Enclosure 1

Changes to Hermes PSAR Chapter 5

(Non-Proprietary)

CHAPTER 5 HEAT TRANSPORT SYSTEMS

5.1 PRIMARY HEAT TRANSPORT SYSTEM

5.1.1 Description

The primary heat transport system (PHTS) transfers heat from the reactor core by circulating reactor coolant between the packed bed of fuel elements (pebbles) and reflector in the reactor core and the primary heat rejection system (PHRS) (Section 5.2) during normal operations. The PHTS includes a primary salt pump (PSP), a primary heat exchanger (PHX), and associated piping. The PHTS also includes capability for primary loop auxiliary heating to maintain the reactor coolant in the liquid phase when the reactor core is not generating heat, and capability to drain external piping and the PHX to allow cooldown, inspection, and maintenance. A process flow diagram of the PHTS is provided in Figure 5.1-1. The key design parameters for the PHTS are provided in Table 5.1-1.

The primary system functions of the PHTS are non-safety related and include the following:

- Transport heat from the reactor core to the PHRS to support nuclear heat generation and transport.
- Manage thermal transients (overall thermal balance) occurring as part of normal operations.
- Support residual heat removal function during normal shutdown.
- Accommodate thermal expansion of the system and components in transitioning between the temperature at assembly and operation.
- Provide capability to drain the PHTS. ~~to reduce parasitic heat loss during over-cooling transients.~~
- Maintain the reactor coolant pressure in the PHX above the PHRS coolant pressure under normal operating or transient conditions until the PHX is drained.
- Support reactor power level transitions (ramp up and ramp down in power).
- Provide for in-service inspection, maintenance, and replacement activities.

The PHTS interfaces with the reactor thermal management system, inert gas system, tritium management system, inventory management system, and the instrumentation and control system. These systems are described in Chapters 7 and 9.

The design of the PHTS ensures that the reactor coolant is maintained at a positive pressure differential with respect to the PHRS during normal operation or transient conditions, until the PHX is drained. This ensures that potential reactor coolant leakage from the PHX is driven into the PHRS to maintain control of reactor coolant chemistry and physical properties.

The primary components of the PHTS are described in the following subsections.

5.1.1.1 Reactor Coolant

The reactor coolant is a chemically stable, molten mixture of fluorine, lithium, and beryllium (Flibe). A description of the reactor coolant material composition, coolant quality requirements, Flibe impurities, and thermophysical properties is provided in the “Reactor Coolant for the Kairos Power Fluoride Salt-Cooled High Temperature Reactor” Topical Report KT-TR-005 (Reference 5.1-1). The reactor coolant performs safety functions associated with reactivity control and fission product retention. The composition of the reactor coolant also enables the reactor core to be designed with a negative coolant temperature coefficient of reactivity. This provides a safety benefit supporting reactivity control, low parasitic neutron absorption for effective fuel utilization, and minimal short-term and long-term activation of the coolant for improved operations and maintenance. The reactor coolant also serves as a fission product barrier providing retention of fission products that escape the fuel particle and fuel pebble barriers for fuel in the reactor core. This additional retention capability contributes to the