Kairos Power

KP-NRC-1811-001

November 4, 2018

Docket No. 99902069

US Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Kairos Power LLC
Presentation Materials for Kairos Power Pre-Submittal Meeting on Principal Design Criteria and Regulatory Gap Analysis

This letter transmits presentation materials for the subject meeting between Kairos Power and Nuclear Regulatory Commission (NRC) Staff to be held on November 7, 2018. Portions of these materials are considered proprietary, and Kairos Power requests it be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390. Enclosure 1 provides the proprietary materials and Enclosure 2 provides the non-proprietary materials. An affidavit supporting the withholding request is provided in Enclosure 3.

If you have any questions or need any additional information, please contact James Tomkins at tomkins@kairospower.com or (510)-467-0922.

Sincerely,

Peter Hastings, PE
Vice President, Regulatory Affairs and Quality

Enclosures:

1) Presentation Materials for Kairos Power Pre-Submittal Meeting on Principal Design Criteria and Regulatory Gap Analysis (Proprietary)
2) Presentation Materials for Kairos Power Pre-Submittal Meeting on Principal Design Criteria and Regulatory Gap Analysis (Non-Proprietary)
3) Affidavit Supporting Request for Withholding from Public Disclosure (10 CFR 2.390)

xc (w/enclosure):

J. P. Segala, Chief, NRO Advanced Reactor and Policy Branch
J. F. Williams, Project Manager, NRO Advanced Reactor and Policy Branch

Enclosure 2

Presentation Materials for Kairos Power Pre-Submittal Meeting on Principal Design Criteria and Regulatory Gap Analysis (Non-Proprietary)

(Note that the enclosed information is preliminary and pre-decisional and is subject to change during detailed planning and project execution. It is provided for planning and familiarization purposes in support of pre-application discussions with the NRC Staff.)

Kairos Power

KAIROS POWER PRE-SUBMITTAL MEETING ON PRINCIPAL DESIGN CRITERIA AND REGULATORY GAP ANALYSIS

NOVEMBER 7, 2018

Kairos Power's mission is to enable the world's transition to clean energy, with the ultimate goal of dramatically improving people's quality of life while protecting the environment.

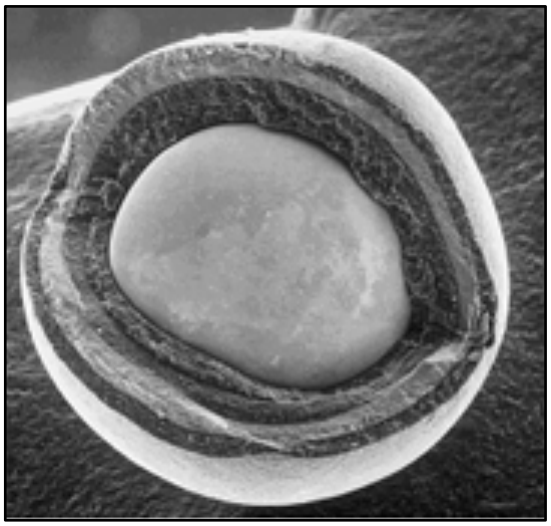
Agenda

- Introductions and Opening Remarks
- Open Session
  - KP-FHR Design Concept
  - Licensing Approach
  - PDC Topical Report Development Methodology
  - Regulatory GAP Analysis Development Methodology
- Closed Session
  - PDC Topical Report
  - GAP Analysis Topical Report
- Action Items/Future Actions

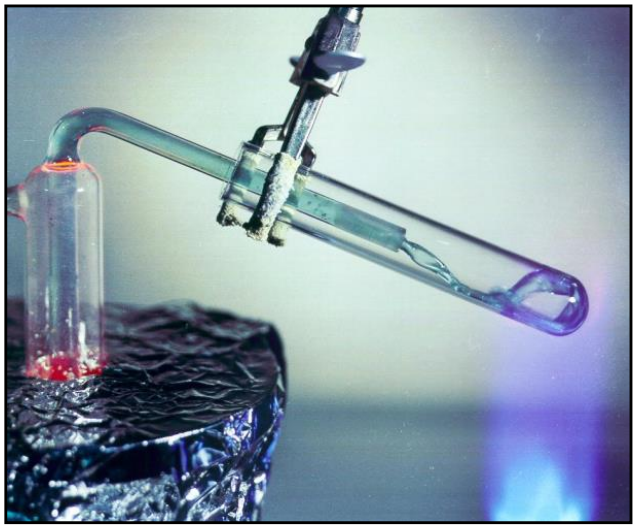
KP-FHR Design Concept

Technology Basis

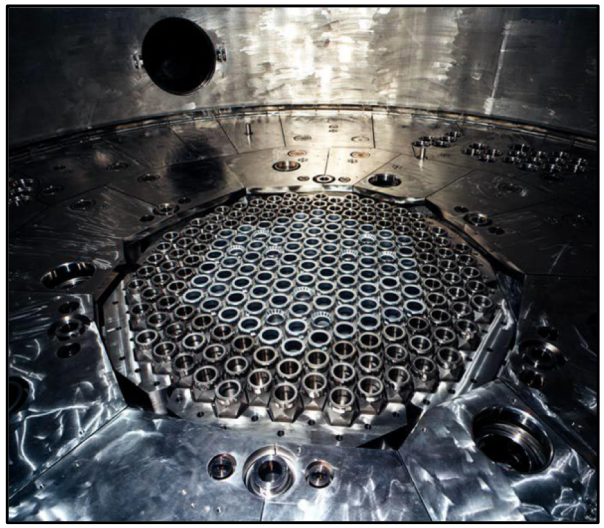
Coated Particle Fuel
[High Temperature Gas Reactors]



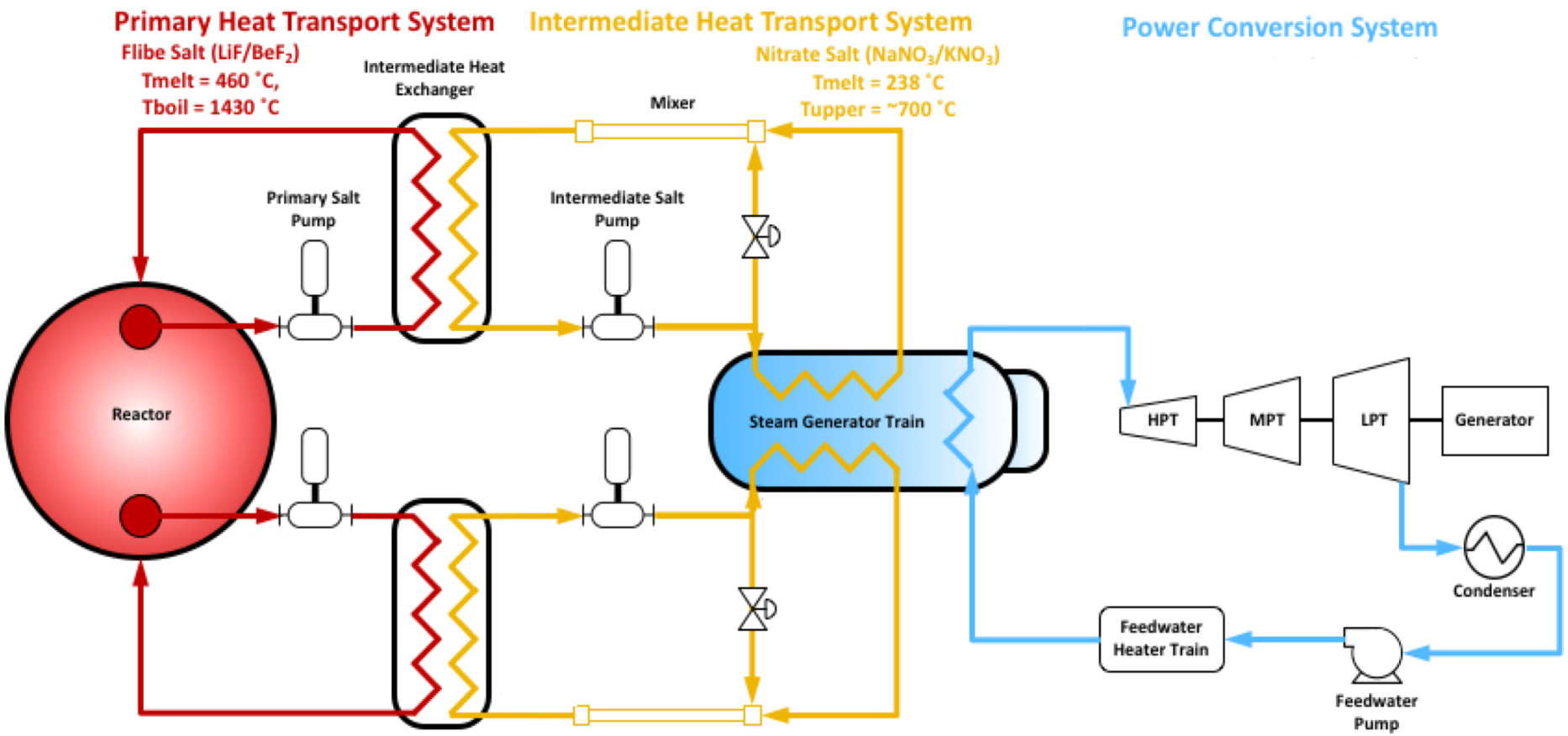
Liquid Fluoride Salt Coolants
[Molten Salt Reactors]



Low-Pressure Pool Vessel
[Sodium Fast Reactors]



Basic System Configuration with Steam Cycle



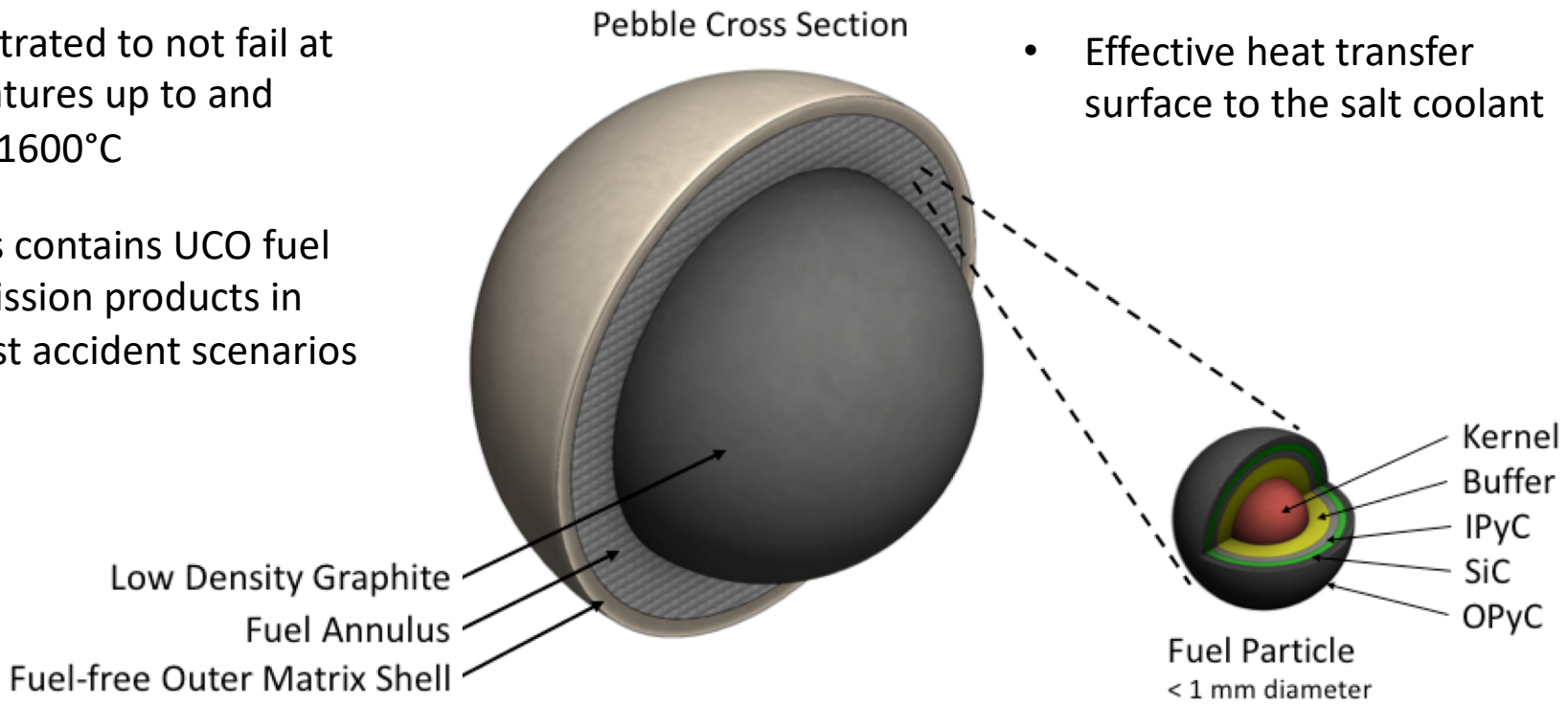
Fuel Particles and Pebbles

Fuel Particles

- Sized as < 1mm diameter
- Encapsulated in four layers of isotropic coatings
- Demonstrated to not fail at temperatures up to and beyond 1600°C
- Coatings contains UCO fuel and its fission products in the worst accident scenarios

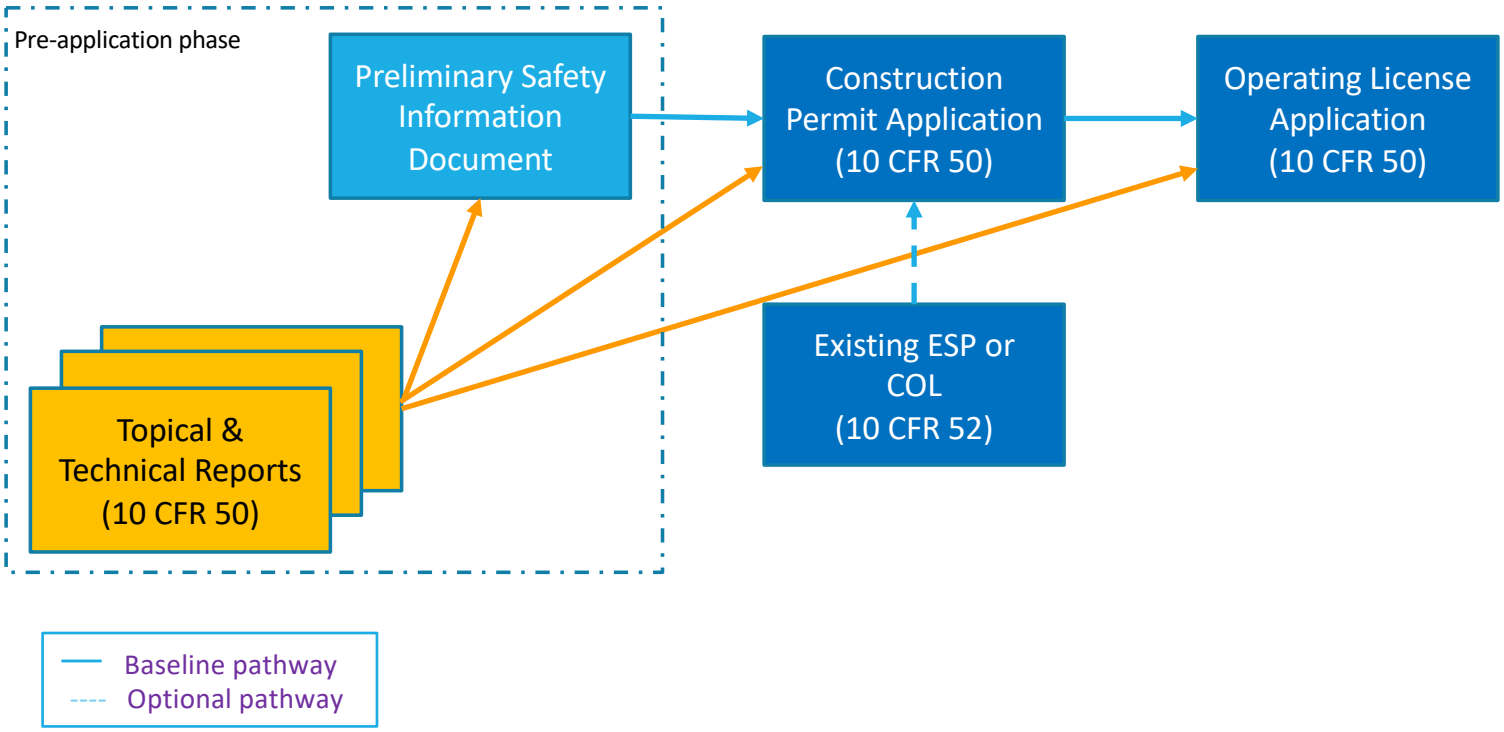
Fuel Pebbles

- Designed for positive buoyancy
- Facilitates on-line refueling
- Effective heat transfer surface to the salt coolant



Licensing Approach

Licensing Approach



Licensing Approach

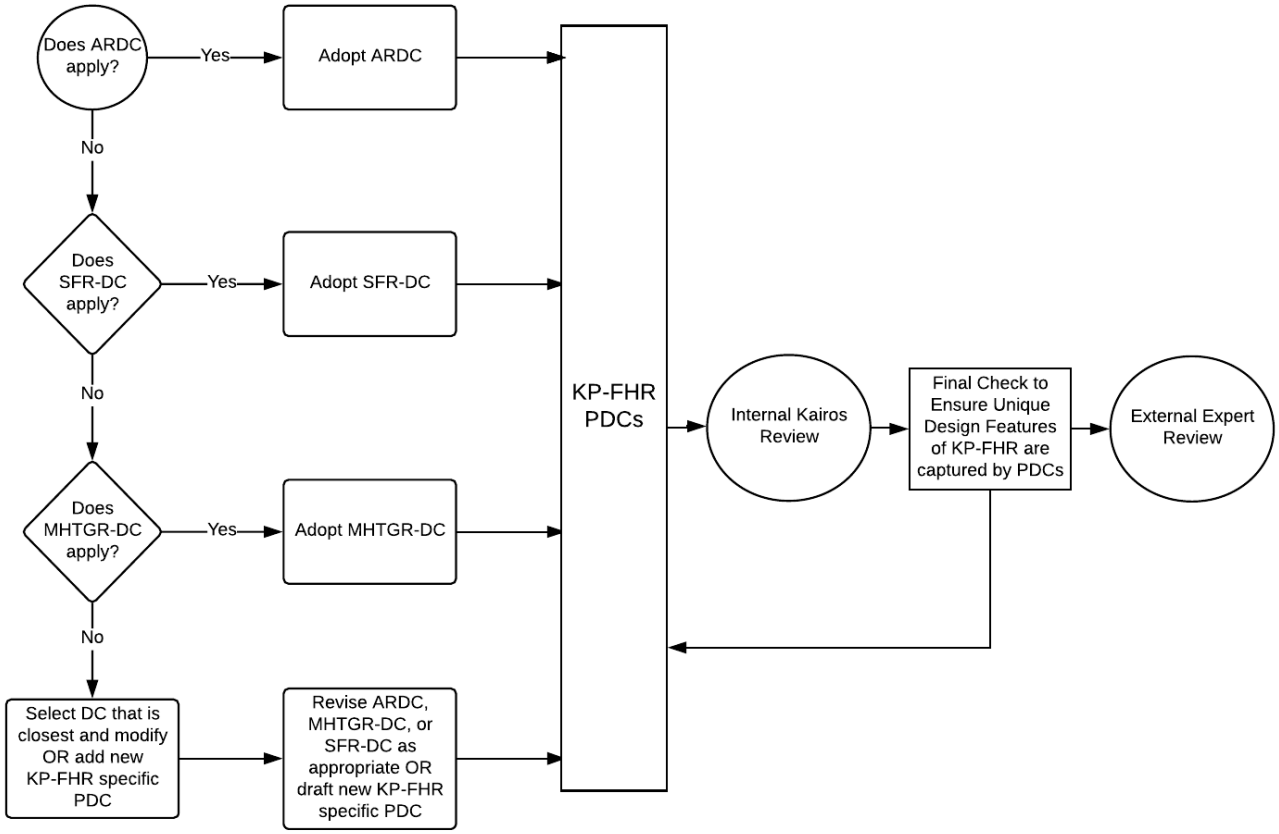
- Early engagement during pre-application phase in advance of license applications:
  - Technical/Topical Reports - address regulatory, technical, and analysis issues
  - PSID –early review/approval of key design features and how regulations are satisfied
    - Design-specific format/content – not NUREG-0800 approach
    - Utilize bounding or generic assumptions where site-specific data is needed
- Implement industry-DOE-NRC supported efforts for advanced reactors
  - Implement Licensing Modernization Project process - PRA informed design
  - Utilize modern safety analysis codes
- Regulatory Engagement Plan
  - Provide plan/schedule for Pre-application planned submittals
  - Conduct Pre- and post-meetings for topical report submittals
- This meeting supports two pending topical report submittals

PDC Topical Report Development Methodology

Methodology

- Starting point is RG 1.232
- Evaluated all ARDC in Appendix A of RG 1.232 for applicability
- Considered PDC in RG 1.232 for SFR and MHTGR for applicability
- "Applicable" ARDC, SFR-DC, and MHTGR-DC reviewed for consistency with KP-FHR key technology features
  - Modifications were proposed as needed
- KP-FHR key design features were mapped against ARDC to determine if additional criteria were needed
  - Ensured all KP-FHR key design attributes governed by proposed PDC
- Final PDC Selection
  - Internal cross-discipline review
  - External review by Industry experts from LWRs, SFRs, and MHTGRs

PDC Development Process



Key Features of KP-FHR Design

- TRISO Particle Fuel
- Radioactivity retaining molten-salt coolant
- Functional containment
- Near Atmospheric RCS Pressure
- Passive RHR system
- Low source term
- No ECCS

Example PDC Review

Title:	1. Quality Standards and Records
KP-FHR	Structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. A quality assurance program shall be established and implemented in order to provide adequate assurance that these structures, systems, and components will satisfactorily perform their safety functions. Appropriate records of the design, fabrication, erection, and testing of structures, systems, and components important to safety shall be maintained by or
Position	The KP-FHR PDC 1 adopts the language from ARDC 1 of RG 1.232, Appendix A.
Basis	The language in this ARDC, which adopts the GDC with no changes, is applicable and requires no KP-FHR modification.
Source:	RG 1.232, Appendix A, Criterion 1

PDC Development

- Example of Wording Changes
  - Use of SARRDLs vs. SAFDLs
  - Removal of “helium” from MHTGR adopted PDCs
  - Removal of “sodium” from SFR adopted PDCs

Summary

- The proposed PDC are comprehensive for KP-FHR
  - Capture KP-FHR unique design attributes
  - Important part of licensing framework

Regulatory Gap Analysis Topical Report Development Methodology

Regulatory Gap Analysis

- Purpose
  - Establish the design and licensing framework for the KP-FHR
- Methodology
  - Review of NRC regulations
    - 10 CFR Parts (1-199)
  - Review of NRC Guidance Documents
    - Regulatory Guides
    - Standard Review Plans
    - Interim Staff Guidance
    - Bulletins, Generic Letters
    - Generic Safety Issues
  - Applicable regulatory requirements and guidance allocated to KP-FHR design

Gap Analysis Approach

- Regulations and Guidance review categories:
  - What regulations and guidance “APPLIES”
  - What regulations and guidance “DOES NOT APPLY”
  - What regulations require “EXEMPTION”

Gap Analysis Results - DOES NOT APPLY/EXEMPTIONS

- Design technology specific
  - PWR Only
  - BWR Only
  - LWR Only
  - B&W Only (Vendor Specific)
- Facility type specific
  - Fuel cycle facilities
- Exemptions (discussed in closed session)

Note: In some cases the specific regulation literally does not apply but the underlying issue does, and these cases are addressed

Gap Analysis Results - Standard Review Plans

- NUREG-0800 (SRP) oriented towards LWRs
  - Significant portions of guidance in SRP does not apply to non-LWR
- NUREG-1537 developed for non-power reactors
- NUREG-1537 better suited to KP-FHR application, but both relevant and applicable portions of both 0800 and 1537 will be used

Summary

- The applicable 10 CFRs along with the PDCs provide the appropriate design and licensing framework for the KP-FHR design
- The GAP Analysis results (along with the PDCs) in the topical report are acceptable for conducting the design and licensing review of the KP-FHR

Enclosure 3

Kairos Power LLC Affidavit and Request for Withholding from Public Disclosure (10 CFR 2.390)

I, Peter Hastings, hereby state:

1. I am Vice President, Regulatory Affairs and Quality at Kairos Power LLC ("Kairos"), and as such I have been authorized by Kairos to review information sought to be withheld from public disclosure in connection with the development, testing, licensing, and deployment of the Kairos reactor and its associated structures, systems, and components, and to apply for its withholding from public disclosure on behalf of Kairos.
2. The information sought to be withheld, in its entirety, is contained in Kairos' Enclosure 1 to this letter.
3. I am making this request for withholding, and executing this affidavit in support thereof, pursuant to the provisions of 10 CFR 2.390(b)(1).
4. I have personal knowledge of the criteria and procedures utilized by Kairos in designating information as a trade secret, privileged, or as confidential commercial or financial information. Some examples of information Kairos considers proprietary and eligible for withholding under §2.390(a)(4) include:
    a. Information which discloses process, method, or apparatus, including supporting data and analyses, where prevention of its use by Kairos competitors without license or contract from Kairos constitutes a competitive economic advantage over other companies in the industry;
    b. Information, which if used by a competitor, would reduce his expenditure of resources or improve his competitive position in design, manufacture, shipment, installation, assurance of quality;
    c. Information which reveals cost or price information, production capacities, budget levels, or commercial strategies of Kairos, its customers, its partners, or its suppliers;
    d. Information which reveals aspects of past, present, or future Kairos or customer funded development plans or programs, of potential commercial value to Kairos;
    e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection; and/or
    f. Information obtained through Kairos actions which could reveal additional insights into reactor system development, testing, qualification processes, and/or regulatory proceedings, and which are not otherwise readily obtainable by a competitor.
5. Kairos' information contained in Enclosure 1 to this letter contains details of Kairos' regulatory and development strategies, intended among other things to initiate pre-application engagement with NRC staff and to begin familiarizing the staff with Kairos' technology and development plans. These strategies include aspects of Kairos' planning that could provide a competitor with a commercial advantage if the information were to be revealed publicly.

6. Pursuant to the provisions of §2.390(b)(4), the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:

   a. The information sought to be withheld from public disclosure is owned and has been held in confidence by Kairos.

   b. The information is of a type customarily held in confidence by Kairos and not customarily disclosed to the public. Kairos has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitute Kairos policy and provide the rational basis required.

   c. The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR 2.390, it is to be received in confidence by the Commission.

   d. This information is not readily available in public sources.

   e. Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Kairos, because it would enhance the ability of competitors to provide similar products and services by reducing their expenditure of resources using similar project methods, equipment, testing approach, contractors, or licensing approaches. This information is the result of considerable expense to Kairos and has great value in that it will assist Kairos in providing products and services to new, expanding markets not currently served by the company.

   f. The information could reveal or could be used to infer price information, cost information, budget levels, or commercial strategies of Kairos.

   g. Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Kairos of a competitive advantage.

   h. Unrestricted disclosure would jeopardize the position of Kairos in the world market, and thereby give a market advantage to the competition in those countries.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: November 4, 2018

Peter Hastings
Vice President, Regulatory Affairs and Quality