**Enclosure 1**
**Changes to PSAR Chapter 3 and Chapter 5**
**(Non-Proprietary)**

**Table 3.1-2: Principal Design Criteria**

| Principal Design Criteria | SAR Section |
|---|---|
| PDC 1, Quality Standards and Records | 3.5, 4.3, 6.3, 7.3, 7.4, 7.5 |
| PDC 2, Design bases for protection against natural phenomena | 3.5, 4.2.2, 4.3, 4.7, 5.1, 5.2, 6.3, 7.3, 7.4, 7.5, 8.2, 8.3, 9.1.1, 9.1.2, 9.1.3, 9.1.4, 9.1.5, 9.2, 9.3, 9.4, 9.7, 9.8.2, 9.8.4, 9.8.5, 11.2 |
| PDC 3, Fire Protection | 6.3, 7.3, 7.5, 9.3, 9.4 |
| PDC 4, Environmental and dynamic effects design bases | 4.2.2, 4.3, 4.7, 6.3, 7.3, 9.1.1, 9.1.2, 9.1.4, 9.3, 9.7, 9.8.2, 9.8.4, 9.9 |
| PDC 5, Sharing of structures, systems, and components | 3.1.1 |
| PDC 10, Reactor Design | 4.2.1, 4.3, 4.5, 4.6, 5.1, 6.3, 7.3 |
| PDC 11, Reactor Inherent Protection | 4.5 |
| PDC 12, Suppression of reactor power oscillations | 4.5, 4.6, 5.1 |
| PDC 13, Instrumentation and Control | 7.2, 7.3, 7.5, 9.1.3 |
| PDC 14, Reactor Coolant Boundary | 4.3 |
| PDC 15, Reactor coolant system design | 7.3 |
| PDC 16, Containment design | 4.2.1, 5.1 |
| PDC 17, Electric Power systems | 8.2, 8.3 |
| PDC 18, Inspection and testing of electric power systems | 8.2, 8.3 |
| PDC 19, Control room | 7.4 |
| PDC 20, Protection system functions | 7.3 |
| PDC 21, Protection system reliability and testability | 7.3, 7.5 |
| PDC 22, Protection System Independence | 7.3, 7.5 |
| PDC 23, Protection system failure modes | 4.2.2, 7.3 |
| PDC 24, Separation of protection and control systems | 7.3, 7.5 |
| PDC 25, Protection system requirements for reactivity control malfunctions | 7.3 |

| Principal Design Criteria | SAR Section |
|---|---|
| PDC 26, Reactivity control systems | 4.2.2, 4.5 |
| PDC 28, Reactivity limits | 4.2.2, 7.3 |
| PDC 29, Protection against anticipated operation occurrences | 4.2.2, 7.3, 7.5 |
| PDC 30, Quality of reactor coolant boundary | 4.3 |
| PDC 31, Fracture prevention of reactor coolant boundary | 4.3 |
| PDC 32, Inspection of reactor coolant boundary | 4.3 |
| PDC 33, Reactor coolant inventory maintenance | 4.3, 5.1, 9.1.4, 9.3 |
| PDC 34, Residual heat removal | 4.3, 4.6, 6.3 |
| PDC 35, Passive residual heat removal | 4.3, 4.6, 6.3 |
| PDC 36, Inspection of passive residual heat removal system | 4.3, 6.3 |
| PDC 37, Testing of passive residual heat removal system | 4.3, 6.3 |
| PDC 44, Structural and equipment cooling | 9.1.5, 9.7 |
| PDC 45, Inspection of structural and equipment cooling systems | 9.1.5, 9.7 |
| PDC 46, Testing of structural and equipment cooling systems | 9.1.5, 9.7 |
| PDC 60, Control of releases of radioactive materials to the environment | 5.1, 5.2, 9.1.3, 9.2, 9.9.1, 9.9.3, 11.2 |
| PDC 61, Fuel storage and handling and radioactivity control | 9.3 |
| PDC 62, Prevention of criticality in fuel storage and handling | 9.3 |
| PDC 63, Monitoring fuel and waste storage | 9.3, 11.2 |
| PDC 64, Monitoring radioactivity releases | 5.2, 9.1.2, 9.1.3, 9.2, 9.9.1, 9.9.3 |
| PDC 70, Reactor coolant purity control | 5.1, 9.1.1, 9.1.4 |
| PDC 71, Reactor coolant heating systems | 9.1.5 |
| PDC 73, Reactor coolant system interfaces | 5.2 |

| SSC Name | Safety Classification | Seismic Design | Quality Program | SAR Section | Plant Area |
|---|---|---|---|---|---|
| Intermediate Heat Exchanger | Non-safety related | Local Building Code | Not Quality-Related | 5.1.1 | SR area |
| Primary Loop Piping System | Non-safety related | Local Building Code | Not Quality-Related | 5.1.1 | SR area |
| Primary Loop Thermal Management | Non-safety related | Local Building Code | Not Quality-Related | 5.1.1 | SR area |
| Reactor Coolant | Safety-related | N/A | Quality-Related | 5.1.1 | SR area |
| Anti-Siphon Feature | Safety-related | SDC-3 | Quality-Related | 5.1.1 | SR area |
| **Intermediate Heat Transport System** | | | | | |
| Intermediate Salt Pumps | Non-safety related | Local Building Code | Not Quality Related | 5.2 | NSR area |
| Intermediate Piping ~~System~~ | Non-safety related | Local Building Code | Not Quality Related | 5.2 | SR and NSR area |
| Superheater | Non-safety related | Local Building Code | Not Quality Related | 5.2 | NSR area |
| Intermediate Loop Auxiliary Heating Subsystem | Non-safety related | Local Building Code | Not Quality Related | 5.2 | SR and NSR area |
| Intermediate Inert Gas Subsystem | Non-safety related | Local Building Code | Not Quality Related | 5.2 | SR and NSR area |
| Intermediate Coolant Inventory Management Subsystem | Non-safety related | Local Building Code | Not Quality Related | 5.2 | SR and NSR area |
| Intermediate Coolant, Chemistry Control Subsystem | Non-safety related | Local Building Code | Not Quality Related | 5.2 | SR and NSR area |
| Intermediate Coolant | Non-safety related | N/A | Not Quality Related | 5.2 | SR and NSR area |

## 5.2 INTERMEDIATE HEAT TRANSPORT SYSTEM

### 5.2.1 Description

The Intermediate Heat Transport System (IHTS) transfers heat from the PHTS (Section 5.1) by circulating intermediate coolant between the cooling side of the IHX and the power generation systems (Section 9.9) during normal plant operation. The IHTS includes intermediate salt pumps (ISPs), intermediate salt vessels (ISVs), a superheater, and associated piping. The IHTS transports tritium from the IHX to the tritium management system (TMS) in the cover gas portion of the ISVs. The TMS is described in Section 9.1.3. The IHTS also provides for fill/draining control of the IHTS piping, IHX, and superheater tube side.

The information presented in this section is applicable to both Unit 1 and Unit 2. Each unit has its own IHTS and there are no shared IHTS components between units. A process flow diagram of the IHTS showing both units is provided in Figure 5.1-1. The key design parameters for the IHTS are provided in Table 5.2-1.

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

- Transport heat from the PHTS to the steam system.
- Manage thermal transients (overall thermal balance) occurring as part of normal operations.
- Maintain intermediate coolant pressure below primary coolant pressure within the IHX.
- Facilitate tritium transfer from the intermediate coolant to the TMS to capture tritium permeating into the IHTS.

There is one safety-related function associated with the IHTS:

- Relieve IHTS pressure in the event of a superheater tube leak or rupture event.

The design of the IHTS allows for on-line monitoring, in-service inspection, maintenance, and coolant replacement activities. The primary components of the IHTS are described in the following subsections.

#### 5.2.1.1 Intermediate Coolant Inventory Management Subsystem

The intermediate coolant inventory management subsystem maintains the total intermediate coolant inventory in the IHTS above a minimum volume and manages the volume of intermediate coolant within the various components of the IHTS. The ISVs within the intermediate coolant inventory management subsystem store surplus intermediate coolant inventory and support system filling and draining during startup and normal shutdown conditions. The ISVs accommodate thermal expansion of the intermediate coolant.

The intermediate coolant inventory management subsystem includes the functionality to melt new intermediate coolant for addition via the ISVs, and to solidify used intermediate coolant after removal from the ISVs.

#### 5.2.1.2 Intermediate Inert Gas Subsystem

The IHTS design includes an intermediate inert gas subsystem to control intermediate coolant chemistry, to minimize corrosion, and to control and recover tritium. Inert gas within the ISVs is circulated through the TMS to capture tritium in the gas (see Section 9.1.3). Gas composition and impurities within the ISVs inert gas are controlled to maintain conditions which facilitate tritium capture. The intermediate inert gas subsystem is designed to support keeping the intermediate coolant pressure in the heat exchangers lower than the pressure in the PHTS.

The IHTS is equipped with safety-related rupture disks located in the intermediate inert gas subsystem, made of austenitic stainless steel, which prevents overpressure in the IHTS during a postulated superheater tube leak or rupture event.

#### 5.2.1.3 Intermediate Coolant

The intermediate coolant is a eutectic mixture of sodium fluoride and beryllium fluoride (57mol%NaF-43mol%$BeF_2$, referred to as "BeNaF"). BeNaF has similar characteristics to Flibe in that it is thermodynamically stable, is compatible with structural materials, and has analogous chemical properties to the primary Flibe coolant.

#### 5.2.1.4 Intermediate Coolant Chemistry Control Subsystem

The intermediate coolant chemistry control subsystem supports monitoring and control of intermediate coolant chemistry. The intermediate coolant inventory management subsystem may be used to remove and replace a sufficient amount of intermediate coolant to control intermediate coolant chemistry.

#### 5.2.1.5 Intermediate Salt Pumps

The ISPs provide the motive force for the circulation of intermediate coolant between the IHX and the superheater, and provide the needed pressure and flow rate in the IHTS. The intermediate coolant is circulated through the superheater where heat is transferred to saturated steam to produce superheated steam in the power generation systems (see Section 9.9).

~~The IHTS is equipped with safety-related rupture disks located in the intermediate inert gas system, made of austenitic stainless steel, which prevents overpressure in the IHTS during a postulated superheater tube leak or rupture event.~~

#### 5.2.1.6 Intermediate Piping

The intermediate piping serves as the flow conduit within the IHTS. The design of the piping accommodates continuous operation at full thermal power and operates under partial load conditions at reduced flow rate.

The design of the IHTS piping includes provisions for filling, draining, and high point venting, and accommodates thermal expansion between the ISPs, the ISVs, and the superheater.

#### 5.2.1.7 Intermediate Loop Auxiliary Heating Subsystem

The IHTS contains an auxiliary heating subsystem to provide non-nuclear heating as needed for plant startup, shutdown, and supplemental heating during normal operation. The auxiliary heating maintains the IHTS piping at or above the trace heating setpoint temperature. The source of the heat depends on the subsystem or component requiring the heat. The selected heat source will be described in the application for an Operating License.

### 5.2.2 Design Basis

Consistent with PDC 2, the safety-related SSCs located near the IHTS are protected from the adverse effects of postulated IHTS failures during a design basis earthquake.

Consistent with PDC 60, the IHTS includes features that support the control of radioactive materials during normal reactor operation.

Consistent with PDC 64, the IHTS is designed to monitor radioactive releases.

Consistent with PDC 73, the IHTS includes a passive barrier (IHX) for the reactor coolant system that is chemically compatible with the IHTS coolant and IHTS features that support the control of radioactive materials during normal reactor operation. The IHTS provides two passive barriers (IHX and superheater) between Flibe in the PHTS and steam in the steam system.

Consistent with 10 CFR 20.1406, the IHTS is designed, to the extent practicable, to minimize contamination of the facility and the environment, and to facilitate eventual decommissioning.

### 5.2.3 System Evaluation

The design of the IHTS is such that a failure of components of the IHTS does not affect the performance of safety-related SSCs due to a design basis earthquake. Those safety-related SSCs will be protected from seismically induced failures of the IHTS by either seismically mounting the applicable components, confirming sufficient physical separation, or by the erection of barriers to preclude adverse interactions. Also, the IHTS is located in safety-related and non-safety related portions of the Reactor Building. As a result, portions of the IHTS may cross the isolation moat discussed in Section 3.5. SSCs that cross the base isolation moat may experience differential displacements as a result of seismic events. The IHTS is designed so that postulated failures of SSCs in the system from differential displacements do not preclude safety-related SSCs from performing their safety function. Design features addressing differential displacement are discussed in Section 3.5. This satisfies the requirements of PDC 2 for the IHTS.

Tritium will be present in the intermediate coolant as part of normal operations of the plant. Control measures will be taken to minimize the release of radioactive material and ensure that it is also below allowable limits. Tritium which permeates through the IHX heat transfer surface is expected to enter the intermediate coolant in the chemical form of HT or $T_2$. As described in Section 9.1.3, anhydrous hydrogen fluoride will be added to the intermediate inert gas system to convert the tritium to a tritium fluoride that will move into the gas space of the ISVs. The TMS will capture tritium from the gas mixture. Removal of tritium from the ISV gas spaces reduces tritium inventory that is available for release, as described in Section 9.1.3. Postulated failures of the IHTS could cause intermediate coolant or cover gas to leak into the reactor building. Such events are evaluated in Section 13.1. These features demonstrate conformance with the requirements in PDC 60.

Radiation monitoring is provided in the ISV cover gas space for the evaluation of radioactivity levels in the gas. This monitoring supports the evaluation of the radioactive material releases that might occur as a result of a system failure. This design feature, in part, satisfies PDC 64.

The IHTS coolant has the potential to be contaminated with Flibe due to a postulated leak of the IHX, as the Flibe is maintained at a higher pressure than the intermediate coolant. However, the two fluids are chemically compatible. Flibe is separated from the water in the power generation system by two passive barriers, the IHX and superheater boundaries. The IHTS is provided with safety-related rupture disks to mitigate the effects of a postulated superheater tube leak or tube rupture event. These features demonstrate conformance with the requirements in PDC 73.

The IHTS piping is designed to the ASME B31.3 Code. The superheater is designed to ASME BPVC Section VIII. The ISVs are designed to ASME BPVC Section VIII. The IHTS coolant has the potential to be contaminated with tritium or other radioactive materials in a postulated leak from the PHTS into the IHTS, via the IHX. As such, the IHTS includes features that support monitoring radioactive material releases from breaks and leaks in the piping system or via pressure relief equipment. Therefore, the design of the system minimizes contamination and supports eventual decommissioning, consistent with the requirements of 10 CFR 20.1406, as described in Chapter 11.