UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

May 16, 2023

Honorable Christopher T. Hanson
Chair
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: KAIROS NON-POWER REACTOR HERMES CONSTRUCTION PERMIT APPLICATION

Dear Chair Hanson:

During the 705th meeting of the Advisory Committee on Reactor Safeguards, May 3-5, 2023, we completed our review of the Kairos Non-Power Reactor Hermes Construction Permit Application and the associated Safety Evaluation (SE). Dates on which our Kairos Subcommittee reviewed this matter are provided in Appendix I. A list of the topical reports that supported our review of this application is in Appendix II. A listing of the memoranda providing our detailed reviews of the application and associated SE is found in Appendix III. During the meetings, we had the benefit of discussions with NRC staff and representatives from Kairos Power LLC (Kairos). We also had the benefit of the referenced documents. This report fulfills the requirements of Section 182b of the Atomic Energy Act, as amended, and Title 10 of the *Code of Federal Regulations* (10 CFR) 50.58(a).

Conclusions and Recommendations

1. Key attributes of the Hermes design include low thermal power of the reactor, use of TRISO fuel and Flibe coolant as an effective functional containment, and passive heat removal capability. The overall design results in projected dose consequences with large margins to regulatory siting criteria, allowing a unique approach to safety classification.

2. Because of the first-of-a-kind nature of the Fluoride High-Temperature Reactor (FHR) technology, there are performance uncertainties that can most directly be addressed during Hermes operation.

    - A scaled demonstration plant like Hermes will be valuable to test key technical elements, design features, safety functions, and equipment performance for this technology.

    - A key concern is the management of airborne beryllium and tritium in the facility to stay below relevant regulatory limits and protect the safety of workers.

3. As noted by the staff in their SE, there is confidence that the facility can be constructed in accordance with relevant regulations and the design bases outlined in the Preliminary Safety Analysis Report (PSAR). Detailed design, analysis, and technology qualification will be completed prior to the Operating License (OL) review. Combustible gas generation, associated with graphite oxidation, should be included in these evaluations.

4. The construction permit for Hermes should be approved.

Background

The Hermes facility is a 35 MWth test reactor that will be licensed under 10 CFR Part 50.21, "Class 104 licenses; for medical therapy and research and development facilities," paragraph (c). The non-power reactor will serve as a scaled demonstration plant to test and demonstrate key technical elements, design features, safety functions, and equipment performance for the Kairos Power Salt-Cooled, Fluoride High-Temperature Reactor (KP-FHR) technology. As noted in our previous letters, we continue to support a prototype licensing pathway for advanced reactors. This pathway is outlined in the staff's "Regulatory Review Roadmap for Non-Light Water Reactors."

The Hermes test reactor uses TRISO-fueled pebbles in a molten salt, Flibe[1] coolant, resulting in a high-temperature low-pressure system with robust inherent safety characteristics. Key inherent safety features include:

- Functional containment provided by TRISO fuel and Flibe;
- Primary heat transport system that operates near atmospheric pressure;
- Negative reactivity coefficients (fuel, moderator, and coolant temperature); and
- Reactor vessel and other safety-related components located within a seismically isolated structure.

The staff's SE presents a chapter-by-chapter review of the applicant's PSAR in accordance with the guidance provided in NUREG-1537 for non-power reactors. In addition, Appendix A of the staff SE contains a list of additional construction permit conditions and elements of design, analysis, or administration that require additional development. These items must be addressed to support the OL application for Hermes.

This letter discusses the overall safety of the Hermes facility by summarizing (a) novel or unique features in the design; (b) the key safety functions and their implementation in the design; (c) the principal design criteria, safety classification, and defense-in-depth; (d) postulated event selection, analysis results, and safety margin; (e) operational reliability; (f) worker safety; and (g) technology development activities that remain to be completed prior to the OL.

[1] Flibe is a eutectic mixture of LiF and BeF_2.

Novel or Unique Aspects

There are many novel or unique aspects of the Hermes design. These include:

- The first nuclear reactor application with functional containment[2] (as discussed in SRM-SECY-18-0096)
- The first application of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC), Section III, Division 5 for high temperature materials
- Buoyancy of the fueled pebbles and graphite reflector in the Flibe coolant
- A spherical shell of TRISO particles in a pebble that is smaller than those used in German and Chinese high temperature reactors
- Anti-siphon features that limit the loss of coolant in the event of breaks in the primary heat transport system cold leg
- Four fluidic diodes in the upper plenum that enable natural circulation when forced circulation is lost
- The design of the pebble handling system that provides for handling, sorting, and storing fuel and moderator pebbles

Kairos was able to identify operating experience relevant to their design related to the use of TRISO fuel, Flibe coolant, pebble bed reactor cores, and graphite moderated reactors.

Safety Functions

The applicant has identified three safety functions: limiting radionuclide release, controlling heat removal, and controlling reactivity. Given the passive design of the systems used to address these safety functions, power is not needed during the identified design basis events. This includes electric power from an off-site or any backup power source. Also, operator action is not required to mitigate any design basis events.

Limit Release of Radionuclides

Kairos uses the concept of ‘functional containment’ to limit release of radionuclides. This approach controls radionuclides at their source in the TRISO-coated uranium oxycarbide particle fuel inside the Hermes pebbles. In their evaluation of pebble performance, Kairos assumed a pre-accident level of TRISO fuel particle failure 100 times greater than that observed in the Department of Energy Advanced Gas Reactor TRISO fuel qualification program. The Flibe molten salt serves as an additional inherent barrier to the release of fission products given its strong chemical affinity for several fission product species that may escape the fuel pebble (except noble gases).

Taken together, these two inherent robust retention barriers, combined with the low thermal power of the reactor, result in projected dose consequences with large margins to regulatory siting criteria at the site boundary. In addition, doses at the site boundary are below the Environmental Protection Agency (EPA) Protective Action Guides. The large safety margins,

[2] Functional containment is defined as a barrier, or set of barriers, that when taken together limit the transport and release of radionuclides to the environment under normal operation, anticipated operational occurrences and postulated accidents.

functional containment, passive decay heat removal, fluidic diodes, and anti-siphon features allow a unique approach to structures, systems, and components (SSC) classification, as discussed later in this letter.

Kairos has opted to perform a bounding calculation to estimate annual tritium releases from the facility by assuming that all tritium generated in the Flibe will permeate through the heat exchanger and be directly released to the environment. These conservative simplifying assumptions support demonstrating compliance with 10 CFR Part 20 dose limits. However, this level of annual tritium release is higher than current operating reactors around the world (e.g., AGR, PWR, BWR, and CANDU), and more typical of the magnitude of releases from nuclear reprocessing facilities that treat spent fuel. Kairos has indicated that a tritium cleanup system will be included in the facility. Such a system would be expected to reduce airborne tritium concentrations in the facility to protect workers and should result in annual releases to the environment well below the calculated value presented in the PSAR. This could allay concerns from stakeholders about tritium release from this facility.

Control Heat Removal

The decay heat removal system (DHRS) is a passive cooling system with four independent trains that are actuated once a target level of heat generation in the reactor is reached. The DHRS provides adequate heat removal to ensure that the vessel temperature remains below design limits and fuel integrity is not challenged. The applicant has demonstrated that three of the four trains provide sufficient capacity to remove the decay heat. The ultimate heat sink is provided by water tanks that feed, by gravity, thermosyphon thimbles that remove vessel heat and reject steam to the atmosphere. The decay heat is transferred from the pebbles to the vessel wall by natural circulation of the Flibe coolant and then by conduction through the vessel and radiation to the DHRS. The water tanks are sized to provide passive cooling for up to seven days, and the staff has verified the sizing with their own calculations. Testing is planned to verify operation. The staff specified that certain effects (e.g., corrosion and fouling, flow instability during transitions, and dynamic loads during operation) must be examined in the operational testing program.

Control Reactivity

Two different sets of control elements are used to control reactivity in Hermes. Four control elements in the reflector are used to manage reactor power during operation; whereas three shutdown elements are inserted into the pebble bed to shut down the reactor. Two of the three shutdown elements are sufficient to maintain adequate shutdown margin under postulated event scenarios. Testing is planned to demonstrate adequate performance of both systems. Beyond these systems, the fuel, moderator, and coolant have inherent strong negative temperature coefficients that provide reactivity control.

Principal Design Criteria, Safety Classification, and Defense-in-Depth

Kairos has identified and described the principal design criteria for the SSCs required to ensure reactor facility safety and prevent uncontrolled release of radioactivity. The Kairos licensing approach for the Hermes design does not use a probabilistic approach (e.g., NEI 18-04 or Regulatory Guide 1.233) for identification of licensing basis events, SSC classification, and evaluation of defense-in-depth. Instead, NUREG-1537 deterministic evaluations for postulated events, the single failure criterion, and the maximum hypothetical accident (MHA) are used to evaluate plant safety and classify SSCs. There are only two SSC classifications used in the safety analysis report: “safety-related” and “non-safety related.” Also, a spectrum of “postulated events” (regardless of frequency of occurrence) was considered to verify the MHA was bounding.

The primary safety feature of the design is the unique combination of the TRISO fuel and Flibe reactor coolant. Other safety-related SSCs include the reactor vessel and internals, the reactor shutdown system, the DHRS, the spent fuel storage racks of the pebble handling and storage system, and the safety-related portion of the reactor building structure. The staff found these systems, as described, would comply with the applicable regulations and standards commensurate with their safety classification; however, additional design and performance analyses will be necessary for evaluation of the operating license.

The large safety margins allow a unique approach to safety classification. Our assessment of the validity of this approach is provided below, based on comparing historical practice to important Hermes safety characteristics.

While the reactor vessel and its welds are classified as safety grade, the primary heat transport system (PHTS) is considered non-safety related and is not required to maintain a safe and stable shutdown for any postulated event. This classification is predicated on successful design and the yet-to-be-demonstrated performance of the fluidic diodes and anti-siphon features. The anti-siphon features prevent excessive loss of coolant inventory in the vessel so that the coolant level remains above the active pebble bed core in the event of an ex-vessel pipe rupture. The fluidic diode allows natural circulation in the vessel to transfer heat from the pebble bed core through the reflector to the reactor vessel and the DHRS.

Further, the applicant proposes to use an alternative definition of “safety-related” by changing “integrity of the reactor coolant pressure boundary” to “integrity of portions of the reactor coolant boundary relied upon to maintain the reactor coolant level above the active core.” In the Hermes design, the reactor coolant boundary, except for the reactor vessel, is not credited for fission product retention. As such, the vessel is classified as safety-related while the remainder of the reactor coolant boundary is classified as non-safety related. This revised definition, as applied to design basis events involving a major break in the PHTS, would address the continued cooling of the pebble bed core and passive decay heat removal.

This approach potentially weakens overall defense-in-depth and independence of barriers/safety functions. In addition, classifying the PHTS piping as non-safety related suggests that the system may not survive a design-basis earthquake, potentially challenging reactor vessel integrity with a break at the nozzle/piping interface. (The PSAR states that PHTS failures will not impact safety-related SSCs and the SE notes this will be evaluated in the operating license application).

On the one hand, for this first-of-a-kind reactor, designing, analyzing, and constructing the PHTS to the same quality level as the reactor vessel (ASME BPVC, Section III, Division 5, design and construction, and Section XI testing and inspection) would enhance confidence that the probability of significant pipe rupture (thermally or seismically induced) is low. Making the entire primary coolant boundary safety-grade is historical practice, even in low-pressure systems (e.g., sodium fast reactors).

By contrast, from the safety analysis perspective, no credit is taken in the Hermes safety analysis for the holdup of fission products by the PHTS. Furthermore, since Flibe does not react significantly with humid air, the piping of the PHTS is not needed as a barrier to prevent chemical attack as is done in sodium-cooled reactors. Thus, in this unique situation, the large safety margins to radiological consequences to the public, derived from the combination of low thermal power and functional containment, outweigh the need for safety classification of PHTS based on additional defense-in-depth and historical practice. This may not be the case for other reactor system designs that employ functional containment, and each should be evaluated on a case-by-case basis.

Postulated Event Selection, Analysis Results, and Safety Margin

The Hermes accident analysis evaluated a broad range of postulated events to establish the MHA. These event categories included: (a) insertion of reactivity, (b) salt spills, (c) loss of forced circulation, (d) malfunction of the pebble handling and storage systems, (e) radioactive releases from a subsystem or component, (f) general challenges to normal operation, and (g) internal (fire and flood) and external hazards (seismic, wind, and flood). Within each event category, several specific events were examined to determine the bounding event scenario.

The accident analysis also examined events precluded by the design and the rationale for their exclusion. Events considered include re-criticality or reactor shutdown failure, degraded heat removal, large Flibe spills, in-service failures greater than assumed, significant ingress of air, DHRS cavity flooding, insertion of excess reactivity, criticality external to the core, excessive radionuclide release from Flibe, and internal or external events interfering with safety-related SSCs.

For each included event, conservative assumptions about initial conditions, response of safety-related SSCs (including invoking single failure criterion, as required by principal design criteria in KP-TR-003-P-A), and transient characteristics were used to evaluate the accident system response. Historically, keeping metallic structures within their allowable temperatures in high temperature reactors has been a concern. Transient analyses done by Kairos show about ~ 100 to 150°C margin to stainless steel limits for the core barrel and vessel. The fuel and control rod materials are also well below their associated temperature limits.

The staff performed a thorough review of the event selection and analysis methodology, assumptions, and results. In some cases, the staff performed scoping calculations of the same event to gain additional confidence in the Kairos calculational results. Before completion of the OL review, combustible gas generation, associated with graphite-air oxidation, should be addressed for air ingress events.

The MHA is constructed such that the defined accident time-temperature profiles, boundary conditions, and the radionuclide source term assumptions will result in calculated radiological releases that encompass those from each bounding event scenario in each event category. The MHA event assumes a hypothetical time-temperature history that (a) considers the thermal impacts of conservative trip and actuation delays associated with the reactor protection system and (b) bounds preliminary calculations of reactivity events, overheating events and overcooling events in the reactor, and other less challenging ex-reactor postulated events. Conservative estimates for releases from TRISO fuel, tritium in graphite structures, and Ar-41 from activation of the cover gas were considered in the source term assessment. Even with these assumptions, the MHA results in radiological doses at the site boundary that are well below the siting criteria of 25 rem and also below the EPA Protective Action Guides. Doses were dominated by tritium and Ar-41, not fission products.

The MHA used for research and test reactors does not consider beyond design basis events such as anticipated transient without scram (ATWS) and station blackout. As noted above, station blackout is not a concern because power is not required to execute Hermes' safety functions. For ATWS events, the consequences depend on the severity of the reactivity insertion. However, the strong negative temperature coefficient in the Hermes design and the limited excess reactivity in a pebble bed core should prevent fuel failure. We note that similar inherent safety features were demonstrated by testing in other advanced reactors, such as EBR-II (a metal fueled sodium fast reactor), AVR (a German pebble bed high temperature gas reactor), and HTTR (a Japanese high temperature gas reactor), providing unique data for code validation for these technologies.

Operational Reliability

There are performance uncertainties associated with the FHR technology most directly addressed during Hermes operation. A few key areas include:

- Ability to control the chemical potential (i.e., REDOX) of Flibe in a temperature gradient during irradiation;
- Ability to control the composition of Flibe near the eutectic point within allowable limits to prevent deleterious viscosity changes; and
- Effects of impurities in the salt on fuel performance due to corrosion.

In addition, the presence of uranium impurities and fission products in the Flibe will produce a mixed hazardous waste (hazardous beryllium and radioactive material). Kairos informed us that they have identified a disposition path for the contaminated Flibe.

Worker Safety

Key worker safety concerns in Hermes are related to the ability to control airborne tritium in the facility because of permeation through high temperature components and to contend with beryllium volatility in salt to protect workers during operation, maintenance, and inspection. Thus, two items remain to be considered going forward: (a) whether a system is needed to control airborne beryllium concentrations in the reactor building and reactor cell (during maintenance activities) below the National Institute for Occupational Safety and Health (NIOSH) limit of 0.2 $\mu g/m^3$ for short term exposure and 0.5 $\mu g/m^3$ averaged over 8 hours and (b) whether derived airborne concentrations (DAC) will be below 20 $\mu Ci/m^3$ such that personnel protective equipment will not be needed to protect workers from tritium and beryllium in the reactor building and reactor cell air during maintenance.

Technology Development

Numerous ongoing research and development activities have been identified as necessary to confirm the adequacy of the design of SSCs to resolve safety questions prior to the completion of construction. These are related to confirming fuel pebble behavior; high temperature material qualification and surveillance; oxidation of graphite; validation of computer codes; development of a fluidic diode; justification of thermodynamic and vapor pressure correlations used in source term analysis; development of process sensor technology for key reactor process variables; and development of reactor coolant chemical monitoring instrumentation. Kairos stated these activities will be completed before completion of construction.

Because this is a PSAR to support a construction permit, many of the details of the design and the associated analyses are reasonably left for the Final Safety Analysis Report. In-reactor testing planned during startup, and monitoring and inspection details are not yet available, the analytic tools are not fully validated, and safety analysis uncertainties are not fully assessed. Kairos has acknowledged this situation; the staff has also noted these items in their review and are tracking them to closure as part of the OL review or during initial reactor startup.

Summary

Key attributes of the Hermes design include low thermal power of the reactor, use of TRISO fuel and Flibe coolant as an effective functional containment, and passive heat removal capability. The overall design results in projected dose consequences with large margins to regulatory siting criteria. Because of the first-of-a-kind nature of the FHR technology, there are performance uncertainties that can most directly be addressed during Hermes operation. A scaled demonstration plant like Hermes will be valuable to test key technical elements, design features, safety functions, and equipment performance for this technology. There is confidence that the facility can be constructed in accordance with relevant regulations and the design bases outlined in the PSAR. The construction permit for Hermes should be approved.

Sincerely,

Joy L. Rempe Signed by Rempe, Joy on 05/16/23

Joy L. Rempe
Chairman

APPENDIX I: ACRS Review of Construction Permit Application for Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor - Hermes

APPENDIX II: ACRS Review of Topical Reports Supporting the Kairos Power Fluoride Salt-Cooled, High-Temperature Reactor Design

APPENDIX III: Lead Member Memoranda on Preliminary SE Chapters on Kairos Power Hermes Non-Power Reactor Preliminary Safety Analysis Report

References

1. Kairos Power LLC, “Submittal of the Preliminary Safety Analysis Report for the Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor (Hermes),” Revision 2, February 2023 (ML23055A672).
2. Kairos Power LLC, KP-TR-003-NP-A, “Principal Design Criteria for the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor,” June 12, 2020 (ML20167A174).
3. Kairos Power LLC, KP-TR-017, “KP-FHR Core Design and Analysis Methodology,” September 29, 2021 (ML21272A375).
4. Kairos Power LLC, KP-TR-018, “Postulated Event Analysis Methodology,” February 28, 2023 (ML23055A672).
5. USNRC, “SAFETY EVALUATION Related to the Kairos Power LLC Construction Permit Application for the Hermes Test Reactor,” 2023 (ML23108A119).

6. USNRC, ACRS letter report, “10 CFR PART 53 Licensing and Regulation of Advanced Nuclear Reactors,” October 21, 2020 (ML20295A647).

7. USNRC, ACRS letter report, “Preliminary Proposed Rule Language for 10 CFR Part 53, “Licensing and Regulation of Advanced Nuclear Reactors,” Interim Report,” May 30, 2021 (ML21140A354).

8. USNRC, NUREG-1537, Part 1, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Format and Content,” February 1996 (ML042430055).

9. USNRC, NUREG-1537, Part 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria,” February 1996 (ML042430048).

10. USNRC, “A Regulatory Review Roadmap for Non-Light Water Reactors,” December 2017 (ML17312B567).

11. USNRC, SECY-18-0096, “Functional Containment Performance Criteria for Non-Light-Water-Reactors,” September 28, 2018 (ML18114A546).

12. USNRC, SRM-SECY-18-0096, “Staff Requirements – SECY-18-0096 - Functional Containment Performance Criteria for Non-Light-Water-Reactors,” December 4, 2018 (ML18338A502).

13. Nuclear Energy Institute, NEI 18-04, "Risk-Informed Performance-Based Technology-Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development,” Revision 1.

14. USNRC, Regulatory Guide 1.233, “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,” Revision 0, June 2020 (ML20091L698).

15. The National Institute for Occupational Safety and Health (NIOSH), Beryllium compounds (as Be), https://www.cdc.gov/niosh/idlh/7440417.html.

16. Code of Federal Regulations, 10 CFR Part 20 - Standards for Protection Against Radiation.

17. Agency for Natural Resources and Energy, Ministry of Economic Trade and Industry, Government of Japan, Briefing Slides, “The Outline of the Handling of ALPS Treated Water at Fukushima Daiichi NPS (FDNSPS),” February 2020 https://www.meti.go.jp/english/earthquake/nuclear/decommissioning/pdf/brief20200203.pdf.

18. Canadian Nuclear Safety Commission, ‘Tritium Releases and Dose Consequences in Canada in 2006,’ December 2009 https://nuclearsafety.gc.ca/pubs_catalogue/uploads/CNSC_Release_and_Dose_eng_rev2.pdf.

19. US Environmental Protection Agency, “PAG Manual: Protective Action Guides and Planning Guidance for Radiological Incidents,” EPA-400/R-17/001 | January 2017, https://www.epa.gov/radiation/protective-action-guides-pags.

May 16, 2023

SUBJECT: KAIROS NON-POWER REACTOR HERMES CONSTRUCTION PERMIT APPLICATION

Accession No: ML23130A183 **Publicly Available (Y/N):** Y **Sensitive (Y/N):** N
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APPENDIX I

ACRS Review of Construction Permit Application for Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor - Hermes

Subcommittee (SC) / Full Committee (FC) Meetings	Date	Subject	Transcript Accession No.
SC	4/21/2022	Overview of Construction Permit Application for Kairos Power Fluoride Salt-Cooled, High Temperature Non-Power Reactor - Hermes	ML22119A253
SC	3/1/2023	Hermes Non-Power Reactor Preliminary Safety Analysis	ML23087A087
SC	3/23-24/2023	Hermes Non-Power Reactor Preliminary Safety Analysis	ML23109A130
SC	4/4/2023	Hermes Non-Power Reactor Preliminary Safety Analysis	ML23123A022
SC	4/18-19/2023	Hermes Non-Power Reactor Preliminary Safety Analysis	ML23129A092

APPENDIX II

ACRS Review of Topical Reports Supporting the Kairos Power Fluoride Salt-Cooled, High-Temperature Reactor Design

Subcommittee (SC) / Full Committee (FC) Meetings	Date	Subject	Transcript Accession No. / Letter Accession No.
SC	2/21/2020	Topical Report (KP-TR-006), "Scaling Methodology for Kairos Power Testing Program," and Topical Report (KP-TR-005), "Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor"	ML20091M844
FC	4/9/2020 and 5/6-8/2020	Kairos Advanced Reactor Design – Scaling Methodology and Reactor Coolant Topical Reports	ML20115E457 / ML20148M230
SC	9/24/2020	Topical Report (KP-TR-009), "KP-FHR Risk-Informed Performance-Based Licensing Basis Development Methodology"	ML20335A521
SC	7/6/2021	Topical Report (KP-TR-010), "KP-FHR Fuel Performance Methodology"	ML21203A312
FC	9/8/2021	Kairos Topical Report, KP-TR-010, Revision 3, "KP-FHR Fuel Performance Methodology"	ML21287A635 / ML21256A221
SC	11/19/2021	Topical Report (KP-TR-012), "KP-FHR Mechanistic Source Term Methodology November 19, 2021	ML21356A607
FC	11/30/2021	Kairos Topical Report (KP-TR-012), "KP-FHR Mechanistic Source Term Methodology Topical Report"	ML22013B263 / ML21342A179
SC	10/17/2022	Kairos Topical Report KP-TR-011, Revision 2, "Fuel Qualification Methodology for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor"	ML22299A013
FC	11/30/2022	Kairos Topical Report KP-TR-011, Revision 2, "Fuel Qualification Methodology for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor"	ML22348A122 / ML22340A628
SC	1/12/2023	Kairos Power Topical Report (KP-TR-013), "Metallic Materials Qualification for the Kairos Power Fluoride Salt-Cooled High-Temperature Reactor"	ML23031A060

APPENDIX II - CONTINUED

ACRS Review of Topical Reports Supporting the Kairos Power Fluoride Salt-Cooled, High-Temperature Reactor Design

Subcommittee (SC) / Full Committee (FC) Meetings	Date	Subject	Transcript Accession No. / Letter Accession No.
SC	1/12/2023	Kairos Power Topical Report (KP-TR-014), "Graphite Material Qualification for the Kairos Power Fluoride Salt-Cooled High-Temperature Reactor"	ML23031A014
FC	2/1/2023	Kairos Power Topical Report (KP-TR-013), "Metallic Materials Qualification for the Kairos Power Fluoride Salt-Cooled High-Temperature Reactor"	ML23053A245 / ML23037A951
FC	2/1/2023	Kairos Power Topical Report (KP-TR-014), "Graphite Material Qualification for the Kairos Power Fluoride Salt-Cooled High-Temperature Reactor"	ML23053A245 / ML23038A168

APPENDIX III

Lead Member Memoranda on Preliminary SE Chapters on Kairos Power Hermes Non-Power Reactor Preliminary Safety Analysis Report

Subject	Date	ADAMS Accession No. *(Package No. is ML23117A000)*
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 1, “THE FACILITY”	4/272023	ML23117A002
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 2, “SITE CHARACTERISTICS”	4/272023	ML23117A003
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 3, “DESIGN OF STRUCTURES, SYSTEMS, AND COMPONENTS”	5/1/2023	ML23117A005
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 4, “REACTOR DESCRIPTION”	4/27/2023	ML23117A008
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 5, “HEAT TRANSPORT SYSTEM”	4/27/2023	ML23117A010
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 6, “ENGINEERED SAFETY FEATURES”	4/27/2023	ML23117A011
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 7, “INSTRUMENTATION AND CONTROL SYSTEMS”	4/27/2023	ML23117A016
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 8, “ELECTRIC POWER SYSTEMS”	4/27/2023	ML23117A017
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 9, “AUXILIARY SYSTEMS”	4/27/2023	ML23117A019
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 10, “EXPERIMENTAL FACILITIES AND UTILIZATION”	4/28/2023	ML23117A027

Lead Member Memoranda on Preliminary SE Chapters on Kairos Power Hermes Non-Power Reactor Preliminary Safety Analysis Report

Subject	**Date**	**ADAMS Accession No.** ***(Package No. is ML23117A000)***
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 11, "RADIATION PROTECTION PROGRAM AND WASTE MANAGEMENT"	4/272023	ML23117A030
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 12, "CONDUCT OF OPERATIONS"	4/292023	ML23117A050
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 13, "ACCIDENT ANALYSIS"	4/272023	ML23117A052
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 14, "TECHNICAL SPECIFICATIONS"	4/272023	ML23117A061
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 15, "FINANCIAL QUALIFICATIONS"		N/A
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 16, "OTHER LICENSE CONSIDERATIONS"	4/272023	ML23117A065
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 17, "DECOMMISSIONING AND POSSESSION-ONLY LICENSE AMENDMENTS"	4/272023	ML23117A069
Input for ACRS Review of Kairos Non-Power Reactor Hermes Construction Permit Application - Safety Evaluation for Chapter 18, "HIGHLY ENRICHED TO LOW ENRICHED URANIUM CONVERSION"		N/A