

**Enclosure 2**  
**Graphite Material Qualification Presentation Materials for the February 1, 2023,**  
**ACRS Full Committee Meeting**  
**(Non-Proprietary)**



# Kairos Power

## Graphite Material Qualification Topical Report

ACRS Full Committee Meeting

February 1, 2023



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.

# Background

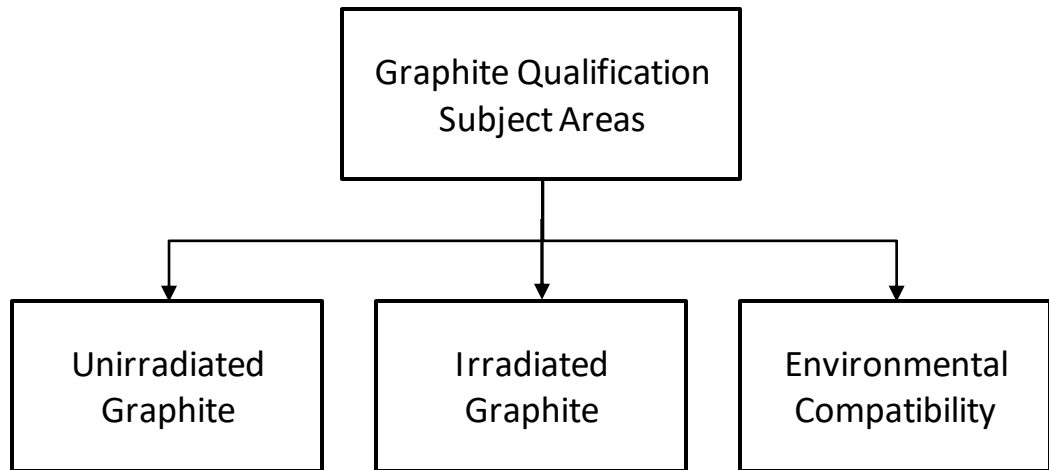
---

- Purpose: This report presents the methods for qualifying structural graphite for use in KP-FHRs
  - Qualification is subject to the conditions specified in topical report
- Scope: This report is applicable to a KP-FHR test or power reactor provided that the report conditions are met
- Graphite to be Qualified: ET-10 is a superfine grain graphite with nearly isotropic properties
- Safety Functions
  - The graphite reflector provides a physical pathway for maintaining core cooling and a physical pathway for reactivity control element insertions
  - Structural integrity ensures the safety functions can be met
- Quality Assurance
  - The qualification for the power reactor will satisfy an NQA-1 based QA program
  - The qualification for the test reactor will satisfy an ANSI/ANS-15.8-1995 based QA program

# ASME Code Application

---

- The qualification plan follows the ASME BPV, Section III, Division 5, code with a few exceptions.
  - A portion of the code specifically addresses graphite materials
- The code and the topical report organize qualification into three elements:
  - Characterization of as-manufactured graphite mechanical and thermal properties
  - Characterization of graphite properties under irradiation
  - Environmental compatibility



# Qualification of Unirradiated and Irradiated Graphite

---

- Qualification for unirradiated ET-10 would follow ASME Code III (5), *As-Manufactured Graphite*:
  - Kairos Power will conduct testing for mechanical properties, thermal properties, and purity with limited departures from the code.
  - Both with grain and against the grain properties will be measured. The final design of the reflector structure will take into account uncertainty in property values due to anisotropy.
  - A combination of testing data and historical data will be used to assess property variation.
- Qualification will apply ASME Code III (5) HHA-2200, *Material Properties for Design and HA-III-3000 Properties to be Determined*, for irradiated graphite properties.
  - Applicable data exists for basic irradiation properties for use in either a power and test reactor application.
  - Kairos Power will generate new test data to characterize irradiation creep for a power reactor application.
  - Applicable data exists for irradiation creep coefficients for use in a test reactor application.

# Environmental Compatibility Between Flibe and ET-10

- Phenomena relevant to qualification were identified through review of applicable phenomena identification studies and other technical literature

Phenomenon	Qualification Plan	Purpose
Infiltration	Confirmatory testing (applicable to power reactor conditions only)	Confirm that graphite mechanical properties are not degraded by Flibe infiltration.
Abrasion and Erosion	Confirmatory testing	Demonstrate no significant abrasion or erosion under prototypical operating conditions.
Chemical Compatibility	No testing planned	Applicable literature indicates that intercalation is thermodynamically unfavorable in Flibe.
Oxidation	Testing (applicable to test and power reactors)	Measure ET-10 oxidation kinetic parameters; determine weight loss vs strength; determine oxidation depth profile; confirm that oxidation of submerged graphite does not occur to a degree that would affect strength.



# Summary

---

- The qualification plan in the Graphite Material Qualification Topical Report describes the plan to qualify ET-10 for safety-related structural graphite component design for use in a KP-FHR.
- The qualification plan conforms with the ASME BPV, Section III, Division 5, code with limited departures.
- The qualification plan will use existing data and data from new tests.
- Seismic qualification of the reflector structure is outside the scope of the topical report.