19K PRA-Based Reliability and Maintenance

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

STD DEP T1 2.4-3 (Table 19K-1, Table 19K-2, Table 19K-4)

STD DEP T1 3.4-1 (Table 19K-1, Table 19K-2, Table 19K-4)

STP DEP T1 5.0-1 (Table 19K-4)

STD DEP 8.3-1 (Table 19K-1, Table 19K-2, Table 19K-3, Table 19K-4)

STP DEP 10.4-2 (Table 19K-4)

STD DEP 19.3-1 (Table 19K-1, Table 19K-2, Table 19K-4)

STP DEP 19R-1 (Table 19K-4)

19K.3 Determination of "Important Structures, Systems and Components" for Level 1 Analysis

STD DEP T1 2.4-3

STD DEP T1 3.4-1

STD DEP 8.3-1

STD DEP 19.3-1

To determine which plant structures, systems and components (SSCs) are the most important with respect to CDF, the Level 1 analysis results were analyzed. The SSCs were listed in order of Fussell-Vesely (FV) importance, or the percent of cutsets that contribute to the CDF, as calculated by the CAFTA code. A second criterion for selecting SSCs was to consider those SSCs with high "risk achievement worth", or the increase in CDF if that SSC always fails. The ~~21~~ 34 SSCs of greatest importance, in that they had modest FV importance are shown in Table 19K-1. ~~Five additional SSCs with modest values of risk achievement worth were considered.~~ Not shown in Table 19K-1 are several post initiating event human error contributions. Significant human errors are addressed in Subsection 19D.7.

~~The 26 SSCs in Table 19K-1 were further evaluated to eliminate those with a combination of low values for both FV importance and risk achievement worth. The five SSCs meeting this criterion are so indicated. However, one of those five is retained because of its designation as a "critical task" in the human factors evaluation of Subsection 18E.2. The other four are not considered further in this subsection.~~

The ~~remaining 22 designated~~ SSCs of Table 19K-1 should be included with important SSCs being considered for periodic testing and/or preventive maintenance (PM) as part of the Reliability Assurance Program (RAP) of the plant owner/operator. The

reliability and maintenance actions suggested for the listed SSCs are identified in Subsection 19K.11.

A second table, Table 19K-2, was prepared to show those SSCs with small to moderate values of risk achievement worth. These SSCs all have very low Fussell-Vesely importance, indicating a low probability of failure. However, if they fail, the impact on CDF is not negligible. Most of these SSCs have ~~the same~~ similar *risk achievement worth*s *because their failure would result in failure of the* RHR system or the *RCIC system to perform ~~its function~~* their functions*.*

Initiating events that are significant contributors to CDF in the Level 1 analysis are listed in Table 19K-3. There are ~~five~~ seven *such events which are shown.* Three of the*~~The three~~ most significant events, accounting for more than one-half of the CDF, are all station blackout events. The* remainder of the *~~next two~~ events, contributing small fractions ~~of~~* to *CDF are* loss of offsite power for two to eight hours, unplanned manual reactor shutdown, medium break loss of coolant accident (LOCA), and *isolation/loss of feedwater ~~and manual reactor shutdown~~. All other initiating events contribute small amounts to CDF.*

19K.7 Determination of "Important Structures, Systems and Components" for Flood Analysis

STP DEP T1 5.0-1

STP DEP 10.4-2

STP DEP 19R-1

The following site-specific supplement discusses the effects of the RSW pump house floods.

The flood analysis considers the potential for core damage from plant damage resulting from internal or external floods. *The important SSCs identified by this analysis are the ECCS room*s*, RCW rooms* Reactor Service Water (RSW) pump rooms and RSW electrical equipment rooms, *and* all *control and reactor building external water tight doors*, including the watertight barriers on the equipment access to the diesel generator rooms*, which prevent water from flowing into rooms other than the one with the leak or from external flood sources to the safety-related buildings;* redundant supply side *isolation valves on the ~~Reactor Service Water~~* RSW *System ~~and anti-siphon capability,~~* prevent gravity drainage of the UHS basin, *which limit*s *the amount of water spilled into the control building* or RSW pump rooms*; circuit breakers that will trip RSW pumps, which also limits the amount of water spilled into the control building; isolation valves in the Circulating Water System (CWS); ~~circuit breakers that will trip CWS pumps;~~ level switches in the turbine building condenser pit*, the *~~and~~ control building RCW rooms* and the RSW pump rooms*; sump pump operation; overfill lines in reactor building sumps on floor BIF; and room drain lines.*

19K.10 Identification of Important Capabilities Outside the Control Room

STP DEP T1 5.0-1

The identified activities outside the control room are:

(8) Verifying all watertight doors are closed on notification of a main cooling reservoir breach.

19K.11.1 Component Inspections and Maintenance

STD DEP T1 2.4-3

STD DEP T1 3.4-1

STP DEP T1 5.0-1

STD DEP 8.3-1

STD DEP 19.3-1

The two individual *component types with the highest FV importances in the Level 1 analysis are the combustion turbine generator and the emergency diesel generators. Maintenance activities to assure high reliability of these components are discussed in 19K.11.10 and 19K.11.11.*

The Reactor Building Cooling Water System and the Reactor Service Water System have high FV importance with respect to common cause failure impacts, as these systems support a number of front-line safety systems. Maintenance and testing tasks are provided for the key components in each division, including pumps, heat exchangers and the service water cooling tower fans

*The system*s *of greatest FV importance* with respect to outage time ~~*is*~~ are *the RCIC System, which has been assigned a small unavailability for test and maintenance* and the RHR Loops*. The amount of time* ~~*the*~~ these systems are ~~*RCIC System is*~~ *unavailable because of test and maintenance should be monitored to assure that* ~~*it*~~they *remain*~~*s*~~ *within the specified assumption*s *annually. Sensitivity studies of increased SSC unavailabilities showed that an increase in RCIC unavailability would cause the greatest increase in estimated core damage frequency of any SSC. The RCIC System was also found to be the most sensitive system to increased outage time assumptions. The highest contributor to uncertainties in the CDF as well as the CDF estimate was RCIC test and maintenance.*

STD DEP T1 3.4-1

The Remote Digital Logic Controller (RDLC) performs the Remote Input/output Function (RIF). Components that provide this function ~~*Multiplexers which provide multiple signals to several systems*~~ *are identified by the Level 1 analysis as high importance components. Safety system* RDLCs ~~*multiplexers*~~ *have* self-diagnostics ~~*a built in self test*~~ *that* detect failures during on-line operation~~*checks circuits frequently*~~*. In addition, one* division *of* RDLCs ~~*four multiplexers*~~ *can be bypassed and tested during plant operation without loss of system function. Such tests provide a* periodic verification ~~*complete simulation*~~ *of the* RDLC operability~~*multiplexer signals, more than included in the self test*~~*. During plant outages more detailed* RDLC ~~*multiplexer*~~ *tests*

are possible, including a complete system test and identification of signal errors. These tests will include verification that the remote RDLCs ~~*multiplexing units*~~ function properly. RDLC RIF ~~*Multiplexer*~~ *tests that are suggested as part of the RAP are given in Table 19K-4.*

STD DEP T1 2.4-3

The turbine of the RCIC System is an important component, as identified in Table 19K-1. Periodic startup and operation of the RCIC turbine is one way to monitor this turbine, and less frequent turbine inspection and refurbishment are also recommended. The RCIC pump is tested at the same time by measurement of speed, flow rate, differential pressure, and vibration. ~~*The turbine lube oil pump operation and many*~~ Many *of the RCIC valves are also tested when the turbine testing is done. These RAP activities are included in Table 19K-4.*

STD DEP T1 3.4-1

Trip logic ~~*unts*~~ *functions (*~~*TLUs*~~TLFs) *for the Reactor Protection System (RPS) represent another high importance component. Functional tests of these* ~~*TLUs*~~TLFs *are performed at* ~~*frequent*~~ predetermined *intervals* ~~*by the online, self test feature of ABWR solid state logic*~~*. Additional offline,* ~~*semi-automatic,*~~ *end-to-end (sensor input to trip actuator) testing of* ~~*TLUs*~~TLFs*, which exercises the safety system logic and control logic processes, is important because it allows the detection of failures not sensed by the online system. The*~~*TLUs*~~ TLF *tests that are suggested as part of the RAP are given in Table 19K-4.*

Common-cause miscalibration of RHR flow meters, and of Level 8 sensors, and common-cause failure (CCF) of digital trip ~~*modules (DTMs)*~~ function (DTFs)*, and of Level 2 sensors, will have acceptable probabilities if adequate administrative controls are exercised. Calibration procedures for RHR flow meters and for Level 8 sensors should include notes about the safety importance of these instruments. Historical trend analysis should be performed for Level 2 sensors at each calibration. The procedure for testing* ~~*DTMs*~~ DTFs *should include a warning about their importance to safety. Suggested RAP activities are given in Table 19K-4.*

19K.11.13 Flood Protection

STP DEP T1 5.0-1

STP DEP 19R-1

The following site-specific supplement discusses the effects of the RSW pump house floods.

The important SSCs for flood protection are the water tight doors on external entrances to the control and reactor buildings, including the watertight barriers on the equipment access to the diesel generator rooms, *and in ECCS*, RSW pump house, *and RCW rooms, the RSW and CWS isolation valves,* ~~*anti-siphon capability,*~~ *the circuit breakers that trip* the *RSW* ~~*and CWS*~~ *pumps and water level sensors in the turbine building*

condenser pit, RSW pump rooms, *and control building RCW rooms; sump pump operation; overfill lines on reactor building sumps on floor BIF; and room drain lines (Subsection 19K.7). Periodically room water barriers should be inspected to assure that they will prevent the spread of flooding, room drain lines should be checked to ensure no blockage exists, RSW isolation valves (MOVs) should be stroke tested (normally accomplished by switching from one pump to the standby pump in a given loop), CWS isolation valves should be stroke tested, the ability of RSW ~~and CWS~~ pump circuit breakers to trip upon receipt of a trip signal should be demonstrated, as well as RSW System ~~anti siphon~~ isolation capability. These RAP activities are included in Table 19K-4.*

Table 19K-1 ABWR SSCs of Greatest Importance for CDF, Level 1 Analysis

SSC	Fussell-Vesely Importance (%)*	Risk Achievement Worth*
Combustion Turbine Generator		
Emergency Diesel Generator **CCF**		
SRV **CCF (Open and reseat)**		
RHR Loop Maintenance		
RBCW CCF		
RSW CCF		
RHR Pump (individual pumps)		
Control Rod Drive Injection (Level Control)		
RCIC Unavailable Due To Testing Or Maintenance		
RHR Pump Room AC		
Div II Power Cable		
~~*Multiplex Transmission Network*~~ **Essential Communication Function (ECF)** CCF		
RCIC Turbine		
RHR Core Flooding CCF		
Minimum Flow Bypass Valve E11-F021A (B, C) (NOFO) ‡		
RCIC Pump		
RHR Heat Exchanger Inlet Valve P21-F013A (B,C) (NCFC) ‡		
RHR Strainer E11-D001A (B, C)		
Suppression Pool Return Line Valve E11-F008A (B, C) (NCFC) ‡		
~~*Trip*~~ **System** *Logic* ~~*Units*~~ **Unit CCF**		
~~*Remote Multiplexing Units*~~ **Remote Digital Logic Controller CCF**		
~~*RCIC Turbine Lubrication System*~~		
HPCF-B (Unavailable, Test or Maintenance)		
HPCF CCF		
RCIC Pump Room AC Unit		
Station Batteries CCF		
Single Offsite Power Line ~~‡~~		
RCIC Min Flow Bypass Valve E51-F011 (NOFO) ‡		
RCIC Injection Valve F004 (NCFC) ‡		
RCIC Min Flow Bypass Valve E51-F011 (NCFC) ‡		

Table 19K-1 ABWR SSCs of Greatest Importance for CDF, Level 1 Analysis (Continued)

SSC	Fussell-Vesely Importance (%)*	Risk Achievement Worth*
RCIC Steam Supply Valve E51-F037 (NCFC) ‡		
HPCF Maintenance Valve E22-F005B~~ƒ~~		
Suppression Pool Temperature		
Division 1 Transmission Network (ECF)		
RCIC Isolation Signal Logic		
~~Both Offsite Power Sources~~		
~~HPCF Pump †~~		
~~SRVs †~~		
~~RHR Flow Transmitters (CCF Miscalibration)~~		
~~Level 2 Sensors (CCF)~~		
~~Level 8 Sensors (CCF Miscalibration)~~		
~~Digital Trip Modules (CCF)~~		

* *Not part of DCD (~~Refer to SSAR~~* contained in plant-specific PRA documentation*)*

~~† SSCs with low FV importance and low risk achievement worth. Not considered further for RAP on the basis of Level 1 analysis.~~

‡ Valves that are closed during normal operation, and fail to open when required during a transient, are designated NCFC. Technically, they are "fail as is" conditions, which is closed. The minimum flow bypass valve is closed during normal operation, but during transients requiring RCIC operation, the bypass valve opens. Failure of this valve to open at that demand is shown as NCFC. Later in the transient this bypass valve, which is normally open at this time, should close on demand. If it fails to close, the shorthand description NOFO is used.

~~ƒ SSC with low FV importance and low risk achievement worth, but retained because of human factor importance.~~

Table 19K-2 ABWR SSCs With Moderate Risk Achievement Worth For CDF, Level 1 Analysis*

SSC	Fussell-Vesely Importance % †	Risk Achievement Worth†
Suppression Pool Water Level (Pool Rupture)		
Digital Trip Units CCF		
SRV CCF [ADS]		
Level 8 Sensors (Miscalibrated CCF)		
AC Distribution Power Cables		
1st ESF **RIF** ~~*RMU*~~ *Div* ~~*1*~~ **(3 Divisions)** *Fails*		
2nd ESF **RIF** ~~*RMU*~~ *Div* ~~*1*~~ **(3 Divisions)** *Fails*		
Div 1 **(2, 3) ECF** ~~*EMS Transmission Network*~~ *Failure*		
Class 1E 4160V/480V Transformers		
RBCW Temperature Control Valve P21-F006A (B, C) (NOFC)		
RHR -Flow Transmitter FT008A (B, C) (CCF Miscalibration)		
RHR Pump A (B, C)		
RHR Heat Exchanger Bypass FCV E11-F013A (B, C) (NCFO)		
RHR Wetwell Spray Valve E11-F019A (B, C) (NCFO)		
RHR Injection Valve E11-F005A (B, C) (NCFO)		
RPV SDC Suction Line Isolation Valve E11-F012A (B, C) (NCFO)		
RHR Suppression Pool Suction Valve E11-F001A (B, C) (NOFC)		
RHR Heat Exchanger FCV E11-F004A (B, C) (NOFC)		
RHR Pump Discharge Check Valve E11-F002A (B, C)		
RHR Pump Discharge Manual Valve E11-F003A (B, C)		
RHR Heat Exchanger A (B, C)		
RHR Pump Motor Bearing Cooler A (B, C)		
RHR Pump Mechanical Seal Cooler A (B, C)		
RHR Suppression Pool Temp Signal T53-TRS-601A & B		
RHR Flow Transmitters (CCF Miscalibration)		
Class 1E 4160V Switchgear		
Class 1E 480V Switchgear		
Class 1E 480V MCCs		
Class 1E DC Power Distribution Panels		
RBCW Temperature Control Valve P21-F006A (B, C) (NOFC)		
HPCF Flow Transmitters (CCF Miscalibration)		

Table 19K-2 ABWR SSCs With Moderate Risk Achievement Worth For CDF, Level 1 Analysis*

SSC	Fussell-Vesely Importance % †	Risk Achievement Worth†
HPCF Pressure Transmitters (CCF Miscalibration)		
Level 2 Sensors (CCF)		
Both Offsite Power Sources (CCF)		
Pipe Rupture (RBCW Loop)		
Pipe Rupture (RSW Loop)		
NBS Isolation Check Valve B21-F003B (FW Isolation) Fails Closed		
NBS Isolation Check Valve B21-F004B (FW Isolation) Fails Closed		
RCIC Check Valve E51-F003 Fails to Open		
RCIC Outboard Check Valve F005 Fails to Open		
RCIC Check Valve F038 Fails to Open		
NBS Manual Valve B21-F005B (NOFC) Fails Closed		
RCIC Valve E51-F011 (NOFO) Fails		
RCIC Valve E51-F004 (NCFC) Fails		
RCIC Valve E51-F011 (NCFC) Fails		
RCIC Valve E51-F037 (NCFC) Fails		
RCIC Isolation Valve F035 Fails (NOFC)		
RCIC Isolation Valve F036 Fails (NOFC)		
RCIC Isolation Valve F039 Fails (NOFC)		
RCIC Turbine Exhaust Isolation Valve F039 Limit Switch Fails		
~~*RCIC Steam Supply Bypass Valve F045 Limit Switch Fails*~~		
RCIC Flow Sensor FT-007-2 Miscalibrated		
RCIC Pressure Sensor PIS-Z605 Miscalibrated		
RCIC Flow Sensor E51-FT007-2 Fails		
RCIC Pressure Sensor PIS-Z605 Fails		
Diode SID Open		
SLF/ECF ~~*SLU/EMS*~~ *Link for Div 1 SLU 1 Fails (RCIC Fails)*		
SLF/ECF ~~*SLU/EMS*~~ *Link for Div 1 SLU 2 Fails (RCIC Fails)*		

† *Not part of DCD (*~~*Refer to SSAR*~~ contained in plant-specific PRA documentation*)*

Table 19K-3 ABWR Initiating Event Contribution to CDF, Level 1 Analysis

Initiating Event	Events Per Year*	Total CDF *	Percent CDF Contribution*
Station Blackout for Less Than Two Hours			
Station Blackout for Two to Eight Hours			
Loss of Offsite Power for Two to Eight Hours			
Unplanned Manual Reactor Shutdown			
Station Blackout for More Than Eight Hours			
Medium Break LOCA			
Isolation/Loss of Feedwater			

** Not part of DCD (~~Refer to SSAR~~ contained in plant-specific PRA documentation)*

Table 19K-4 Failure Modes and RAP Activities

Component	Failure Mode/Cause	Recommended Maintenance	Test or Maintenance Interval	Basis	Unavailability, Failure Rate
~~*Multiplexers*~~	~~*Common cause failure of all MUX to give proper signals*~~	~~*System functional test*~~ ~~*Complete system test, error check*~~	~~*3 months*~~ ~~*2 years*~~	~~*Experience*~~ ~~*Experience*~~	~~*~~
ECF	**Common cause failure of all ECF to give proper signals**	**System functional test**	**3 months**	**Experience**	*
		Complete system test, error check	**2 years**	**Experience**	*
One ESF **RIF** ~~*SMU*~~ for Div 1 or one **SLF/ECF** ~~*SLU/EMS*~~ Link for **SLF** ~~*SLU*~~ Div 1	Failure of RIF or link between RIF and SLF ~~*Failure of remote multiplex unit or link between RMU and safety system logic unit*~~	System functional test	3 months	Experience	*
		Complete system test, error check	2 years	Experience	*
RPS **TLFs** ~~*Trip Logic Units*~~	Failure to trip upon demand	System functional test	3 months	Experience	*
		Complete system test, error check	R/M outage	Experience	
~~*RCIC Turbine Lube System*~~	~~*Lube oil pump failure*~~	~~*Lube oil pump operation and oil pressure check*~~	~~*3 months*~~	~~*Experience*~~	~~*~~
Limit Switch~~es~~ on RCIC Turbine Exhaust Isolation ~~and Valve Steam Supply Bypass Valve~~	*Failure of switch to change position when valve movement occurs*	*Observation of limit switch actuation during valve stroke test*	*3 months*	*Experience‡*	†
DTFs ~~*Digital Trip Modules*~~	Common cause failure to trip	*Review trip unit test procedure to assure note about potential safety considerations*	*Annual*	*Judgment*	*

Table 19K-4 Failure Modes and RAP Activities (Continued)

Component	Failure Mode/Cause	Recommended Maintenance	Test or Maintenance Interval	Basis	Unavailability, Failure Rate
Non-ADS SRVs	**Common mode failure of SRVs to open on demand or remain open**	**Inspect and replace degradable parts and test for correct operation**	**5 years (max)**	**Environmental qualification**	*
		Remove valve, test for setpoint pressure, adjust setpoint as necessary, test for seat leakage, repair. Stagger testing of valves, 50% at one outage	**3 years**	**Experience, ANSI/ASME OM1**	*
Firewater System Pumps on Fire Truck **and portable diesel-driven fire pump (Subsection 19.4.6)**	*Failure of pumps to provide required flow at pressure*	*20 min pump at 100% rated flow, 1.13 MPa (150 psi)*	*1 year*	*Judgment*	**
		10 min pump at 70% rated flow, 1.48 MPa (200 psi)	*1 year*	*Judgment*	
		10 min pump at 50% rated flow, 1.82 MPa (250 psi)	*1 year*	*Judgment*	
	Failure of system to deliver required flow	*Test system flow with fire truck pumps, water from tanks & from UHS*	*4 years*	*Judgment*	
		Test system flow with AC-driven and diesel-driven pumps, water from tanks & from UHS	*4 years*	*Judgment*	
DC Div 1 Distribution Panel **(including Diode S1D)**	Panel **or diode failure**	Panel function is demonstrated by system test	3 months	Experience	*
Div 1 ~~*EMS*~~ **ECF** ~~Transmission Network~~	~~*Network failure*~~ Failure	System functional test	3 months	Experience	*
		Complete system test, error check	2 years	Experience	*

Table 19K-4 Failure Modes and RAP Activities (Continued)

Component	Failure Mode/Cause	Recommended Maintenance	Test or Maintenance Interval	Basis	Unavailability, Failure Rate
RBCW Pumps	Failure to provide adequate flow at desired pressure	Discharge pressure test Inlet pressure test Flow test Vibration test	3 months	Table 3.9-8	*
		Monitor pump parameters on the normally running pump to detect abnormalities	Weekly	Judgment	*
RSW Pumps	Failure to provide adequate flow at desired pressure	Discharge pressure test Inlet pressure test Flow test Vibration test	3 months	Table 3.9-8	*
		Monitor pump parameters on the normally running pump to detect abnormalities	Weekly	Judgment	*
RBCW Heat Exchangers	Plugging/fouling	Monitor heat exchanger flow and delta temperature/pressure to detect existence of fouling	Weekly	Experience	*
		Internal inspection of heat exchangers for plugging and fouling	R/M Outage	Experience	*
RSW Strainers	Plugging	Monitor R~~B~~SW flow rate and strainer delta pressure for indications of plugging	Weekly	Experience	*
UHS Fans	Failure to provide adequate fan flow through tower	Flow test Vibration Test	3 months	Experience	***
		Inspection and cleaning/lubrication	R/M Outage	Experience	***

Table 19K-4 Failure Modes and RAP Activities (Continued)

Component	Failure Mode/Cause	Recommended Maintenance	Test or Maintenance Interval	Basis	Unavailability, Failure Rate
Control and Reactor Building, RSW pump House, *and ECCS Room Watertight Doors*	*Failure to retain integrity*	*Inspection of watertight doors, including penetrations*	*1 year & after major maintenance*	*Judgment*	*
RSW ~~and CWS~~ Pump Circuit Breakers	*Failure to trip pump on demand*	*Breaker trip test to assure trip on Demand*	*6 months*	*Judgment*	*
HPCF Pumps	**Failure to provide adequate flow at desired pressure**	**Discharge pressure test Inlet pressure test Flow test Vibration test**	**3 months**	**Table 3.9-8**	†††
HPCF Injection Valves F003 and F005	**Failure to open because of mechanical problems**	**Stroke test**	**3 months**	**Experience; ASME Code ISI**	†††
		Visual and penetrant inspection of stem, ultrasonic inspection of stem; replace if necessary.	**10 years**	**Low failure rate; ASME Code ISI.**	*
	Failure to open because of electrical problems	**Electrical circuit test**	**3 months**	**Experience**	*
RHR Injection Valves F001, F003, F005, F006	**Failure to open because of mechanical problems**	**Stroke test**	**3 months**	**Experience; ASME Code ISI**	††
		Visual and penetrant inspection of stem, ultrasonic inspection of stem; replace if necessary.	**10 years**	**Low failure rate; ASME Code ISI.**	*
	Failure to open because of electrical problems	**Electrical circuit test**	**3 months**	**Experience**	*

Table 19K-4 Failure Modes and RAP Activities (Continued)

Component	Failure Mode/Cause	Recommended Maintenance	Test or Maintenance Interval	Basis	Unavailability, Failure Rate
RHR Heat Exchangers	Fouling	Monitor and trend delta-temperature across heat exchanger during RHR testing and operation	R/M Outage	Judgment	††
ESF SLF Divisions	Failure to operate; failure to properly generate initiation signals	System functional test	3 months	Experience	*
		Complete system test, error check	2 years	Experience	*
Suppression Pool	Loss of structural integrity; leakage	Periodic inspection of suppression pool structural elements to detect degradation, incipient leakage or corrosion	R/M Outage	Experience	***
Common Cause Failures					
RHR System (Shutdown Cooling & LPFL Modes) ■ Pumps ■ Room Air Conditioners ■ Injection MOVs	Common mode failure ■ Start and Run ■ Start and Run ■ Open	System walkdown to identify CCF type problems	R/M outage	Judgment	***

Table 19K-4 Failure Modes and RAP Activities (Continued)

Component	Failure Mode/Cause	Recommended Maintenance	Test or Maintenance Interval	Basis	Unavailability, Failure Rate
HPCF System ■ Pumps ■ Injection MOVs ■ F005	Common mode failure ■ Start and Run ■ Open ■ Mispositioning	System walkdown to identify CCF type problems Position check	R/M outage Quarterly	Judgment	***
RBCW System ■ Pumps	Common mode failure ■ Run	System walkdown to identify CCF type problems	R/M outage	Judgment	***
RSW System ■ Pumps ■ Strainers	Common mode failure ■ Run ■ Plug	System walkdown to identify CCF type problems Operation verification	R/M outage Quarterly	Judgment	***
UHS System ■ Fans	Common mode failure ■ Run	System walkdown to identify CCF type problems	R/M outage	Judgment	***
Emergency Diesel Generators	Common mode failure ■ Start and run	Start up to full load	1 month	Tech Spec	***
Suppression Pool Temperature sensors T53-TRS-601A and B	Sensor fails	Calibration of sensor	R/M outage	Experience	***
	Common mode failure	Analyze Level 2 calibration data for trends of drifting or other CCF indications	R/M Outage	Judgment	***

Table 19K-4 Failure Modes and RAP Activities (Continued)

Component	Failure Mode/Cause	Recommended Maintenance	Test or Maintenance Interval	Basis	Unavailability, Failure Rate
Containment Penetrations	**Leakage**	**Periodic inspection of penetrations to detect indications of degradation**	**R/M Outage**	**Experience**	**N/A**
		Local leak rate testing	**R/M Outage (based on Tech Spec requirements)**	**Tech Spec**	*
~~*RSW Anti-siphon Capability*~~	~~*Isolation valves don't close after pumps trip*~~	~~*Open RSW motor breakers with isolation valves open and monitor system flow rate*~~	~~*6 months*~~	~~*Judgment*~~	~~*~~

*** Contained in the plant-specific PRA documentation

† *These types of valves ~~and turbines~~ have been used in operating BWRs, so there is much experience to guide owners/operators in care of the equipment.*

‡‡ *RHR component failure rates are included within the system unavailability.*

††† HPCF component failure rates are included within the system unavailability