



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

May 26, 2022

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

SUBJECT: KAIROS POWER, LLC - SAFETY EVALUATION FOR, "REGULATORY ANALYSIS FOR THE KAIROS POWER FLUORIDE SALT-COOLED HIGH TEMPERATURE REACTOR," REVISION 4 (EPID NO: L-2021-TOP-0007/CAC NO. 000431)

Dear Mr. Hastings:

This letter provides the final safety evaluation for the Kairos Power LLC (Kairos) topical report KP-TR-004, "Regulatory Analysis for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor," Revision 4. By letter dated January 24, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19024A483), as supplemented by letters dated October 31, 2019, November 23, 2020, August 19, 2021, and January 18, 2022, (ADAMS Accession Nos. ML19304C666, ML20328A234, ML21231A296, and ML22018A161, respectively), Kairos submitted the topical report Revisions 0 through 4 for the U.S. Nuclear Regulatory Commission (NRC) staff review.

The NRC staff's final safety evaluation for topical report, "Regulatory Analysis for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor," Revision 4, is enclosed.

The NRC staff provided Kairos a draft of the safety evaluation for the purpose of identifying proprietary information on April 4, 2022 (ML22094A106). On April 15, 2022 (ML22133A093), Kairos confirmed that the SE does not include proprietary information.

The NRC staff requests that Kairos publish an accepted version of this topical report within 3 months of receipt of this letter. The accepted version shall incorporate this letter and the enclosed safety evaluation after the title page. The accepted version shall include an "-A" (designating accepted) following the topical report identification symbol.

If you have any questions, please contact Samuel Cuadrado at 301-415-2946 or via e mail at Samuel.CuadradoJesus@nrc.gov.

Sincerely,



Signed by Kennedy, William
on 06/02/22

William B. Kennedy, Acting Chief
Advanced Reactor Licensing Branch 1
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Project No.: 99902069
Enclosure:
As stated

SUBJECT: KAIROS POWER, LLC - SAFETY EVALUATION FOR, "REGULATORY ANALYSIS FOR THE KAIROS POWER FLUORIDE SALT-COOLED HIGH TEMPERATURE REACTOR," REVISION 4(EPID NO: L-2021-TOP-0007/CAC NO. 000431) DATE: MAY 26, 2022

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NRR-043

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

June 2, 2022

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO TOPICAL REPORT KP-TR-004, REVISION 4, "REGULATORY ANALYSIS
FOR THE KAIROS POWER FLUORIDE SALT-COOLED HIGH TEMPERATURE REACTOR,"

(EPID NO. L-2021-TOP-0007)

PROJECT NO.: 99902069

1.0 INTRODUCTION

By letter dated January 24, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19024A483), Kairos Power LLC (Kairos, the applicant) submitted Revision 0 of Topical Report (TR), "Regulatory Analysis for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor," for the U.S. Nuclear Regulatory Commission (NRC) staff's review. By letter dated October 31, 2019 (ML19304C666), Kairos submitted Revision 1 of the TR to address the NRC staff's questions regarding Revision 0. Subsequent to this submission, Kairos decided to pursue licensing a test reactor before licensing a power reactor and, by letter dated November 23, 2020 (ML20328A234), submitted Revision 2 to expand the scope of the TR to cover the planned test reactor. On May 10, 2021 (ML21153A004), the NRC staff held a public meeting with Kairos to discuss the NRC staff's feedback on Revision 2 of the TR. On August 19, 2021 (ML21231A296), Kairos submitted Revision 3 of the TR. Subsequently, Kairos submitted the TR Revision 4, dated January 18, 2022 (ML22018A161), which is the subject of this safety evaluation (SE).

Kairos requested the NRC staff's review and approval of the TR Revision 4, including concurrence with the applicability of design-related and non-design related regulations to the Kairos Power Fluoride Salt-Cooled High Temperature Reactor (KP-FHR) power reactor, as listed in Appendices A and B, respectively. Kairos also requested the NRC staff's review and approval of the applicability of the design-related regulations and non-design-related regulations to the KP-FHR test reactor, as listed in Appendices D and E, respectively. Kairos expects that TR Revision 4, along with a separate TR regarding the KP-FHR principal design criteria (PDC) (ML20167A174) will be used by applicants for licenses, approvals, or certifications of a KP-FHR under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," and NRC staff reviewers. Kairos also performed a review of the NRC staff's regulatory guides and included a list in Appendices C and F of the TR of those it considered to be relevant to the KP-FHR. Kairos did not ask for a formal review of Appendices C and F.

2.0 REGULATORY EVALUATION

As part of broader efforts related to non-light-water reactors (non-LWRs), the NRC staff issued a Draft White Paper that evaluated the applicability of NRC regulations to non-LWRs (which focused on power reactors), dated July 2021 (ML21175A287). The draft white paper provisionally identified the generic applicability of the NRC regulations, noted that it was not final, and noted that circumstances that are applicable to specific non-LWR applicants could result in different applicability determinations for those designs. Kairos is pursuing the design, licensing, and deployment of the KP-FHR. To facilitate future licensing reviews, it is useful to identify the specific regulatory framework used for the KP-FHR during the initial stages of the licensing process. This TR performs that function for both a test reactor and a power reactor.

The TR Revision 4 reflects Kairos' screening of all 10 CFR Chapter I, "Nuclear Regulatory Commission," regulations applicable to a power reactor or a test reactor, including requirements in 10 CFR Part 20, "Standards for Protection Against Radiation"; Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material"; Part 40, "Domestic Licensing of Source Material"; Part 50; Part 52; Part 70, "Domestic Licensing of Special Nuclear Material"; and Part 73, "Physical Protection of Plants and Materials." The NRC staff evaluated the regulatory applicability tables in the TR Revision 4 against the Commission's regulations. The NRC staff considers the lists of regulatory applicability determinations to be references that can inform the content of future licensing applications that will be subject to the NRC staff's reviews.

3.0 TECHNICAL EVALUATION

3.1 INTRODUCTION

Kairos is pursuing the design, licensing, and deployment of a KP-FHR test reactor and a power reactor. To support these objectives, Kairos reviewed the NRC's regulations to identify the requirements that it considers to be applicable and appropriate to establish the regulatory framework for the NRC staff's review and licensing of the KP-FHR design, for both a test reactor and a power reactor. The NRC's regulations in 10 CFR Part 50 and 10 CFR Part 52 provide most of the regulations associated with the design and licensing of nuclear reactors.

Kairos categorized the NRC's regulations as those that apply, those that do not apply, and those from which Kairos believes an applicant will need an exemption for the design and licensing of the KP-FHR. Kairos indicated that its review of the regulations considered the KP-FHR unique design attributes.

3.1.1 Design Features

Section 1.1.1 of the TR provides an overview of the key design features of the KP-FHR. The KP-FHR uses tri-structural isotropic (TRISO) particles in pebble form as fuel, and fluoride salt to cool the reactor. Kairos states that the coolant is maintained at "near-atmospheric pressure" and circulated via pumps. In addition, Kairos indicated that the primary coolant transfers heat to an intermediate heat exchanger loop with nitrate salt that is "compatible with reactor coolant." It also states that the design uses a normal (non-emergency) decay heat removal system and a natural circulation vessel cooling decay heat removal system.-

Kairos indicated that the KP-FHR utilizes a functional containment approach, consistent with SECY-18-0096, "Functional Containment Performance Criteria for Non-Light-Water-Reactors," issued September 28, 2018 (ML18114A546), and the associated SRM-SECY-18-0096, "Staff Requirements - SECY-18-0096 - Functional Containment Performance Criteria for Non-Light Water-Reactors," issued December 4, 2018 (ML18338A502). Kairos stated that the ultimate design objective of the functional containment is to meet offsite dose requirements at the plant's exclusion area boundary with margin. According to Kairos, the TRISO fuel particles are the first and primary barrier against the release of radionuclides. In addition, Kairos stated that the fluoride salt coolant is also capable of retaining fission products, aiding in ensuring radionuclides are not released beyond applicable limits.

3.1.2 Regulatory Review

Section 1.2 of the TR outlines Kairos' discussion of the regulatory background. The regulations in 10 CFR Chapter I contain the requirements that must be met to design, license, and operate a nuclear reactor. The TR notes that not all regulations are required to be addressed by every reactor design type as some are design specific, and some regulations are applicable only to non-reactor facilities or other NRC-licensed activities. Additionally, the TR indicates that the regulations allow for exemptions, if appropriate and properly justified, and identifies those regulatory requirements from which Kairos expects a future applicant will need to request exemptions.

3.1.3 NRC Staff Evaluation

As part of the review and evaluation of the proposed classifications, the NRC staff considered the TR descriptions of aspects of the KP-FHR technology that led Kairos to conclude that some of the NRC's regulations do not apply to certain KP-FHR design characteristics. As part of this review, the NRC staff identified several key design features that influenced the Kairos analysis of the regulatory framework and established the design as being different from a light water reactor (LWR). These features include:

- A chemically stable coolant. Adverse interactions between the coolant/fuel, coolant/coolant boundary, and coolant/atmosphere all represent important considerations that could influence the applicable regulations. While the TR states the coolant is "chemically stable," Kairos has not demonstrated this feature in its TR. Verification of coolant performance will be necessary to ensure that the proposed regulations related to the reactor coolant and reactor coolant systems represent an adequate set of criteria.
- TRISO fuel particles and fuel pebbles. This fuel form represents the foundation of the functional containment approach proposed by Kairos. The NRC staff notes that Kairos will need to establish and document performance criteria consistent with the methodology outlined in SECY-18-0096. This entails identifying both event sequences to ensure the plant-level performance criteria are met and those structures, systems, and components (SSCs) and programmatic controls needed to fulfill important safety functions and controlling parameters for the design and operation of risk-significant SSCs. The TR states that the TRISO fuel particles

and the fluoride salt reactor coolant provide the credited functions during accident conditions and that the integrity of the entire reactor coolant system is not necessary during accident conditions. If additional design features are needed to provide credited design functions, Kairos will need to reevaluate whether these regulations represent the appropriate set of applicable regulations.

- An intermediate coolant loop using a coolant that is chemically compatible with reactor coolant. Verification that secondary coolant is demonstrated not to have a significant impact on the primary system is necessary to ensure the proposed regulations represent an adequate set associated with the primary coolant.
- “Near-atmospheric” pressure for the reactor coolant system. The absence of an energetic release of coolant during a loss-of-coolant type accident results in a fundamentally different risk profile of the KP-FHR compared to the LWR designs. This characteristic is important to ensure the proposed regulations applicable to the reactor coolant pressure boundary are appropriate.

Kairos requested the NRC staff’s approval of the identified list of regulations applicable to the KP-FHR design without the detailed system specifications, drawings, and calculations. The NRC staff acknowledges that continued development of the KP-FHR may result in changes to design features outlined in Section 1 of the TR. In this event, a revision to the identified regulations in the TR may be necessary. These key design features of the KP-FHR, if changed, could necessitate the modification or addition of regulations and, therefore, the use of the TR is restricted as discussed in Section 4.0, “Limitations and Conditions,” of this SE.

The NRC staff finds that, based on the information Kairos has provided on the KP-FHR as of January 18, 2022, when TR Revision 4 was submitted, the regulations identified in Tables A-1, A-2, A-3, A-4, B-1, B-2, D-1, D-2, D-3, E-1, and E-2 of the TR generally encompass the regulations a KP-FHR power or test reactor must address. The NRC staff also recognizes that the spectrum of regulations that apply to a given application, whether a power or test reactor, will differ based on the scope of approval requested and specific applicability to the prospective application types identified in the tables in the TR appendices. Further findings on these tables are listed below in this SE.

3.2 REGULATORY ANALYSIS METHODOLOGY

Section 2 of the TR describes the process used by Kairos to identify a regulatory framework for the KP-FHR. For each regulation, Kairos’ cross-discipline engineering and licensing team screened the content and categorized the regulation based on the type or nature of the regulation. The TR states that screening categories are not defined in the NRC’s regulations or guidance but were defined by the Kairos review team to facilitate and document its review. The TR indicates the initial screening of the regulations was done, in part, to distinguish requirements specifically relevant to the technical design of the facility from requirements considered to be administrative, process, or programmatic in nature, a distinction that Kairos deemed useful to its development of functional design requirements and performance of design reviews. The screening categories that the Kairos’ review team established and defined are stated below:

- **Regulatory Process** – Rules and guidance associated with NRC implemented activities [e.g., the conduct of NRC inspections].
- **Not applicable** – Rules and guidance not applicable to nuclear reactors. [Example: regulations specific to a production or fuel fabrication facility].
- **Administrative** – Rules, guidance, and support information associated with the conduct of an applicant or licensee. Examples: 10 CFR 50.5 [Deliberate misconduct], 50.7 [Employee protection], 50.9 [Completeness and accuracy of information].
- **Process** – Rules and guidance related to regulatory processes required for an applicant or licensee (primarily activities that require procedures). [...]
- **Program** – Rules and guidance related to regulatory or operational programs. Examples: inservice inspection, quality assurance.
- **Design** – Rules and guidance related to plant design, engineering, and analyses. In cases where requirements include administrative, process or program requirements in addition to design, the requirement is conservatively categorized as design. [...]

The TR states that if regulations were not initially screened out as being “not applicable,” Kairos further evaluated them for specific applicability to the KP-FHR technology using the following evaluation categories:

- **Applies** – The regulation applies to the KP-FHR [...] as written.
- **Does Not Apply** – The regulation is not literally applicable to the KP-FHR due to the wording of the rule or [does not have a technically applicable basis or is directly not applicable] to the KP-FHR technology. Examples are requirements that apply to LWRs only, certain reactor developers/vendors, or to existing licensed facilities only. [Also, some of] the regulations apply to a plant licensed in a specific time period [that] is no longer applicable [and some] apply to test reactors [and] do not apply to power reactors.
- **Exemption** – This category is used where the regulation is literally applicable to the design of KP-FHR [...], but it requires a design solution or feature that the KP-FHR technology does not include or [Kairos] intends to provide an acceptable alternative design solution. [...]

The TR further indicates that, in some instances, specific 10 CFR Chapter I requirements may be applicable to the KP-FHR design, but only for a certain licensing pathway or application type. Thus, the TR identifies which NRC requirements are deemed applicable to a specific KP-FHR licensing path or license application type (i.e., Construction Permit, Operating License, Limited Work Authorization, Standard Design Approval, Combined Operating License, Design Certification, Manufacturing License, or Early Site Permit).

3.2.1 NRC Staff Evaluation

The NRC staff reviewed the Kairos categorization scheme against the existing regulatory framework and determined that the proposed scheme allows for classification of regulations to be applied in a future application. The NRC staff considers the evaluation categories (“applies,” “does not apply,” and “exemption”) generally appropriate to identify the regulations listed in Appendices A, B, D, and E; however, the NRC staff does not reach a finding as to the propriety of the screening criteria used to group them because the criteria do not alter regulatory requirements.

In addition, the NRC staff also reviewed the regulations that Kairos designated as “exemption,” which reflect Kairos’ position that certain requirements should not apply to the KP-FHR design or that Kairos plans to seek relief premised on an alternate solution. The NRC staff finds that, with the exception of the conclusions that the 10 CFR 50.2 safety-related SSC definition and that 10 CFR 50.34(a)(4) requires a test reactor applicant to submit analyses related to 10 CFR 50.46 and 10 CFR 50.46a, the regulations designated as “exemption” may apply (in whole or in part) to the licensing of the KP-FHR. The 10 CFR 50.2 safety-related SSC definition and the portion of 10 CFR 50.34(a)(4) related to 10 CFR 50.46 are not required when applied to a testing facility. The NRC staff acknowledges that, under the NRC’s regulations, an interested person may request (and the NRC staff may grant) an exemption from the requirements of a regulation, provided that the NRC staff can make the requisite findings. The NRC staff’s consideration of whether an exemption is appropriate or can be justified will await consideration of detailed information submitted in a license application. Accordingly, this SE does not reach any conclusion as to the acceptability or viability of any exemption request. The evaluation of whether an exemption should be granted would occur after the submittal of a specific exemption request and would be documented in the SE associated with a future licensing submittal.

Although the NRC staff does not reach a conclusion regarding the appropriateness of all screening criteria, the NRC staff generally finds that the methodology described in the TR is a detailed approach and is acceptable to identify the design and licensing requirements applicable to the KP-FHR. The NRC staff’s evaluation of the Kairos team’s assessment of the regulations is provided in the subsequent sections of this SE.

3.3 RESULTS

3.3.1 Summary of Results

Section 3.1 of the TR provides a summary of the results of the regulatory review as it applies to the KP-FHR power reactor. The results were grouped as follows:

- Design regulatory requirements in 10 CFR that apply.
- Design regulatory requirements in 10 CFR that do not apply.
- Regulatory requirements in 10 CFR from which Kairos believes an applicant will require an exemption.
- Non-design regulatory requirements in 10 CFR that apply.
- Non-design regulatory requirements in 10 CFR that do not apply.

Appendix A of the TR provides tables that list the applicability of the design regulatory requirements to the KP-FHR design in accordance with the first three groups listed above. Appendix B of the TR provides tables that list the applicability to the KP-FHR design of the non-design regulatory requirements to the KP-FHR design in accordance with the last two groups listed above.

Section 3.2 of the TR provides a summary of the results of the regulatory review as it applies to the KP-FHR test reactor in a similar form to the power reactor listed above, with Appendix D listing the design regulatory requirements and Appendix E listing the non-design regulatory requirements.

The NRC staff's evaluation of the Kairos determinations regarding the applicability of NRC regulations listed in TR tables to the Kairos power and test reactor is provided below.

3.3.2 NRC Staff Evaluation

The NRC staff determined that Kairos adequately implemented the methodology described in the TR and that the tables in the appendices to the report adequately group the regulatory requirements for the two types of Kairos reactors. The NRC staff's review focused on the minimum required level of detail for a given regulation or approval, but some regulatory licenses and approvals (such as a standard design approval) allow for flexibility in scope and level of detail. Providing additional pre-application information on the scope of the requested approval is an option available to applicants and is encouraged to assist the NRC staff in performing an efficient review of the application.

The TR distinguishes between design and non-design requirements for power and test reactors in Appendices A and B. The TR lists the "Design" requirements that Kairos categorized as being applicable to the KP-FHR technology and included in the list regulatory requirements to be addressed as part of the KP-FHR design requirements identification process. Because the TR does not request that the NRC staff confirm that the design versus non-design distinctions drawn are appropriate, the NRC staff does not reach any conclusions regarding these categorizations.

The NRC staff independently reviewed the regulatory requirements in 10 CFR Chapter I and determined that, in general, Kairos correctly categorized the applicability of the regulations listed in Appendices A, B, D, and E to a KP-FHR power or test reactor. The NRC staff also finds that the use of the regulatory applicability statements can generally inform the contents of a future application, provided the applicant conforms to the limitations and conditions stated in Section 4.0 of this TR and meets the regulations in effect at the time of the submittal of the future application. Further, the NRC staff compared the general design characteristics of the Kairos facility (described in the Kairos design overview documentation submitted by Kairos as part of its pre-application activities (ML20045E423)) to the LWR requirements in the NRC's regulations and determined that the features set forth in Section 3.1.3 and accompanying condition set forth in this SE are sufficient to distinguish the KP-FHR from a LWR design, and therefore the requirements applicable to LWRs only do not apply to the proposed KP-FHR. In order to demonstrate reasonable assurance of adequate protection of public health and safety or no undue risk, an applicant could decide to be informed by or voluntarily address requirements that apply to other facility types. Similarly, the NRC staff's decisions could be informed by content of regulatory provisions that Kairos has deemed inapplicable.

In this regard, the NRC staff observed that, based on preliminary interactions with Kairos, the applicant's determinations of the applicability of regulations to the KP-FHR design largely conforms with expected applicability of regulations for a generic non-LWR design, as described in the NRC staff draft white paper on that topic (ML20241A024). As part of its initial examination of the report conducted to enhance its understanding of Revision 2, the NRC staff provided feedback to Kairos, noting areas in the TR Tables A-1, A-2, A-3, A-4, B-1, B-2, D-1, D-2, D-3, E-1, and E-2 that could benefit from discussions at an upcoming public meeting or correction (ML21104A420). This feedback provides a detailed documentation of the NRC staff's initial review regarding the applicable regulations with respect to the assessment provided in the TR. At a public meeting held on May 10, 2021 (ML21153A004). Kairos and the NRC staff discussed areas where Kairos sought clarification and documented its changes in the TR Revision 4. The NRC staff finds that the tables listed above incorporated the NRC staff's feedback to Kairos and generally can be used to inform a future applicant's determination of regulatory applicability for the KP-FHR design.

However, the NRC staff's approval of the TR Tables A-1, A-2, A-3, A-4, B-1, B-2, D-1, D-2, D-3, E-1, and E-2 is limited to the applicability determination noted for each regulation (e.g., 50.34(b)(1)), and does not include the associated title, bases, or supporting information provided in these tables. Because the NRC staff identified inaccuracies in some of the bases stated for Kairos' determinations, the NRC staff does not approve the stated bases for the applicability determination, even though the inaccuracies did not undermine the ultimate applicability determination. The NRC staff also found that, in some cases the table entries lack a consistent level of detail with respect to applicability determinations of detailed individual regulations. Requirements at lower levels of detail may differ from the assessed applicability (as an example, specific individual regulations within an appendix to a part may be inapplicable even if the entire appendix is specified to be applicable).

Kairos's regulatory applicability determinations regarding 10 CFR 50.2 definitions also contain inaccuracies. Some licensing types specified in the TR are not accurate for all uses of the definition and may be over- or under-specified. The NRC staff's position is that, regardless of the reactor technology, the definition is applicable. Mapping all the regulatory definitions to each of the contextual use cases would present issues related to the specificity of information available at this juncture (compared with having a detailed application ready for submittal with all the associated context), and the licensing cases intended by Kairos for the KP-FHR should not interfere with the stated purpose of this TR. As such, the NRC staff finds the table to be acceptable for the purposes outlined here subject to the restrictions specified in Limitation and Condition 3.

With the exception of the determination that 10 CFR 50.55a(h)(3) applies to a testing facility and 10 CFR 50.46 partially applies to the KP-FHR power reactor (as noted in Table 1), the NRC staff finds that an applicant will need to demonstrate that it meets regulations designated as "apply" (e.g., those in Table A-1) when it submits its application (unless an exemption is requested and justified). At this time, the NRC staff makes no finding as to whether the KP-FHR can satisfy applicable NRC requirements. The NRC staff further finds that regulations that are designated as inapplicable (e.g., those in Table A-2, listed above in this paragraph), need not to be met and no information related to these regulations is required in a future KP-FHR application that references this TR, subject to the limitations and conditions associated with this SE.

The TR also includes Kairos' positions on possible guidance applicability, but these statements do not appear to be comprehensive and are not within the scope of the approval requested in the TR (i.e., the approval of Appendices A and B for the power reactor and Appendices D and E for the test reactor). As such, the NRC staff does not reach any conclusions regarding the content in Appendix C or F.

3.4 Applicant Conclusions

The TR Section 3.4 states that the applicable regulatory requirements in Appendices A, B, D, and E, along with the PDC identified separately in another TR for the power reactor (ML19212A756), provide a comprehensive regulatory framework for the design and licensing of the KP-FHR. Kairos concluded that while some of the existing NRC regulations are not directly applicable to the KP-FHR design and licensing, there are a sufficient set of applicable regulations to support the conduct of a safety review and enable a conclusion of reasonable assurance of adequate protection of public health and safety.

3.4.1 NRC Staff Evaluation

As stated above, the NRC staff concludes that Kairos developed an acceptable methodology for identifying the regulatory framework for licenses, approvals, and certifications of a KP-FHR under 10 CFR 50 and 10 CFR 52, based on the information provided in the TR. The NRC staff will review any license application that uses the KP-FHR design to determine whether the design falls within the parameters of the TR, whether the regulatory framework for the KP-FHR is acceptable, and whether the submitted design complies with all the applicable requirements.

Although Kairos requests the review and approval of the list of regulations deemed applicable to the KP-FHR design in Appendices A, B, D, and E, a final NRC staff determination regarding the applicable regulations will await review at the time of a license application submittal. While the lists provided by Kairos appear to be inclusive, a determination of applicable regulations at the time of the application submittal may be influenced by the application type, ongoing rulemaking efforts at the agency (such as the Part 53 rulemaking, discussed in SECY-200032 (ML19340A056)), and additional design details not yet available. Therefore, the NRC staff's approval of this TR does not presume that Appendices A, B, D, and E contain the comprehensive regulations that will be applicable to any future application, but only that the applicability determinations in those appendices are appropriate based on the design information available to the NRC staff when the TR Revision 4 was submitted.

The NRC staff further recognizes that the TR is based on information known to Kairos as of the TR submission date; further, the NRC staff finds the Appendices A, B, D, and E lists of the KP-FHR-applicable regulations to be acceptable based on the limitations and conditions provided below and the facts available at the time of a license application submittal. If those facts change, applicability may change as well. The applicability determined in this SE is based on the scope of information submitted. Some regulations, for instance, have technology-based entry conditions within the text of the regulation; if it is not established whether that entry condition is satisfied based on the below limitations and conditions associated with the KP-FHR design, the regulation was deemed applicable until additional information is available to satisfy any such entry condition.

4.0 LIMITATIONS AND CONDITIONS

In reviewing the TR, the NRC staff noted that Section 1.1 of the TR identifies certain design criteria, which are inherent in the KP-FHR design. Because these criteria are an important element of the NRC staff's review, the criteria are herein adopted by the NRC staff as technical limitations and conditions regarding its review of Appendices A, B, D, and E in the TR:

1. (Section 3.1.3) As presented in the TR, there are key design features without which the proposed regulatory applicability statements would not be appropriate or encompass the full set of necessary design criteria. Therefore, a KP-FHR design referencing the TR must have the following:
 - A "chemically stable molten fluoride salt mixture" coolant.
 - TRISO fuel particles and fuel pebbles that, combined with other design features as applicable, 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, and that is demonstrated not to have a safety significant impact on the primary system.
 - "Near-atmospheric" primary coolant pressures.
 - The ability to ensure core cooling by maintaining coverage of the reactor fuel with reactor coolant.

These key design features of the KP-FHR, if changed, could necessitate modification of the applicability or inapplicability of regulations described in Appendices A, B, D, and E of the TR. Approval in this TR is therefore limited to the explicit information conveyed in the TR and based on the NRC staff's current understanding of the design.

Further, as stated above, the NRC staff will evaluate an application against the Commission's regulations at the time of a license application submittal. Therefore, the TR is subject to the following regulatory related limitations and conditions:

2. The NRC staff's approval of this TR does not endorse the use of the tables in Appendices A, B, D, and E as a final comprehensive list of applicable regulations for a future KP-FHR application, but only as an assessment of applicable regulations provided at the relevant level of detail within the tables. The NRC staff will determine the full scope of regulations that apply to a future application at the time of a license application submittal based on the regulations that are in effect at that time. For example, regulatory applicability may depend on the scope of the submittal materials requirements that apply to combined licenses and operating licenses licensees but would likely not apply to design certification licensees and may or may not apply to a construction permit applicant. At the time of approval of this evaluation, the applicability statements in the

tables are generally correct for the described KP-FHR based on information considered in this SE.

3. This SE does not override the requirements within the regulations themselves. The information provided in this TR was used to provide an assessment of applicability based on the information available to the NRC staff at the time of the review and represents one potentially adequate method for complying with the regulations. If at the time of the detailed review of an application the applicability determinations noted here conflict with any regulatory requirements or subsequent NRC interpretations of its regulations, those requirements and interpretations would take precedence over the positions in this TR.

5.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that the TR describes an acceptable methodology for determining the applicable regulatory requirements for the KP-FHR power and test reactor, and that its assessment of the regulations will help to identify an appropriate set of regulations applicable for the KP-FHR subject to the limitations and conditions listed in Section 4.0 of this SE. Based on the information considered by the NRC staff as of the date of this SE, with the exception of the items identified in Section 3.2.1 and Section 3.3.2 above, the applicability statements in the tables of Appendices A, B, D, and E correctly identify regulations applicable to the proposed KP-FHR. A more detailed evaluation of applicable regulations and other necessary requirements for licensing the Kairos facility will accompany the NRC staff's SE following the completion of a specific facility's design and submittal of a license application.

6.0 REFERENCES

1. Kairos Power LLC, "Principal Design Criteria for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor," KP-TR-003, Revision 1, July 2019, (ADAMS Accession No. ML19212A756)
2. Kairos Power LLC, "KP-FHR Risk-Informed Performance-Based Licensing Basis Development Methodology Topical Report," KP-TR-009, August 2019, (ADAMS Accession No. ML19217A420)
3. Nuclear Energy Institute, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," NEI 18-04 (Draft).
4. U.S. Nuclear Regulatory Commission, "Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors," DG-1353, April 2019.
5. U.S. Nuclear Regulatory Commission, "Functional Containment Performance Criteria for Non Light-Water-Reactors," SECY-18-0096, October 16, 2018.
6. U.S. Nuclear Regulatory Commission, "Staff Requirements - SECY-18-0096 Functional Containment Performance Criteria for Non-Light-Water-Reactors," December 4, 2018.

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