6.3 Emergency Core Cooling Systems

The information in this section of the reference ABWR DCD, including all subsections, tables, and figures, is incorporated by reference with the following departures and supplements.

STD DEP Admin

STD DEP T1 2.4-1

STD DEP T1 2.4-3

STD DEP T1 2.4-4 (Figure 6.3-1)

STD DEP T1 3.4-1

STD DEP 1.8-1

STD DEP 7.3-11 (Figure 6.3-7)

STD DEP 6C-1 (Table 6.3-8, Table 6.3-9, Figure 6.3-1)

As required by Section IV.A.3 of Appendix A of Part 52, the ABWR Design Certification Rule, the plant-specific DCD must physically include the proprietary and safeguards information referenced in the ABWR DCD. Section 6.3 in the reference ABWR DCD references proprietary information in various tables and figures.. That proprietary information is provided in COLA Part 10, has finality in accordance with Section VI.B.2 of the ABWR Design Certification Rule, and does not constitute a supplement to or departure from the reference ABWR DCD. Table 6.3-6 and Figures 6.3-10 through 6.3-79 are located in COLA Part 10. The departures described in this section have no impact on these proprietary tables and figures.

6.3.2.2 Equipment and Component Descriptions

STD DEP T1 2.4-4

Regulatory ~~Guide~~ Guides *1.1* and 1.82 *~~prohibits~~* prohibit *design reliance on pressure and/or temperature transients expected during a LOCA for assuring adequate NPSH. The requirements of ~~this~~* these *Regulatory ~~Guide~~* Guides *are applicable to the HPCF, RCIC and RHR pumps.*

6.3.2.2.3 Reactor Core Isolation Cooling System (RCIC)

STD DEP T1 2.4-3

The RCIC System consists of a steam-driven turbine ~~which drives a~~ integral with a *pump assembly. The system also includes piping, valves, and instrumentation necessary to implement several flow paths. The RCIC steam supply line branches off one of the main steamlines (leaving the reactor pressure vessel) and goes to the RCIC turbine with drainage provision to the main condenser. The turbine exhausts to the suppression pool with vacuum breaking protection. Makeup water is supplied from the*

*CST and the suppression pool with the preferred source being the CST. RCIC pump discharge lines include the main discharge line to the feedwater line, a test return line to the suppression pool, a minimum flow bypass line to the ~~pool~~*suppression pool*~~, and a cooling water supply line to auxiliary equipment~~. The piping configuration and instrumentation is shown in Figure 5.4-8. The process diagram is given in Figure 5.4-9.*

6.3.2.2.4 Residual Heat Removal System (RHR)

STD DEP T1 2.4-1

In the shutdown cooling mode, with the pump suction being taken from the reactor pressure vessel (via the shutdown cooling lines), the pump discharge within these loops provides a flow path back to the reactor vessel via the core cooling discharge return lines, and feedwater line, or to the upper reactor well via the fuel cooling system ~~(on two loops only)~~.

With the pump suction being taken from the skimmer surge tanks of the fuel pool cooling system, the pump discharge is returned to the fuel pool ~~on two loops only~~.

For each loop, a minimum flow bypass line is also provided to return water to the suppression pool to prevent pump damage due to overheating when the injection valves on the main discharge lines are closed. The bypass line connects to the main discharge lines between the main pump and the discharge check valve. A motor-operated valve on the bypass line automatically closes when flow in the main discharge line is sufficient to provide the required pump cooling. A flow element in the main discharge line measures system flow rate during LOCA and test conditions and automatically controls the motor-operated valve on the bypass lines. The motor-operated valve does not receive an *automatic signal~~s~~* to open *unless the associate pump indicates a high discharge pressure.*

6.3.3.2 Acceptance Criteria for ECCS Performance

STD DEP Admin

Criterion 2: Maximum Cladding Oxidation

"The calculated total local oxidation of the cladding shall nowhere exceed 0.17 times the total cladding thickness before oxidation." Conformance to Criterion 2 is shown in ~~Figure 6.3-10 (Break Spectrum) and~~ Table 6.3-4 (Summary of LOCA Analysis Results) for the system response analysis. This limit will be assured for the limiting break. See Subsection 6.3.6 for COL license information.

Criterion 4: Coolable Geometry

"Calculated changes in core geometry shall be such that the core remains amenable to cooling." As described in Reference ~~6.2-1~~ 6.3-1*, Section III.A, conformance to Criterion 4 is demonstrated by conformance to Criteria 1 and 2.*

Criterion 5: Long-Term Cooling

"After any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long-lived radioactivity remaining in the core." Conformance to Criterion 5 is demonstrated generically for GE BWRs in Reference ~~6.2-1~~ 6.3-1, Section III.A. Briefly summarized, for any LOCA, the water level can be restored to a level above the top of the core and maintained there indefinitely.

6.3.3.10 Severe Accident Considerations

STD DEP Admin

If the LPFL is not initiated in time to prevent core damage, LPFL injection is still beneficial *by enhancing cooling and preventing radioactive heating from the core debris. If injection is initiated prior to vessel failure, melt progression may be arrested in-vessel. However, if vessel failure occurs, debris will relocate from the vessel breach into the lower drywell. Water flowing into the lower drywell will cover the core debris and enhance debris cooling.*

6.3.4.2.2 ADS Testing

STD DEP T1 3.4-1

*An ADS logic system functional test and simulated automatic operation of all ADS logic channels are to be performed at least once per plant operating interval between reactor refuelings. ~~Instrumentation~~*Sensor and logic *channels are demonstrated operable by the performance of a ~~channel~~*divisional *functional test~~ and a trip unit calibration~~ at least once per month and a transmitter calibration at least once per operating interval.*

6.3.5 Instrumentation Requirements

STD DEP 1.8-1

*All instrumentation required for automatic and manual initiation of the HPCF, RCIC, RHR and ADS Systems is discussed in Subsection 7.3.1, and is designed to meet the requirements of IEEE~~-279~~*603 *and other applicable regulatory requirements. The HPCF, RCIC, RHR and ADS Systems can be manually initiated from the control room.*

6.3.6 COL License Information

6.3.6.1 ECCS Performance Results

The following site-specific supplement addresses COL License Information Item 6.6.

No departures are being taken from the fuel design licensing basis that is described in the reference ABWR DCD, including the core loading map used for response analysis in Figure 4.3-1 and the basic control strategy in Table 4A-1. Consequently, the exposure-dependent MAPLHGR, peak cladding temperature, and oxidation fraction

for the initial core bundle design based on the limiting break size are provided in subsection 6.3.3 of the DCD.

6.3.6.2 ECCS Testing Requirements

The following site-specific supplement addresses COL License Information Item 6.7.

In accordance with the Technical Specifications, a test will be performed every refueling outage in which each ECCS subsystem is actuated through the emergency operating sequence. The test procedure will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 6.3-2)

6.3.6.3 Limiting Break Results

The following site-specific supplement addresses COL License Information Item 6.7a.

No departures are being taken from the fuel design licensing basis that is described in the reference ABWR DCD, including the core loading map used for response analysis in Figure 4.3-1 and the basic control strategy in Table 4A-1. Consequently, the analysis results for the limiting break for the bundle design are provided in subsection 6.3.3.7.3 of the DCD.

Table 6.3-8 Design Parameters for HPCF System Components

(1) Main Pumps (C001)

NPSH Required	~~2.2m~~ 1.7m

Table 6.3-9 Design Parameters for RHR System Components

(1) Main Pumps (C001)

NPSH Required	~~2.4m~~ 2.0m