

NRC Evaluation of KP-TR-011-P, “Fuel Qualification Methodology for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor (KP-FHR)”, Rev. 2

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Introduction

- Kairos Power, LLC requested staff review and approval of KP-TR-011-P, Rev. 2, “Fuel Qualification Methodology for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor (KP-FHR)”
- Provides a methodology by which the Kairos fuel pebble design will be qualified for use in either a KP-FHR non-power or KP-FHR power reactor
- The staff’s review focused on the overall qualification framework including:
 - Use of existing data
 - Surveillance
 - Unirradiated testing
 - Irradiation testing

Regulatory Basis

Title 10 of the *Code of Federal Regulations* (10 CFR) Sections 50.34(a), 50.34(b), 50.43(e), and corresponding regulations for design certification applications, combined license applications and standard design approvals

10 CFR 100.11 “Determination of exclusion area, low population zone and population center distance”

Kairos PDC 10 – “Reactor design” which has been approved by the staff (KP-TR-003-NP-A)

KP-FHR PDC 16, “Containment Design” which has been approved by the staff (KP-TR-003-NP-A)

Staff Evaluation

Applicability of Existing Data

- KP-TR-011, Rev. 2 is applicable based on a comparison of the Kairos and AGR-2 particles as well as the operating conditions
- Use of existing carbon matrix property data is applicable for determining pebble testing conditions for fuel qualification

Fuel Surveillance

- Surveillance of the cover-gas, non-destructive examinations, and planned destructive examinations are acceptable for monitoring fuel performance and detecting particle failure

Staff Evaluation (cont.)

Unirradiated Testing

- Planned tests include mechanical, tribology, buoyancy and salt infiltration, and material compatibility
- The planned unirradiated pebble testing is acceptable based on the conservative test conditions and plant operating conditions

Irradiation Testing

- Fuel pebble irradiation in a gas environment
- Purge gas monitoring for fission gas
- Post Irradiation Examinations

Coolant Salt Impurities

- The staff considered sources available for impurities which could attack the particles (e.g. Fe, Cr, Ni, etc.)
- The transport of significant impurities to the fuel particles is not feasible given the chemistry monitoring system, solubility limits in molten salt, cover gas monitoring system, and significantly lower temperatures as compared with AGR-5

Staff Limitations

The staff's approval of KP-TR-011-P includes the following staff limitation in addition to the limitations provided by Kairos in Section 4.2 of the topical report:

Future license applications for non-power KP-FHRs will include justification of the applicability of this methodology during rapid reactor transient events.

Conclusions

The staff reviewed the topical report KP-TR-011-P, Rev. 2 and concludes that the fuel qualification methodology contained within is acceptable for supporting fuel qualification of Kairos fuel pebbles in either non-power or power reactor versions of the KP-FHR.

Questions?