Enclosure 1
Changes to PSAR Chapter 4
(Non-Proprietary)

core. A fuel-free carbon matrix shell is located on the surface of the fuel region to protect the fuel primarily from mechanical damage.

The fuel annulus is composed of a carbon matrix embedded with TRISO fuel particles with a packing fraction of approximately 37%. The fuel particles are located near the pebble surface which reduces particle temperatures relative to non-annular designs. The TRISO particles are fabricated in accordance with a fuel specification that is similar to DOE's AGR program fuel particles matching critical parameters related to fuel performance. The kernels are composed of UCO, a mixture of UO_2, UC, and UC_2 phases, which differs from the traditional TRISO fuel particle kernels containing only UO_2. The addition of carbon to the kernel mitigates the generation of CO gas thus reducing the risk of kernel migration, over-pressurization of the particle with CO gas, and CO gas reactions with the SiC layer. The fuel pebbles are safety-related.

The reactor also contains moderator pebbles. These pebbles have the same diameter as the fuel pebbles, contain no uranium, and are made entirely of the same graphite matrix material that is used in the fuel pebbles and there is no inner low density core. The moderator pebbles have the same buoyancy characteristics as the fuel pebbles. As described in Section 4.5, these pebbles provide neutron moderation. The moderator pebbles are non-safety related. The moderator pebbles will be tested using the methodology in the Fuel Qualification topical report (Reference 2) for buoyancy, wear, impact, and salt infiltration. In addition, the moderator pebbles will be subject to the inspection for physical damage as described in Section 4.2.1.7.

Fuel properties are provided in Table 4.2-1 (particle) and Table 4.2-2 (pebble). The primary safety-related functions performed by each of the fuel components are described in Table 4.2-3.

4.2.1.2 Fuel Qualification

The qualification of the initial reactor fuel is based on U.S. and international historical experience with TRISO fuel elements and the advancement in fuel technology through the DOE AGR program. This historical experience provides confidence that the reactor will operate with large thermal margins and therefore the integrity of the fuel is not expected to be challenged. The DOE initiated the AGR project in the early 2000s to design and develop a High Temperature Gas Reactor to support the U.S. domestic electricity and process heat market. A critical part of this effort was evaluating past issues with U.S. manufactured particle fuel in comparison to the successful German experience. The result was a TRISO fuel particle design that was fabricated at laboratory and engineering scales and irradiated in a series of tests in the Advanced Test Reactor at the Idaho National Laboratory (INL). These irradiation tests serve as a foundation for the qualification of a TRISO fuel particle design for application in the KP-FHR test reactor.

The fuel qualification program is described in the "Fuel Qualification Methodology for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor (KP-FHR)" topical report (Reference 2). The main elements of this qualification program are:

- DOE AGR and Legacy Data
- Fuel Specification, Manufacturing, and Quality Control through Inspection
- Fuel Element Phenomena Identification and Ranking Table
- Development of Operating Envelope
- Fuel Element Laboratory Testing
- Fuel Irradiation Test Program
- Fuel Performance Modelling
- Fuel Surveillance Program