Enclosure 2
Metallic Material Qualification Topical Report
Limitations and Conditions Closure Plans
(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

High-Temperature Materials Qualification Topical Report Limitation and Condition Closure Plans

PUBLIC SESSION

JULY 22, 2024

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.

In order to achieve this mission, we must prioritize our efforts to focus on a clean energy technology that is ***affordable*** and ***safe***.

Introduction

- There are 11 topical reports that directly support Hermes licensing. These reports are:
  - Fuel Qualification Methodology for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor (KP-FHR)
    - References EPRI TRISO topical (which also contains limitations and conditions)
  - KP-FHR Fuel Performance Methodology
  - Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor
  - KP-FHR Mechanistic Source Term Methodology
  - Graphite Material Qualification for the Kairos Power Fluoride Salt-Cooled High-Temperature Reactor
  - Metallics Material Qualification for the Kairos Power Fluoride Salt-Cooled High-Temperature Reactor

Introduction *(continued)*

- Regulatory Analysis for the Kairos Power Fluoride Salt-Cooled, High Temperature Reactor
- Principal Design Criteria for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor
- Scaling Methodology for the Kairos Power Testing Program
- Quality Assurance Program for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor
- Instrument Setpoint Methodology for the Kairos Power Fluoride Salt-Cooled High-Temperature Reactor

Documentation of Limitation and Condition Closure

- These topical reports and the associated safety evaluation reports (SERs) contain limitations and conditions that must be met to allow use of the report in the Hermes OLA.
- Closure plans have been developed for each one of these. In most cases the plans are straightforward.
- The plan is to summarize the closure of the limitations and conditions in the Hermes OLA. The limitations and conditions will be closed in the chapter that references the topical report. These will primarily be in Chapter 4.
- The closures will be validated with a Kairos internal document or test report.
  - These documents would be available for NRC audit
- A roadmap table of the closure of each topical report condition for each topical report will be provided in the FSAR.
- There are a few conditions associated with the High Temperature Materials topical report that we would like to discuss today. The limitations and conditions are provided in the following slides.
- The detailed technical closure plans for these will be discussed in the non-public session.

Hi-Temperature Material Topical Limitation and Conditions

- Topical Report SER Limitation and Condition # 4 - ER16-8-2 material must be qualified to a temperature of 750°C or higher in accordance with the requirements of ASME Code, Section III, Division 5, and for a time that bounds the postulated accident conditions and be approved by the NRC staff.

Hi-Temperature Material Topical Limitation and Conditions

- Topical Report SER Limitation and Condition # 13 - (Section 4.2.6.1) Testing for irradiation-induced embrittlement of ER16-8-2, 316H, and the associated heat affected zone of 316H must be performed that bounds the environment representative of the KP-FHR designs, including the expected irradiation damage dpa and helium content. The program describing this testing must be submitted in future license applications for NRC staff review and approval to verify this testing program is sufficient to address irradiation-induced embrittlement of the reactor vessel.

Hi-Temperature Material Topical Limitation and Conditions

- Topical Report SER # 14 - (Sections 4.2.6.2 and 4.2.6.3) As described in Sections 4.2.6.2 and 4.2.6.3 of the TR, a materials surveillance program and an inspection and monitoring program must be implemented for all non-power test reactors and commercial power reactors using KP-FHR designs to assess and monitor both irradiation-affected corrosion rates and irradiation-affected stress corrosion cracking rates of 316H and ER16-8-2 in the environment of KP-FHR designs. The materials surveillance program and the inspection and monitoring program must be submitted in future license applications for NRC staff review and approval to verify these programs are sufficient to address both irradiation affected corrosion and irradiation-affected stress corrosion cracking of the reactor vessel.