:

- 10 CFR 50.34(a)(1)(ii)(C), which states that reactor design characteristics and proposed operation including "[t]he extent to which the reactor incorporates unique, unusual or enhanced safety features having a significant bearing on the probability or consequences of accidental release of radioactive materials," will be considered by the Commission.

- 10 CFR 50.34(a)(1)(ii)(D), which states that reactor design characteristics and proposed operation that will be considered by the Commission includes safety features and barriers that must be breached before a radiological release can occur. This includes a requirement for an applicant to perform an evaluation and analysis of postulated fission product release along with systems intended to mitigate the consequences of accidents.

- 10 CFR 50.34(a)(2), which requires an applicant to provide "[a] summary description and discussion of the facility, with special attention to design and operating characteristics, unusual or novel design features, and principal safety considerations."

- 10 CFR 50.34(a)(3)(i), which requires a facility licensed under 10 CFR 50 to describe principal design criteria (PDC) in its PSAR. The PDC applicable to the Kairos Power KP-FHR design are described later in this section.

Note that the design characteristics descriptions related to these regulations are required to be updated as part of application for an operating license per 10 CFR 50.34(b)(4).

Additionally, applicants for combined licenses under 10 CFR Part 52 are required to provide a final safety analysis report that provides a safety assessment of the facility as well as a description of reactor design characteristics.

Specifically, the following regulations pertain to the Reactor Coolant TR:

- 10 CFR 52.79(a)(2), which requires a description and analysis of certain structures, systems, and components sufficient to allow understanding of system designs and the relationship to SSCs.

- 10 CFR 52.79(a)(2)(iii), which states unique, unusual or enhanced safety features with a significant bearing on the probability or consequences of an accidental release of radioactive materials will be considered by the Commission.

- 10 CFR 52.79(a)(2)(iv), which states safety features and barriers to a radioactive release during an accident will be considered by the Commission.

As described in the Kairos Power topical report KP-TR-003, "Principal Design Criteria for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor," Revision 1 (ADAMS Accession No. ML19212A756), and the NRC staff SE documenting approval of Revision 1 of this TR (ADAMS Accession No. ML20015A424), Kairos has developed PDC for its KP-FHR design. The specific PDC that pertain to the Reactor Coolant TR are described below:

- PDC 11, "Reactor inherent protection," which requires the KP-FHR reactor core and associated systems contributing to reactivity feedback be designed so that, while in power operating range, the net effect of prompt inherent nuclear feedback characteristics compensate for a rapid increase in reactivity. The properties of the reactor coolant, in part, relate to this PDC as the neutronic characteristics of the reactor coolant allow the KP-FHR reactor core to be designed with a negative coolant temperature coefficient of reactivity.

- PDC 14, "Reactor coolant boundary," which requires safety significant elements of the reactor coolant boundary to have an extremely low probability of abnormal leakage, rapidly propagating failure, or gross rupture. Control of reactor coolant chemistry and the associated corrosion controls relate to PDC 14.

- PDC 16, "Containment design," which requires a reactor functional containment to control the release of radioactivity to the environment to ensure safety significant functional containment design conditions are not exceeded for as long as postulated accident conditions require. The ability of the reactor coolant to retain fission products is related to PDC 16.

- PDC 26 "Reactivity control systems," which requires, in part, a reactivity control system or means to insert negative reactivity at a sufficient rate and amount to assure, with appropriate margin for malfunctions, that the design limits for fission product barriers are not exceeded and safe shutdown is achieved and maintained during normal operation, including anticipated operational occurrences.

- PDC 31 "Fracture prevention of reactor coolant boundary," which requires, in part, the reactor coolant boundary to behave in a nonbrittle manner and to minimize the probability of rapidly propagating failure of the reactor coolant boundary, accounting for effects of coolant composition (including contaminants and reaction products) on material properties.

- PDC 60, "Control of releases of radioactive materials to the environment," which requires a means to control the release of radioactive materials. The ability of the reactor coolant to retain fission products is related to PDC 60.

- PDC 70 "Reactor coolant purity control," which requires that systems are provided to maintain the purity of the reactor coolant within design limits based on chemical attack, fouling or plugging of passages, radionuclide concentrations, and air or moisture ingress. The initial reactor coolant purity limits for the KP-FHR described in Table 4, as well as chemistry control provisions to maintain the required purity are related to PDC 70.

- PDC 73, "Reactor coolant system interfaces," which describes requirements for separation of chemically compatible and incompatible primary and secondary coolants. The compatibility of the reactor coolant to the nitrate salt (secondary coolant) is related to PDC 73.

## 3.0 TECHNICAL EVALUATION

### 3.1 Introduction

To support future licensing action regarding the KP-FHR under 10 CFR Parts 50 or 52, Kairos Power submitted this TR to engage with the NRC regarding the development of its reactor coolant.

As requested by Kairos Power in Section 1, “Introduction,” of the Reactor Coolant TR, the NRC staff has reviewed the thermophysical properties provided in Table 1, and reactor coolant specification provided in Table 4, of the Reactor Coolant TR. The applicant stated that these properties and specifications will be used in potential future licensing actions as well as safety analyses required for the KP-FHR reactor. The remainder of the Reactor Coolant TR was not evaluated by the staff. It was only reviewed as technical background and to identify any potential impacts on the portions of the Reactor Coolant TR for which Kairos Power requested staff review.

Because the TR is requesting approval of certain characteristics of the reactor coolant without the full scope of knowledge of detailed system specifications, there may be instances where the design features as outlined in the TR change between submittal of this TR and a future licensing submittal. Accordingly, the staff added conditions and limitations to the TR contingent on the design features provided for in Section 1.1.2 of the TR. This is discussed in the Limitations and Conditions section of this SE (Section 4.0).

#### 3.1.1 Design Features

Section 1.1 of the TR provides an overview of the key design features of the KP-FHR. The applicant stated that these features are not expected to change during the design and development of the KP-FHR. The applicant also stated that these features provide the basis for the safety review of the Reactor Coolant TR and that if fundamental changes occur to the key design features, or new or revised regulations are issued, these changes would be reconciled and addressed in future submittals (see Limitation and Conditions 2 and 3).

The KP-FHR is a molten fluoride salt cooled high temperature reactor that operates at “near-atmospheric pressure.” The fuel proposed for this reactor is based on the tri-structural isotropic (TRISO) pebble fuel element. The applicant has stated that the coatings on the particle fuel will provide retention of fission products, as will the molten fluoride salt mixture $2LiF:BeF_2$ (Flibe) for any fission products that escape via fuel defects. The KP-FHR design includes a primary coolant loop that transfers heat to an intermediate coolant loop which utilizes a nitrate salt, that is “compatible with the reactor coolant,” to transfer heat to a steam generator. Additionally, the KP-FHR includes a normal decay heat removal system, as well as a passive decay heat removal system.

Rather than a traditional containment building, the KP-FHR utilizes a functional containment approach, consistent with that discussed in SECY-18-0096, “Functional Containment Performance Criteria for Non-Light-Water-Reactors,” (Reference 6) which has been approved by the Commission in its Staff Requirements Memorandum to the SECY (Reference 7). The applicant states the ultimate design objective of the functional containment is to meet offsite dose requirements at the plant's exclusion area boundary with margin.

The TRISO fuel particles are the first and primary barrier to ensure that radionuclides are not released beyond limits, and the coolant is also capable of retaining fission products. Additionally, the applicant has stated that the additional retention provided by the reactor coolant "…is a key feature of the enhanced safety and reduced source term in the KP-FHR."

3.2 Heat Transport System Fluids

Section 2 of the TR describes the fluids used in the KP-FHR primary heat transport system (PHTS) and the intermediate heat transport system (IHTS). The PHTS uses Flibe as noted earlier in this SE, and the IHTS uses a nitrate salt that is a blend of sodium nitrate and potassium nitrate. Potential interactions between these salts are not evaluated as part of this SE. Kairos noted that this TR doesn't explicitly consider the fission product retention properties of the Flibe and states that these properties, as well as methods to predict retention, will be addressed in a separate source term TR (see Limitation and Condition 10).

3.2.1 Flibe Specification

Flibe was chosen as the reactor coolant for the KP-FHR. Table 1 of the Reactor Coolant TR contains a summary of the nominal thermophysical properties of the reactor coolant as well as associated uncertainties. Table 4 of the Reactor Coolant TR contains the design specification for the reactor coolant. **[[**

**]]**

3.2.2 TABLE 1, "THERMOPHYSICAL PROPERTIES OF THE KP-FHR PRIMARY COOLANT"

Table 1 of the Reactor Coolant TR, "Thermophysical Properties of the KP-FHR Primary Coolant," provides **[**

**]]**

**[[**

**]]**

As stated in Section 2.2.1, "Thermophysical Properties," and Section 3.2, "Limitations," Kairos Power will perform data corroboration of the thermophysical properties found in Table 1 of the TR in order to bring this data under the Kairos Power Quality Assurance (QA) program.

Additionally, Kairos Power stated that **[**

**]]**
Kairos Power stated that the measurements would be done under the Kairos QA program. **[[**

**]**

NRC Staff Evaluation

For the Flibe to be suitable as a reactor coolant it must have certain thermophysical properties that support operation of the reaction and certain safety analyses. As described below, the NRC staff reviewed the **[[** **]]** of the reactor coolant as described in Table 1 of the Reactor Coolant TR. The NRC staff has also compared values given for the thermophysical properties in Table 1 to other literature sources to determine whether the proposed values represent reasonable nominal values for these parameters.

The NRC staff determined that the **[**

**]]** Therefore, the staff concludes that the correlations and parameters provided in Table 1 of the Reactor Coolant TR **[[** **]]** to start Kairos Power safety analyses are, in part, consistent with the relevant PDCs as described in Section 3.2.4 of this SE.

As noted in Section 2.2.1, "Thermophysical Properties," and Section 3.2, "Limitations," Kairos Power will perform data corroboration of the thermophysical properties found in Table 1 of the TR in order to bring this data under the Kairos Power QA program. **[**

**]]**

**[[**

**]]**

Based on the discussion above, the staff approves the parameters found in Table 1 of the Reactor Coolant TR for use in safety analyses for the KP-FHR. The staff's approval of Table 1 of the Reactor Coolant TR is contingent upon the Limitations and Conditions that are described in Section 4.0 of this SE. Although the entirety of the KP-FHR design has not been submitted to the NRC, based on the discussion above, these values are reasonable to use in safety analyses because **[[** **]]** and because the Kairos Power safety analyses and system design must be able to bound these parameters and associated uncertainties and still maintain appropriate safety margins per Limitation and Condition 5.

### 3.2.3 TABLE 4, "DESIGN SPECIFICATION FOR KP-FHR REACTOR COOLANT"

Table 4 of the Reactor Coolant TR, "Design Specification for KP-FHR Reactor Coolant," provides: **[[**

**]]**

The composition of the reactor coolant is described in Table 4 of the Reactor Coolant TR as **[[**

**]]**

**[[**

**]]**

In Section 2.2 of the Reactor Coolant TR, Kairos states that a **[[**

**]]**

The TR states that Flibe purity and chemistry will have an impact on material compatibility of the reactor coolant with the structural materials, moderator, and fuel pebbles. It also states that because the MSRE found no attack of the graphite moderator, the structural materials are the basis for setting the KP-FHR corrosion requirements. However, the proposed high temperature materials program still includes carbon-based materials (moderator and fuel pebbles), as well as the proposed structural materials.

Section 2.2.2 of the Reactor Coolant TR, "Corrosion Requirements," states that oxidation of Chromium (Cr) is the primary corrosion mechanism of 316H stainless steel (SS) which contains 16-18 weight percent Cr. The KP-FHR design proposes to use 316 H SS as its structural material. **[**

**]]**

**[[**

**]]** Additionally, Kairos Power stated that the neutronics of the KP-FHR require an enrichment of $^{7}Li$ in the reactor coolant**. [[**

**]]**

NRC Staff Evaluation

The NRC staff evaluated the design specification for the KP-FHR reactor coolant as detailed in Table 4, "Design Specification for KP-FHR Reactor Coolant," of the Reactor Coolant TR. The staff evaluated **[**

**]**

The NRC staff evaluated the **[[**

**]]**

**[[**

**]]**

The NRC staff also evaluated **[[**

the

**]].**

When considered together, these factors allow the staff to conclude that the approach provided by Kairos in this TR is consistent with the appropriate PDCs as described in Section 3.2.4, "Technical Evaluation Conclusions," of this SE.

Table 4 of the Reactor Coolant TR provides a **[[**

**]]**

As noted in the TR, **[[**

**]]**

Kairos Power has stated that **[[**

**]]**

Kairos Power has recognized that the presence of parasitic neutron absorbers in the Flibe will reduce the magnitude of the negative coolant temperature reactivity feedback, if not make it positive, and decrease fuel utilization. Kairos Power stated that **[[**

**]]** The TR did not provide any analyses to support this statement but stated that **[[**

**]]**.

Accordingly, based on the information provided in the TR, NRC staff cannot make any findings associated with the neutronic behavior of the Flibe coolant.

3.2.4 Technical Evaluation Conclusions

Kairos Power stated that the properties and characteristics of the reactor coolant satisfy, in part, requirements of PDCs 11, 14, 26, 31, 70, and 73, as established in the Kairos Power PDC TR (Reference 5). Additionally, Kairos requested NRC review and approval of the reactor coolant specification in Table 4 and the thermophysical properties in Table 1 of the Reactor Coolant TR for use in performance of safety analyses by licensing applicants referencing the KP-FHR design. These safety analyses will be provided within separate specific licensing application documents as required by regulation.

NRC Staff Evaluation

The NRC staff finds that the reactor coolant specification in Table 4 and the thermophysical properties in Table 1 of the Reactor Coolant TR are acceptable, subject to the Limitations and Conditions found in Section 4.0 of the staff's SE below. Additionally, the design parameters provided in these tables are consistent with the PDCs for the KP-FHR as follows:

- PDC 11, The staff makes no conclusions regarding the PDC 11. **[**

  **]**
- PDCs 14 and 31 **[[**

  **]]**
- PDC 26, The staff makes no conclusions regarding the PDC 26. **[**

  **]**
- PDC 70, **[[**

]]

Although Kairos Power also cited this report to partially satisfy PDCs 16 and 60, Kairos Power noted that the properties of the Flibe which demonstrate its ability to retain radionuclides will be described in a future TR. Therefore, the staff will assess the properties of the Flibe which retain radionuclides in the TR in which these properties are discussed, subject to Limitation and Condition 10. The PDC 73 was also cited by Kairos Power as being partially addressed by this TR. However, because the staff was requested to review only Tables 1 and 4 of this TR, the staff did not review the compatibility of the primary and secondary salts. As noted by Kairos Power in Section 3.2 of the TR, the interaction between the reactor coolant and the nitrate salt will be evaluated in a separate TR. Therefore, the staff will evaluate this in a separate TR or license application in which these properties are discussed, subject to Limitation and Condition 11.

## 4.0 LIMITATIONS AND CONDITIONS

The staff imposes the following limitations and conditions with regard to the TR:

1. (**Section 1.0**) As stated by Kairos Power in the TR, NRC review and approval of Tables 1 and 4 was requested. Therefore, a KP-FHR design referencing this TR may only use this TR for purposes related to the information found in these tables subject to the specific Limitations and Conditions found in the NRC staff SE below. All other information related to the reactor coolant will be evaluated in separate documents and licensing actions.

2. (**Section 1.1.1**) Because there is information that has not yet been developed and/or reviewed as part of this TR, a KP-FHR design referencing this TR must provide information that completely and accurately describes the design of the reactor coolant (and associated systems) and any associated functions it is credited to perform for NRC review and approval. As stated in the TR, if key design features of the KP-FHR change, or if new or revised regulations are issued that impact descriptions and conclusions in this TR, these changes would be reconciled and addressed in future license application submittals. Due to the potential for design changes and new or revised regulations, a KP-FHR applicant referencing this TR must demonstrate that all regulatory and safety requirements related to the characteristics of the reactor coolant are met when considering the final design of the KP-FHR.

3. (**Section 1.1.2**) As presented in the TR, there are key design features without which the proposed reactor coolant design and associated properties may not be supported. Therefore, a KP-FHR design referencing this TR must have the following:

    - A "chemically stable molten fluoride salt mixture" coolant with enrichment of the $^{7}$Li isotope

    - TRISO fuel particles and fuel pebbles that, combined with other design features as applicable, including the ability of the reactor coolant to retain fission products, demonstrate functional containment performance criteria consistent with SECY-18-0096 and applicable regulatory dose requirements

- An intermediate coolant loop using a coolant that is compatible with reactor coolant

- “Near-atmospheric” primary coolant pressures

These key design features of the KP-FHR, if added to or changed, could necessitate changes to the parameters discussed in the Reactor Coolant TR and would be subject to NRC staff review.

4. (**Section 2.2.1**) A KP-FHR design referencing this TR shall submit to the NRC, for review and approval, results from confirmatory testing to measure the thermophysical properties in Table 1 of the TR, in order to confirm the data under the Kairos QA program. A KP-FHR design that does not perform such testing shall provide the justification for not conducting confirmatory testing or provide a combination of test results and the justification for only testing certain parameters, to the NRC for review and approval. If testing of parameters outside previously reported ranges of conditions is necessary to support KP-FHR design, the results of this testing shall be submitted to the NRC for review and approval. A KP-FHR design referencing this TR must provide, subject to NRC review and approval, the **[[**

   **]]** As per the discussion in Sections 2.2.1, “Thermophysical Properties,” and 3.2, “Limitations,” and Appendix C, “Thermophysical Property Confirmation,” of the TR, confirmatory measurements will be done under the applicable quality assurance provisions in 10 CFR Appendix B. Results of this testing shall be submitted to the NRC for review and approval.

5. (**Section 2.2.1**) A KP-FHR design referencing this TR must demonstrate, subject to NRC review and approval, that the thermophysical properties of the reactor coolant described in Table 1 of the TR and any associated uncertainties over the range of KP-FHR operating conditions are considered in its safety analyses. Additionally, the effect of the reactor coolant specification in Table 4 of the TR **[[**

   **]]** on thermophysical properties of the reactor coolant, shall be considered in safety analyses.

6. (**Sections 2.2.2 and 3.2**) The Reactor Coolant TR states that high temperature materials qualification activities will be used to confirm corrosion performance of 316H stainless steel in Flibe and corrosion allowances used in engineering and design considerations consistent with the impurity limits specified in Table 4 of the Reactor Coolant TR. A KP-FHR design referencing this TR must demonstrate in its submittal, subject to NRC review and approval, that any materials (including 316H stainless steel) in contact with the reactor coolant that are relied upon to meet a safety or regulatory requirement can do so when exposed to the impurity limits in Table 4 of the TR. The design must demonstrate that material corrosion performance in Flibe is acceptable, subject to NRC review and approval. Additionally, as noted in Section 2.2.2 of the TR, **[**

**]]** will be determined as part of the high temperature materials TR.

7. (**Section 2.5**) The Reactor Coolant TR states that **[[** **]]** Therefore, a KP-FHR design referencing this TR must be able to measure, subject to NRC review and approval, **[[** **]]**

8. (**Section 2.2.2**) A KP-FHR design referencing this TR must demonstrate, subject to NRC review and approval, that **[[** **]]** These control methods are subject to NRC review and approval.

9. (**Section 2.2**) A KP-FHR design referencing this TR must demonstrate in its submittal, subject to NRC review and approval, that the **[[** **]]** if different from what is described in Revision 1 of the Reactor Coolant TR.

10. (**Section 2.1**) A KP-FHR design referencing this TR will demonstrate, subject to NRC review and approval, the ability of the reactor coolant to retain fission products and methods for predicting retention in a separate TR.

11. (**Section 3.2**) A KP-FHR design referencing this TR will characterize, subject to NRC review and approval, reactor coolant and intermediate coolant mixing in license application documents, and through testing, modeling, and validation as stated in Section 2.6 of the TR.

12. (**Section 2.4**) A KP-FHR design refencing this TR will provide a description of the KP-FHR reactor coolant purification system as part of future license application documents for NRC review and approval.

## 5.0 CONCLUSION

Based on the evaluation above, the staff concludes that Kairos Power has provided sufficient information in Tables 1 and 4 of the Reactor Coolant TR to demonstrate that KP-FHR PDCs 14, 16, 31, 60, 70, and 73 as described above, would be satisfied, in part, subject to the Limitations and Conditions in Section 4.0 of this SE. Additionally, the staff concludes the thermophysical properties found in Table 1 and the reactor coolant specification in Table 4 of the TR can be used in safety analyses, subject to the Limitations and Conditions in Section 4.0 of this SE. The information provided in Tables 1 and 4 of the TR establishes certain characteristics of the reactor coolant that will support unique design and safety features of the KP-FHR.

## 6.0 REFERENCES

1. Kairos Power LLC, letter KP-NRC-1903-002, P. Hastings, Vice President, Regulatory Affairs and Quality, to USNRC document control desk, re: "Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor," March 8, 2019 (ADAMS Accession No. ML19079A325)

2. NRC, letter from S. Lynch, Acting Chief Advanced Reactor Licensing Branch, to Mr. P. Hastings, Vice President, Regulatory Affairs and Quality, Kairos Power LLC, re: 'Kairos Power LLC – Acceptance of "Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor Topical Report" (CAC No. 000431),' dated August 9, 2019 (ADAMS Accession No. ML19221B585)

3. NRC, "Preliminary Comments on Kairos Power LLC Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor Topical Report," dated January 10, 2020 (ADAMS Accession No. ML20013G733)

4. Kairos Power LLC, letter KP-NRC-2001-001, P. Hastings, Vice President, Regulatory Affairs and Quality, to USNRC document control desk, re: "Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor, Revision 1," January 16, 2020 (ADAMS Accession No. ML20016A486)

5. Kairos Power LLC, letter KP-NRC-1907-006, P. Hastings, Vice President, Regulatory Affairs and Quality, to USNRC document control desk, re: "Principal Design Criteria for the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor (Revision 1)," July 31, 2019 (ADAMS Accession No. ML19212A756)

6. NRC, SECY-18-0096, from M. M. Doane, to The Commissioners, USNRC, re: "Functional Containment Performance Criteria for Non-Light-Water-Reactors," dated September 28, 2018 (ADAMS Accession No. ML18115A157)

7. NRC, Staff Requirements – SECY-18-0096, "Functional Containment Performance Criteria for Non-Light-Water-Reactors," dated December 4, 2018 (ADAMS Accession No. ML18338A502)

8. M.W. Rosenthal, et. al., Oak Ridge National Laboratory, ORNL-4728, "Molten-Salt Reactor Program Semiannual Progress Report," February 1972.

9. M.S. Sohal, et. al., Idaho National Laboratory, INL/EXT-10-18297, "Engineering Database of Liquid Salt Thermophysical and Thermochemical Properties," March 2010

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